Investigating transparency in collaborative learning and its delivery through Scrum

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Declaration

I, Elizabeth Sokolowski, confirm that the work presented in this thesis submitted at the University of West London is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

Collaborative learning is widespread in higher education and all evidence points to it continuing to grow in importance as a teaching and learning strategy. Collaborative learning is central to constructive education, a paradigm with historical roots in Dewey (1929), Vygotsky (1962) and Piaget (1978) that focuses on student-centred learning, with the learner as an active agent in the process of knowledge acquisition. Its potential advantages have been widely reported, yet evidence suggests that many students are still finding collaborative learning a negative, rather than a positive experience. In searching for ways to address this, the concept of transparency was uncovered as a potential means for improving collaboration, a view also backed by students, though what was meant by transparency in this context was not explained, nor were there any suggestions for how it might improve collaborative learning processes or outcomes. Initial investigations suggested that transparency was an under-researched area in the domain of collaborative learning. At the same time, an examination of successful projects in the computing industry highlighted the central role of Agile processes, and particularly Scrum, in delivering these successes. Scrum promotes transparency and continuous improvement, and this prompted the question of whether it could be adopted for collaborative learning in Higher Education, in order to provide positive outcomes in this domain.

The main aim of this thesis is therefore to investigate whether the outcomes of collaborative learning in Higher Education can be improved through transparency, and to examine whether using Scrum for the management of student collaborative learning can produce high levels of transparency and therefore better outcomes for students.

The study used a mixed methods approach, drawing on the strengths of both qualitative and quantitative research. Research instruments included questionnaires, peer reviews and focus group discussions. An initial study used means-end analysis to define the attributes, consequences and higher order values that students associated with transparency in the context of collaborative learning. This was then followed by an exploratory study which introduced Scrum into the second part of a student group project to compare a cohort's experience of using both 'conventional' and Scrum project management. Students reported high levels of transparency and a preference for using Scrum, however the results revealed that Scrum had only been partially implemented. The final empirical study then investigated the degree to which the student centric view of transparency obtained from the initial study was supported in a collaborative project using a full implementation of Scrum. In addition, the collaborative project was based on a creative task outside Scrum's traditional domain of software engineering, to establish whether it could be used successfully for projects of any type and perhaps become a standard for managing collaborative learning in higher education.

The findings showed transparency to be a complex and multi-dimensioned concept. Although universally concerned with information disclosure, providing too much information can be counterproductive, leading to a reduction in transparency, or 'transparency paradox'. Appropriate visibility and awareness of information was found to be important in this context. The means-end analysis study provided a student view of transparency in the form of attributes that students associated with the concept. Scrum was found to provide high levels of support for these attributes, as well as visibility and awareness through its face-to-face meetings and Product Backlogs. Students rated the transparency provided by Scrum highly, but although it contributed to better process outcomes and more satisfied students, the effect on grades was limited. Nevertheless, the overall findings of this study confirm that Scrum has potential for improving groupwork transparency, student experience and outcomes. The thesis adds to the body of knowledge on efforts to improve collaborative learning, providing a rare empirical study showing how students perceive Scrum to contribute to overall transparency, and how Scrum can be used successfully in projects outside its traditional domain. A theoretical contribution of the study is an examination of a value-oriented approach to students' perceptions of transparency in the context of collaborative learning.

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CHAPTER 1: INTRODUCTION

The aim of this research is to examine the nature and role of transparency in improving the outcomes and processes of collaborative learning within Higher Education (HE) and to investigate whether such transparency can be delivered through the use of Scrum, a popular Agile project management framework used for software development projects in industry. The overall outcome of the study may serve to provide an alternative model for conducting collaborative learning in HE which could deliver the widely acknowledged advantages of collaborative learning to greater numbers of students.

1.1 Motivation and PhD Journey

Collaborative learning (CL) is an increasingly prevalent feature within HE, with an increasing proportion of student assessments being based on group work. This trend reflects the pedagogical advantages of this approach in promoting constructivist learning and the development of higher order thinking and problem-solving skills, as well as, in an era of increasing student numbers and decreasing teaching contact hours, the more practical considerations of enabling educators to 'service' more students with fewer resources (Marginson, 2016). Because of its importance it has attracted continuing research over many decades. Yet, despite the increase in collaborative learning and the high level of academic papers examining its many angles, evidence suggests that it is still an area that is less than satisfactory. In short, too many students are still finding collaborative learning a negative, rather than a positive experience (Capdeferro & Romero, 2012; Gale et al, 2014). Given that one of the aims of HE is to make graduates 'employment ready' then this needs to be addressed, as employers are increasingly expecting graduates to be equipped with sound team working skills. Group working has become the new norm in the workplace and the use of teams is projected to increase (Lacerenza et al, 2018). However, "still, near the top of every failure in an organization is the failure that comes from poor team performance. When a team functions well, it is a marvel to behold, and it lifts the entire organization. When a team fails to function well, the ripple effects hurt the entire organization" (Lenconini, 2002, p1). From personal experience of running collaborative assessments for many years, this quotation is equally applicable to group work within HE.

It is widely accepted that the research process often manifests itself in a shift in the research focus: “It is frequently well into the process of inquiry that one discovers what the research is really about” (Hammersley & Atkinson 2007, p160) and this has proven to be the case in the current study. The initial catalyst for this research came from the experience of running live student projects with a large multinational company, a high-risk strategy where failure could result in reputational damage to the department and university. The tensions in CL within the researcher’s own teaching experience therefore led to an interest in the causes of, and practical remedies for dysfunctional group work and investigations into whether advances in technology and systems, particularly learning analytics, could provide an answer. The research journey began therefore with a systematic review of empirical case studies in collaborative learning employing learning analytics and data mining approaches, covering a range of domains and supporting technologies culminating in the publication of the output as a book chapter (Sokolowski & Oussena, 2016). This was followed by a paper investigating the way that data analytics could be used to predict and correct dysfunctional collaborative learning (Sokolowski & Oussena, 2017). The conclusion reached was that the various studies investigated had contributed to the understanding of group work processes and student interactions, but the holy grail of providing a reliable predictive tool to allow educators to make timely, corrective interventions into CL seemed elusive. Although data mining has become more sophisticated using new methods of analysis, data from collaborative learning remains a challenge to mine.

Attention then turned instead to re-examining factors that could contribute to successful groupwork to see how these might be promoted, which revealed transparency as a strong contender. The widely held view of transparency is that it helps to build trust, leads to improved communication and enables the sharing of knowledge and ideas. Yet research on transparency in CL in educational settings appeared to be lacking, with transparency mostly taken as a ‘given’ in the academic literature. Subsequent probing and discussions with students confirmed that this was also something that they valued highly in group work, although they could not proffer a definition of transparency in this context, nor any suggestions for how transparency might improve collaborative learning processes and outcomes. Furthermore, there was nothing in the literature which looked at CL transparency from a student perspective. These findings set the direction for the current thesis, raising a

number of questions: how is transparency defined in the domain of CL, and how do students view transparency in this context? If transparency is important for collaborative projects, then how can CL outcomes and learning processes in HE be improved through transparency? Furthermore, what methods can be used to deliver this transparency?

An examination of successful collaborative projects in the computing industry highlights the use of Agile project management approaches by software development teams. Agile promotes transparency and continuous improvement and, in an industry that is often plagued with software development failures, Agile processes have tripled the success rate of projects over traditional software development practices such as Waterfall (Saltz, Turk and Anderson, 2019). Scrum is one of the most popular of the Agile approaches and consistently linked with transparency; in 2018 it was used by 72% of companies employing Agile methods (Hassani-Alaoui, Cameron and Giannelia, 2020). This prompted a second line of enquiry, namely could the Scrum approach, used so successfully in industry, be adapted for use in collaborative assignments as a vehicle for delivering transparency?

These ideas formed the motivation for this research, raising a number of questions:

- Firstly, what is meant by 'transparency', and specifically transparency in the context of collaborative learning?
- How do students view transparency in the context of collaborative learning?
- How, and to what extent, can transparency lead to better outcomes and processes in collaborative learning?
- If transparency can lead to better outcomes, then what means are available for delivering transparency?
- Could Scrum, with its perceived attributes of transparency and efficacy, be used for managing collaborative learning to provide transparency and improve CL processes and outcomes?

There are already examples of Scrum being using in HE, but most are primarily in the context of undertaking software development or capstone projects where a major focus is on learning Scrum as process that is used in industry. However, as far as the researcher is aware, there are few, if any, studies examining transparency in the context of collaborative learning or

Scrum, and few empirical studies of Scrum being used as a framework for managing collaborative projects of a general (i.e., non-software development) nature, which are likely to be typical of the bulk of collaborative projects undertaken in HE.

The investigations reported in this thesis are based on collaborative learning undertaken by students on undergraduate courses run within the Computing department of the University of West London. The overall outcome of the studies could serve to provide a clearer understanding of the effect of transparencies in the context of collaborative learning in HE and could contribute to providing an alternative model for conducting collaborative learning which might impact favourably on satisfaction rates and deliver the widely acknowledged advantages of collaborative learning to greater numbers of students in HE.

1.2 Background

The following section provides a brief background to the study, introducing topics that are germane to the development of the thesis.

1.2.1 Increase in Collaborative learning and its perceived benefits

Collaborative learning, succinctly summarised as learning together towards achieving shared goals (Barkley, Cross, & Major, 2014), has been researched extensively over the years as one of the most promising of all instructional approaches associated with fostering growth in students (Johnson & Johnson, 2009). Studies have highlighted the positive effects of collaborative learning, on students' academic achievement (Stump et al, 2011), in the development of critical thinking and problem solving skills (Loes & Pascarella, 2017), the fostering interpersonal and social skills (Laal & Ghodsi, 2012) and in promoting greater satisfaction with learning (Loes et al, 2017). Collaborative learning has also been proposed as an effective strategy for dealing with the recent increases in student numbers in HE, reducing the effort and hours required for supporting and marking large cohorts (Marginson, 2016) as well as improving student retention levels (Loes et al, 2017).

Yet despite the wealth of positive research, empirical and anecdotal evidence still exists to suggest that there are ongoing problems with CL that prevent some of these well documented advantages to be enjoyed by all students. These problems can be attributed to several factors, chief among them: group tensions (Avry et al, 2020), perceived group status (Lamb, 2015) and social loafing (Singh, Wang & Zhu, 2017), which together continue to vex educators

and students and remain the focus for ongoing research. This situation appears to be mirrored in the workplace where, despite the growth in team working, the question 'why are so many workplace teams not successful?' continues to be posed (Brock et al, 2017).

1.2.2 Transparency in Collaborative Learning

Transparency has been widely studied in the field of business and administration where it is generally seen as a force for good, allowing greater insights into organisations and reducing the possibility for fraud. However, it is a vague concept and takes on different meanings in different spheres. Some see it as a multi layered construct consisting of a number of different concepts; it is considered a 'good' thing but is rarely defined or considered in the context of collaborative learning, suggesting that this topic may be ripe for research.

Where it has been mentioned in the context of CL, studies indicate that transparency is an important driver for improved quality (Paulson, 2008) and a key factor in improving the outcome of collaborative projects. Transparency can reduce conflict, improve communication, and enhance team performance by reducing the number of low-quality contributions from students and making high quality work more accessible as a model for others (Stuart et al, 2012). Moreover, transparency can facilitate a culture of continuous improvement and learning and encourage students to develop new ways of thinking and behaving in teams (Jassawalla et al, 2010).

1.2.3 Agile

Agile processes are widely for software development and, in an industry that has long been plagued with failures, it is credited with significantly increasing success rates in software development projects (Sharma & Hasteer, 2016). In contrast to 'traditional' systems development processes such as Waterfall (Royce, 1970), it places less emphasis on following fixed, highly structured and heavily documented phases of development, and instead follows a more flexible approach focusing on close interaction within teams and with clients, iterative development, and adaptability to change (Rico & Sayani, 2009), as embodied in the Agile Manifesto (Beck et al, 2001). This states its core values as individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation, and responding to change over following a plan.

Although the key focus of the manifesto is on software development, once unpacked, there is very little there that is software specific (Girvan & Paul, 2017). The message to communicate often, use self-organising teams, focus on small steps and incremental development, collaborate with clients and be adaptable to changing needs is not context dependent and represents values that can be applied to benefit any collaborative project in any domain. For example, Glas and Ziemer (2009) have shown the efficacy of using agile processes in aircraft development and Mulder, Verlinder & Maruyama (2014) adapted them for the development of cyber-physical systems.

In recent years, a number of competing Agile 'educational manifestos' have been proposed that mirror the original Agile Manifesto but have aligned the Agile values within educational contexts, for example proposing that teachers prioritize the development of students' skills, learning, and understanding rather than detailed lesson plans. These include the Agile Schools Manifesto (Peha, 2011), the Agile Manifesto for Higher Education (Kamat, 2012), the Agile Pedagogy Manifesto (Royle and Nikolic, 2016) and the Agile Manifesto for Teaching and Learning (Krehbiel et al, 2017). What is unclear however, is how these values are to be applied in educational settings (Duvall, Hutchings & Kleckner, 2017).

1.2.4 Scrum

Agile has several method instantiations, such as XP, Scrum and Crystal. Of these, Scrum is the most widely used and is commonly credited with improving the success of system development projects. Scrum is "a simple set of practices and rules that encompasses the transparency, inspection, and adaptation requirements inherent in empirical process control" (Schwaber & Sutherland, 2017, p1). Transparency dictates that all the processes that affect an outcome must be visible and known to everyone involved; inspection requires that various aspects of the process are inspected frequently so that any unacceptable deviations can be detected, and adaptation ensures that appropriate adjustments are made as quickly as possible in order to minimise further deviation. Scrum is an iterative, incremental process based on short bursts of development known as Sprints which involve a number of roles, artefacts and ceremonies.

As with Agile, the success of Scrum in various domains has led to its adoption in education, with the emergence of eduScrum, the application in education of Scrum principles. In eduScrum, the teacher presents students with 'why to study' and 'what will be studied and

delivered', and students decide how they will learn and develop the proposed activity. Like Scrum, eduScrum is founded on empirical process control theory, or empiricism, which asserts that knowledge comes from experience and making decisions based on what is known. eduScrum employs an iterative, incremental approach to optimize the achievability of learning goals and control risk within a given time frame (Delhij, van Solingen and Wijnands, 2015). However, although the eduScrum consulting group have suggested that Scrum can be used by students to learn non-technical material they have not published details on how this might be achieved or what kind of benefits might accrue from this (Duvall, Hutchings & Duvall, 2018). This suggests another gap that could be addressed by the current research.

1.3 Research Questions

Pulling together the above threads, it can be summarised that collaborative learning is pedagogically important and promotes the development of constructive learning and of skills that are increasingly required in the workplace. However, it is not without its problems, a fact acknowledged by both learners and instructors. The academic literature acknowledges transparency to be a complex concept concerned with information disclosure, with wide ranging benefits for stakeholders. However, its coverage in the domain of CL is sparse although it is universally recognised as a force for good, a view backed up in discussions with a cohort of students, during which they suggested that collaborative learning could be improved by making it more transparent, a property that is at the heart of Scrum.

From this, the aim of the research was formulated, namely, to investigate the nature of transparency in collaborative learning to establish how it can improve processes and outcomes in CL, and whether this transparency can be delivered through the use of Scrum. This produced the primary research question:

> Can the outcomes of collaborative learning in Higher Education be improved through transparency, and can Scrum be utilized to promote transparency and improve outcomes in this context?

The following focused questions were then identified:

RQ1 What is meant by transparency in the context of collaborative learning, and what are its benefits? What do students mean by transparency in this context?

RQ2 Does a Scrum approach to group work increase collaborative learning transparency, compared with non-Scrum approaches?

RQ3 How and to what extent can transparency support provided through Scrum improve the outcomes of collaborative learning?

RQ3a Does using Scrum improve student grades?

RQ3b Are students more satisfied with their peers' performance when using scrum?

RQ3c Does using Scrum motivate students to use it for collaborative projects in the future?

RQ3d Does using Scrum improve students' satisfaction with the overall collaborative learning experience?

1.4 Research design

The study objectives will be delivered through an exploratory approach using mixed methods research. Using a mixed methods approach has a number of benefits, for example adding understanding and insights that could be missed when only a single method is used. It also allows triangulation of results which can increase understanding of the constructs being researched and increase the reliability of the overall results (Cresswell & Plano Clark, 2011)

Quantitative data from questionnaires and student outputs will be used to compare aspects of Scrum and non-Scrum collaborative assignments while qualitative data will be obtained from focus groups to allow for the further exploration of ideas and elucidation of quantitative results.

The thesis starts with an investigation of the literature in areas relevant to the thesis, namely collaboration, transparency, and Scrum, thereby providing a background to the topics and establishing current thinking in areas that are germane to the research.

Three studies will then be undertaken, the first, to extract an in-depth understanding of transparency from a student perspective; the second an initial pilot study to compare the outcomes of Scrum and 'conventional' project management methods used in a collaborative project run in a first year undergraduate module; and the third to examine the degree to

which the student perception of transparency is encapsulated in Scrum through a second CL case study.

1.5 Thesis structure

The thesis is organised as follows:

Chapter 2 presents a background to collaborative learning, examining existing literature on its philosophy, role in education and its perceived strengths and weaknesses. It also reviews models of collaborative learning to identify key drivers of its success.

Chapter 3 examines the broad concept of transparency as outlined in the literature and then focuses on aspects of transparency related to collaborative learning.

Chapter 4 presents a background to Scrum, its transparency credentials, and its increasing relevance in HE.

Chapter 5 discusses the overall research approach and considers the philosophical perspective to the study.

Chapter 6 discusses the procedures and results of a 'Laddering Study' which used means-end analysis to identify significant attributes of transparency and their benefits for students.

Chapter 7 describes a preliminary, 'Semi-Scrum' investigation. The study introduced a version of Scrum halfway through a student collaborative project, to compare student satisfaction and outputs from Scrum and non-Scrum project management approaches.

Chapter 8 presents the results of an investigation which aims to establish the degree to which the attributes of transparency identified by students in the Laddering Study are perceived to be present in a full Scrum project and to explore students' collaborative learning experiences and outcomes.

Chapter 9 presents the overall findings of the thesis. The research is evaluated in terms of its objectives, research questions and outcomes.

Chapter 10 presents a summary of the study, its limitations as well as its contribution to practice and areas for further research.

1.6 Summary

This chapter provided a summary of the motivation and rationale for the thesis. It then presented a brief overview of CL and its role in education before addressing transparency in the context of CL, noting that although the concept is widely perceived as beneficial for CL, research is largely lacking in this area. Scrum was then examined as a possible means for implementing transparency due to its strong association with transparency and its track record for delivering successful outcomes for software development projects. Additionally, the process is increasingly being adapted for use within educational contexts, a trend embodied in the eduScrum movement. The chapter concluded with a statement of the thesis aims and research questions.

CHAPTER 2: LITERATURE REVIEW – COLLABORATIVE LEARNING

2.1 Introduction

This chapter presents a review of the literature related to collaborative learning. It covers the definition of collaborative learning, the advantages of this educational strategy and the problems and ongoing issues with group work. The chapter also examines models of teamwork and theories linked to collaborative learning.

2.2 Definitions of collaborative learning

The last few decades have seen an increasing use of group learning approaches in HE. In contrast to the instructional, passive and teacher-centred strategies that have prevailed for many years, educators are now being encouraged to follow active, constructivist approaches where students are engaged in actively discovering, challenging, and applying knowledge in a collaborative learning environment. Here the processes of teamwork, communication and engagement are regarded as important as any outputs and knowledge that is created or constructed.

The main principle behind collaborative learning is that students learn, work, and improve together, rather than independently or as lone learners (Race, 2007). However, this description could equally be applied to other related terms such as teamwork, collective learning, collaborative working and peer tutoring and indeed some of these terms are often used synonymously in the literature. In this context, Parr and Townsend's (2002) peer learning scale which places each term on a continuum between 'learning in a social context' and 'socially constructed learning' can be employed to compare the distinctions (See figure 1). In this, peer tutoring is used to describe a range of approaches where students work in pairs to provide each other with explicit learning support through various strategies such as mentor tutoring, peer assisted learning or reciprocal peer tutoring. The main aim is to establish a social environment that promotes independent learning by fostering open communication (Boud et al, 1999). The common characteristic is that tutors control and drive the process, but pairs of students can take on responsibility for aspects of teaching and for evaluating their success.

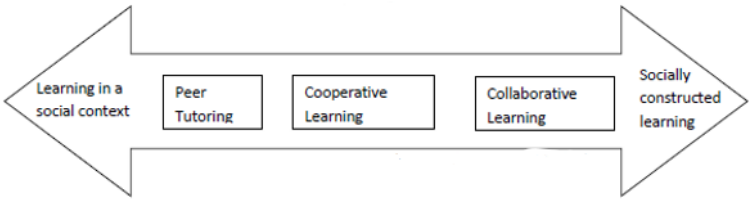


Figure 1: Peer Learning Environments (Parr & Townsend: 2002)

Cooperative learning sits in the middle of the 'learning in a social context' to 'socially constructive learning' continuum and while sharing some characteristics, cooperative learning is seen as having its roots more in the former than the latter. As in peer tutoring, learning is seen as socially constructed but using small groups rather than pairs of learners, who will typically work together to achieve a collective task set by a tutor who will control and guide the small group interactions (Parr and Townsend, 2002). Here 'divide and conquer' strategies tend to prevail, where a group divides up a task into a number of sub-tasks and assigns each to a single group member based on individual strengths and abilities, before assembling the results into the final outcome (Keyser, 2000). This is arguably the most significant difference between cooperative and collaborative learning. Both use group work to achieve the goal of learning something together, but different paths are used to achieve that goal (Pinho-Lopes & Macedo, 2016). Rather than use a 'divide and conquer' approach, collaborative learning members' roles and tasks are more interdependent, with members sharing responsibility and authority within the group (Dillenbourg, 1999). Collaborative learning is therefore located at the 'socially constructed learning' end of the continuum, where "one individual does not hold the knowledge; it is sought and negotiated together so that the one collaborative outcome is greater than the sum of its parts." (Parr & Townsend, 2002, p412). At its core is the requirement for positive interdependence between students, meaning working together on tasks that involve co-operation and challenges that could not be met by a single student (Scager et al, 2016).

Parr and Townsend (2002) also distinguish between peer, cooperative and collaborative environments in terms of the degree and nature of tutor input; in peer tutoring the tutor controls the process of learning in a social context whereas in cooperative learning the tutor directs learning and in the collaborative environment, the tutor facilitates the process of learning being socially constructed by the students.

While Parr and Townsend's (2002) continuum can be seen as a useful construct for comparing the terms, there are those who argue that there is still some level of similarity or shared use between cooperative and collaborative learning, and that it is difficult to clearly differentiate their respective definitions, even more so when many of the advantages of collaborative learning can be equally applied to cooperative learning. The result is that there is no clear consensus on a definition of two terms and they are frequently used interchangeably (Jacobs, 2015; Hammar Chiriac, 2010).

For the purpose of the thesis, the definition of collaborative learning used in the studies is that provided by Laal & Laal (2011): "an instruction method in which learners at various performance levels work together in small groups towards a common goal" and which involves five fundamental elements, "Positive interdependence, Individual and group accountability, Interpersonal and small group skills, Face-to-face promotive interaction, and Group processing." (Laal & Laal, 2011, p491)).

2.2 Benefits of Collaborative learning

As stated above, there are good reasons for engaging in collaborative learning, from the point of view of students, tutors, and other stakeholders.

2.2.1 Benefits for Students

2.2.1.1 Stimulation of higher level thinking and development of social skills

According to Race (2007) human evolution is based on the principle of group learning where learning from others is the most instinctive and innate learning context that we encounter. This type of learning can stimulate the development of a number of social and educational benefits. Chief among them is the promotion of an active rather than passive learning environment, encouraging higher level thinking in the process of collective decision making and group negotiation (Dillenbourg, 1999; Laal & Laal, 2011) and conflict resolution (Doise et al, 2013). Group members can actively construct knowledge through socio-cognitive processes such as knowledge elicitation, knowledge externalization and elaboration (Sangin et al, 2011;) and knowledge negotiation (Fischer & Mandl, 2005). Team working which requires students to research, evaluate, communicate information and defend their ideas to

the group leads to enhancement of students' oral and communication skills (Laal & Ghodsi, 2012) and the promotion of social benefits such as mutual trust, positive affective relationships, feelings of group cohesiveness and a sense of community (Zamecnik, 2021). Reusser (2001) highlights the significance of collaborative knowledge creation within a group, where members reach a common understanding that was not fully present in any individual member beforehand. This approach allows students to construct knowledge at a higher level compared to working alone. Group work can also stimulate more creative output as students can bounce ideas off each other and produce work which is more innovative and imaginative (Hamalainen & Vahasantanen, 2011). Palloff & Pratt (2005) suggest that diverse cultures and learning styles can be easily integrated in effective collaborative learning, as it values and embraces diversity.

Collaborative endeavour can also bring out altruistic motives of individuals which is believed to lead to better performance (Huang & Fu, 2013). Studies have shown that workers will adjust their effort level when the rewards of other workers depend on them (Bandiera, Barankay & Rasul, 2005). Even group conflict can produce positive side effects, fostering dialogue and promoting change and evolution at both individual and group level (Bohm, Rusch & Baron, 2020).

2.2.1.2 Possibility for imitating real life scenarios

Collaborative learning opens up possibilities for students to work on more complex, real life assignments and case studies that would otherwise be too extensive and time consuming for a single student. According to Cognitive Load Theory (CTL), groups are viewed as information processing systems that possess greater processing capacity compared to individual learners, so that learning becomes more effective and efficient when done in groups as task complexity increases (Kirschner, Paas, & Kirschner, 2009). Common candidates for collaborative learning are capstone or inter/multi-disciplinary projects that bring together different strands of a course, or that use an industry-based case study. The benefits to students of working on these simulated or real-life projects are the ability to gain valuable and extensive insights of real-world work or a pseudo-industry, to see how various strands come together and to acquire a more holistic view of a particular area. Carroll et al (2006) have shown that students who are brought together to plan, negotiate and coordinate open-ended, real-world projects

over an extended period of time, while tackling ill-defined problems, are typically changed by the experience. This social and personal development is an important by product of meaningful collaborative learning.

2.2.1.3. Social processes and student wellbeing

Collaborative learning has also been found to be advantageous for social processes such as achieving a sense of community and developing positive affective relationships (Walter & Bruch, 2008). At a time when universities are seeing increasing problems with student mental health and wellbeing and are battling with retention (Britt et al, 2017), collaborative learning strategies can be seen as one of the tools helping to address this by opening students up to potential new and long-lasting friendships. This is particularly relevant in the first year of study where many freshers can feel isolated; In this respect, it can form an important piece of a retention strategy (Roseth et al, 2008).

2.2.2 Benefits of Collaborative Learning for tutors

Collaborative learning also provides potential advantages for tutors. With increasing numbers of students entering HE and education budgets being squeezed, universities are having to deal with larger class numbers with fewer resources (Marginson, 2016). Organising a cohort into groups of 3 or 4 students means there are far fewer assignments to mark, and this can often be a strong motivating factor for setting collaborative work. On the other hand, some of the problems raised by group work suggest that many would rather take the hit on greater numbers of individual assignments, than deal with the issues of dysfunctional group work.

The reduction in teaching hours and increasing expectations of students to achieve good grades also puts pressure on tutors running collaborative assignments. There is often insufficient classroom time for supporting groups and achieving the constructivist ideal of students creating meaning together by allowing them to explore, develop and clarify ideas as a group.

2.2.3 Benefits for employers

The increasing focus on group work is also being dictated by the needs of industry and employers who view the ability to work effectively in a team environment as a key skill that graduates must possess to be able to contribute to the workplace (Kalfa & Taska, 2015). Using

online platforms to work collaboratively, as is increasingly the case with collaborative work in HE, is also seen as reflecting an emerging employment need (Putro, Carbone & Sheard, 2014). In short, collaborative work gives students the opportunity to develop these skills and thus to have a better chance to enter an increasingly competitive workplace. This emphasis on group skills is also being reflected in student recruitment practices where assessment centres invariably assess candidates' abilities through group work activities (Dolot, 2014).

2.3 Conditions for effective group work

The above potential advantages can materialise only if collaborative learning is effective, and this is not always the case. Success is determined by a multitude of factors, chief among them being the quality of social interaction during collaboration (Le, Janssen & Wubbels, 2018). Convergence or shared understanding leading to co-construction of knowledge is a demanding task that relies on complex cognitive and social processes that may or may not materialise during the collaborative process. Collaborative learning does not occur automatically when learners are brought together (Dillenbourg, 1999; Weinberger, Stegmann & Fischer, 2005) and for successful collaboration, team members must remain dedicated to continual negotiation and frequent monitoring and evaluation of their progress and accomplishments. When students are required to work together in a learning task, they are expected to establish shared understanding and goals. To achieve this, they need to fully commit themselves to the collective project. However conflicting views can often develop and challenge motivational and affective processes. Groups can face a range of diverse challenges, from personality conflicts to emerging problems in social relationships (Lee, Huh, & Reigeluth, 2015). Culturally diverse groups often encounter additional obstacles due to greater variations in personal characteristics and backgrounds. These differences can make it more difficult for individuals to step outside their comfort zone and collaborate effectively with unfamiliar peers (Zhu, 2011). All these factors can impact on a student's motivation and can result in low levels of engagement, leading to poor collaboration.

2.4 Theories linked to collaborative learning

Collaborative learning can be beneficial for students under favourable circumstances, and various theories developed in different disciplines (such as social and development psychology) can be employed to explain why this is the case.

Social psychology emphasizes the positive impacts of social cohesion that arise from interdependent collaboration on a group task (O'Donnell & O'Kelly, 1994). The desire of group members to assist each other and contribute equally to the group task is bolstered by social cohesion. Cognitive development theories underscore the significance of learning mechanisms that encourage the development of new cognitive schemas during collaboration (Fawcett & Garton, 2005). The concept of the zone of proximal development, as proposed by Vygotsky (1978) is frequently used to illustrate that collaborative learning is advantageous for leaners. This is because a more skilled learner can provide assistance and scaffolding to less skilled learners, allowing them to accomplish a task that they would not have been able to achieve on their own.

Cognitive Load Theory (Sweller, 1994) describes the way that the cognitive abilities of a group of students can provide a larger pool of cognitive capacity for working on a collaborative task, than students working alone. This also means that not all group members need to possess all the necessary knowledge or skills to undertake the task but can share their skills as long as there is effective coordination and communication between the group members (Langfred, 2005; Wegner, 1995). This can potentially lead to group members investing less cognitive effort on a task. However, to this should be added the cognitive load that is exerted by members in the necessary inter-individual communication and coordination of task, referred to as 'transaction cost', which is not required if a student is working alone on an individual task. This transaction load can be a positive thing, for example, where the process enhances shared understanding, trust, and mutual performance monitoring (Salas et al, 2005), or it can be a more negative factor in group collaboration, for example when it is ineffective and used to solve conflict, errors, and unnecessary duplication. The kind of cognitive load imposed on a group by the transaction costs, and their effects on students' learning will be determined by a number of factors including task, learner, and group characteristics (Janssen et al, 2010).

2.5 Models of teamwork

A body of research has looked at the components and processes involved in collaborative learning and team working to identify those that contribute to its effectiveness.

Salas et al (2005) have proposed a model that incorporates the 'Big Five' components of teamwork: team leadership, mutual performance monitoring, backup behaviour, adaptability, and team orientation. Each of these elements are important only if the task

being carried out requires a highly interdependent team, i.e., where team members are dependent on the commitment and participation of all members for the task's successful completion (Fransen, Kirschner & Erkens, 2011). Each of the 'Big Five' is required for team effectiveness, and in addition, there are three overriding coordinating mechanisms: shared mental models, closed-looped communication, and mutual trust. Interdependent team members need to be able to foresee and forecast each other's requirements through common understanding of expectations, goals and tasks, frequently referred to as 'mental models'. Two types of mental models can be distinguished in relation to team performance: team-related mental models, which are concerned with the team functioning and expected behaviours, and task-related mental models which contain the information related to the materials needed for a task.

Salas et al have linked the 'Big Five' and coordinating mechanisms with 'behavioural markers' which indicate the expected activities within each element, as shown in Table 1:

'Big Five' components of Teamwork
Team leadership: Ability to direct and coordinate the activities of other team members, assess team performance, assign tasks, develop team knowledge, skills, and abilities, motivate team members, plan and organize, and establish a positive atmosphere;
Mutual performance monitoring: Ability to develop common understandings of the team environment and apply appropriate task strategies to accurately monitor teammate performance;
Backup behaviour: Ability to anticipate other team members' needs through accurate knowledge about their responsibilities. This includes the ability to shift workload among members to achieve balance during high periods of workload or pressure;
Adaptability: Ability to adjust strategies based on information gathered from the environment using backup behaviour and reallocation of intra-team resources. Altering a course of action or team repertoire in response to changing conditions (internal or external);
Team orientation: Propensity to take other's behaviour into account during group interaction and the belief in the importance of team goals over individual members' goals;
Coordinating mechanisms
Shared mental models: An organizing knowledge structure of the relationships among the task the team is engaged in and how the team members will interact;
Mutual trust: The shared belief that team members will perform their roles and protect the interests of their teammates;
Closed-loop communication: The exchange of information between a sender and a receiver irrespective of the medium.

Table 1: Big Five and the Coordinating Mechanisms of Teamwork (Salas et al, 2005)

Clearly, many elements need to be synchronised for team work to be a success. The model provides a useful reference point for assessing the effectiveness of various processes and means of conducting CL.

2.6 Problems and ongoing issues with group work

Despite the advantages and potential of collaborative learning, a number of problems and ongoing issues continue to impact negatively on its efficacy and outcomes.

2.6.1 Popularity of group work

Recent surveys have shown that despite all its benefits, group work is not always popular with students. Pope-Ruark et al (2011) found that 73% of a student sample viewed group projects negatively, largely due to perceived issues of fairness and fear of being dependent on other learners for their grades. This significant proportion suggests that there may already be negativity towards a collaborative project, before it even starts. Boud et al (1999) acknowledge there is evidence that some high achieving students, in particular, dislike group work because they believe it could have a negative impact on their grades and give an advantage to weaker students.

This view is backed up by a study involving 4000 UK HE students (Almond, 2013) which found that, on average, lower ability students obtained higher marks in group assignments than in individual assignments, whereas higher ability students scored lower marks in collaborative assignments than in individual assignments.

2.6.2 Student interaction issues

There are often problems with poor group dynamics and group makeup leading to conflict and possible exclusion of group members. These can occur for a number of reasons.

Groups are typically made up of students with mixed abilities, with stronger students expected to help their weaker team members in order to achieve the project aims. This can put pressure on the stronger students who may end up resentful that they are taking on what they see as the tutor's role (Boud et al, 1999).

Another reason for conflict can be students' hoarding of individual knowledge which they see as giving them a personal advantage. They are reluctant to share it therefore as this leads to loss of ownership of the knowledge and therefore loss of power (Chiu, Hsu & Wang, 2006). For effective collaboration, individuals need to put the success of the team ahead of their personal inclination to keep knowledge for themselves.

According to Trimbur (1989), collaborative learning has the potential to stifle individual expression, with certain group members conforming to the group's ideas instead of expressing their own, which can lead to a lack of individual creativity. This can be the case where a group finds itself with dominant members.

2.6.3 Social Loafing

Social loafing occurs when a group member does not fully participate in a group activity and instead relies on other members to complete the assigned tasks (Aggarwal & O'Brien, 2008). This is particularly rife when the outcome of group work is evaluated with a single group mark given to all members. Because it is often difficult to evaluate an individual's contribution when working on a collective task, members can feel that they are able to reduce their efforts and remain safe hiding in the crowd (McQuade et al, 2020). Kerr et al (2008) suggest that students can also exert less effort because they may feel that their inputs are not essential to the collective outputs of the group. Whatever the motivation, the fact that such individuals receive the same grade as their more diligent colleagues is often a source of longstanding resentment and a major contributor to dissatisfaction with group work.

2.6.4 Inefficient use of time

Collaborative learning can be seen as an inefficient way of utilizing students' time. While this can create tension in group learning, Isaac (2012) acknowledges that group work may be slower and can require more effort from students as each group member needs to find time do the work required as well as time to manage their group social interaction. This can be compounded by students having different timetables or different class commitments, as is often the case in HE, particularly when group work is applied to inter-disciplinary projects.

2.6.5 Lack of skills for collaboration

Students are often expected to 'do group work' without being taught the cognitive and social skills required for collaborative practice and this can impact on their performance (Dzionek-Kozlowska & Broadwick, 2017). Cognitive skills involve creating understanding for a task using evidence and recreating experiences, whereas social skills involve managing tasks, conflicts, competition, and being open to accepting different viewpoints (Hesse et al, 2015). Students with previous experience of group work have reported this as an advantage when embarking on new collaborative projects (Colbeck, Campbell & Bjorklund, 2000), suggesting that students need practice to get it right. Kolb and Kolb (2005) posit that many students are unprepared to take responsibility for their own learning, which makes it difficult for them to engage in the active learning environment implicit in collaborative learning. This suggests that tutors who aim for effective interaction with students in collaborative projects must understand that these students will need guidance and training in skills such as

communication, conflict resolution, and other social skills. This training may need to be provided before the start of the project or through direct support during group work. These skills are not ones that tutors overseeing collaborative projects may themselves possess.

2.6.6 Difficulties in managing Collaborative Learning

Collaborative learning transfers the process of learning largely into the hands of students, with the tutor quite often the 'outsider looking in', without the insider knowledge of what has been happening within the group. It has been proposed that the level of tutor input varies, depending on the generic stage of the group development, as described in Tuckman's stages of forming, storming, norming, performing and adjourning (Tuckman, 1965). To improve overall performance, the group needs to establish a collaborative identity early on and this entails high levels of interaction which may require higher levels of oversight by tutors (Jaques, 2000). Just because a student does not actively participate in group activities, it does not necessarily mean that they have not been engaged throughout the process; it may be that they have simply not let others know that it has taken place. However, if a student appears not to be interacting, it can hinder the progress of the entire group and impact the collaborative learning experience. Therefore, it is crucial for the tutor to manage and facilitate interaction among the group members early in the group's development. The challenge for tutors is finding the right balance between structing the interaction too much, which can hinder higher-level learning and the benefits of interaction, and not structuring it enough, which may result in only low-level learning (Cohen, 1994).

Group work can also be difficult for students to manage. Tasked with the job of organising their own learning, they need to juggle the coordination and management of varying levels of group member contribution to construct knowledge against a deadline imposed by a tutor and this can lead to stress (Lawless & Allan, 2004). These coordination issues may relate to the content space, i.e. exchanging information or discussing answers and alternatives in the course of problem solving, or to the relational space, i.e. maintaining a harmonious group environment and ensuring effective collaboration (Barron, 2003).

This can be made easier when the expectations of group members are negotiated and clarified prior to starting a task in order to set pre-agreed accepted practices and guidelines for the group to follow (Isaac, 2012). There is also evidence to suggest that management is enhanced if students are co-located and can engage in face-to-face activities rather than

being forced to rely on digitally mediated forms of group work, although today the reality is that group work is likely to have at least some digitally mediated element, as Computer Supported Collaborative Learning (CSCL) becomes the norm.

Regulation of a collaborative team has been shown to play a clear role in its success. Jarvela & Hadwin (2013) describe three main types of regulation, self-regulation by individual team members, co-regulation where team members support each other's regulation, and socially shared regulation, in which the team regulates learning as a whole unit. While all are important in collaboration, studies have shown that socially shared regulation results in better collaborative outcomes (Hensley et al, 2016; Khosa & Volet, 2014). Jarvela & Hadwin (2013) argue that socially shared regulation and joint construction of shared meaning often develop together, but socially shared regulation is a distinct process referring to metacognitive processes which are distinct from domain knowledge. Three dimensions of social regulation can be identified: planning a group's approach to a task, monitoring of understanding and progress, and behavioural engagement involving getting group members to engage with tasks (Rogat & Linnenbrink-Garcia, 2011). A group's engagement with each dimension can vary in quality, from high quality social regulation leading to socially shared regulation where groups sustain joint attention on the learning activity, through to low-quality regulation such as 'other-regulation' where one student dominates and directs the rest of the team. Barron (2003) has demonstrated the clear relationship between effective collaboration (which is taken as high quality, socially shared regulation) and positive learning outcomes at both individual and group level. This view considers a group that has successfully met learning outcomes, but through one member's regulation of other team members, as failing to display effective collaboration.

Another aspect of regulation of collaborative learning is the transaction cost involved in the process of regulation. Socially shared regulation means team members are interdependent and as part of the regulation process they will all need to engage in metacognitive activities such as organising tasks, monitoring and evaluating plans, and so on (Phielix et al., 2010). It is argued that this engagement detracts from participation in task-related learning activities and can sometimes diminish the positive effects of collaborative learning for individual learners (Kirschner, Paas & Kirschner, 2009). Any method of regulation of collaborative learning should therefore aim to reduce these overheads.

2.6.7 Group Composition

Another stress factor among students is the question of group composition, which can be a highly emotive subject. Students often show a preference for working with their friends and are resentful when assigned to random groups by tutors, effectively starting the collaborative process on a negative footing. However, research has demonstrated that creating groups based on pre-existing friendships can lead to a comfortable environment and a tendency towards "group think", where members are hesitant to challenge each other, ultimately hindering the group's progress (Economides, 2008).

Group composition can vary in terms of ability levels (and whether to have homogenous or heterogeneous ability grouping), numbers of students comprising a group, whether randomly picked by tutor or selected by students, whether friend groups are preferable to random teams, and so on. The size, makeup, and level of expertise in a group ultimately represents the potential amount of knowledge and collaboration available to the group (Wang & Lin, 2007).

In terms of size, it is generally accepted that smaller groups are more productive and effective than larger groups where it becomes difficult to manage the group interactions and to contribute to tasks. In any group, contributions could be unequal, however in larger, mixed ability groups this is likely to be magnified, with high-ability students tending to contribute more, and low-ability students more likely to be off-task. Other issues associated with larger groups are the possibility of cliques, where sub-groups could negatively affect the behaviour of the entire group (Cho et al, 2005), and the difficulties in fostering trust and close relationships, compared to small group learning environments (Soboroff, 2012).

2.6.8 Assessment of group work

Methods of assessment can also produce challenges for tutors and negative repercussions for the collaborative process and outcomes. It is general agreement that both process and product need to be considered (MacDonald, 2003) but there are conflicting views on whether assessment should be individual or group based (Davies, 2009). If group members are assessed individually, then their competitive instinct may take over and lead members to act sub-optimally in their own best interests. In contrast, rewarding the group with a single group mark has been shown to promote more peer interaction. However, this can also violate individual accountability, resulting in free-riding, social loafing and the 'sucker effect', where

a group member might respond to social-loafing by reducing their efforts in order not to be "taken for a sucker" (Simms & Nichols, 2014). Peer and self-assessment based on criteria that the group has negotiated can be employed to remedy this situation, but this often comes with its own issues and problems, for example unrealistic peer assessment based on friendly collusion or reciprocity (Magin, 2001). Moderation can also be undertaken by tutors, whereby a group mark can be altered based on evidence of process and contribution, but this is often a time-consuming process wrought with problems if the evidence is not easily available. Tutors cannot fully know the experience of the group as they are merely 'outsiders' looking in on the learning process and are therefore often least capable of moderating marks based on intangibles such as 'effort' or 'cooperation'.

All evidence suggests that a transparent process for achieving fair marks is a major concern for students engaged in collaborative learning and that fairness involves recognising differing levels individual effort in a marking scheme.

2.7 Conclusion

The review has highlighted a number of issues, chief among them the importance of collaborative learning as a vehicle for constructivist learning and for fostering the development of skills that employers expect to see in graduates entering the workplace. It is also increasingly being viewed as device to supports the teaching of more students with fewer tutors. The elevated status of collaborative learning means it needs to be executed well for the stated benefits to accrue, yet problems and issues that have plagued collaborative projects for decades still abound.

Despite its many advantages, group work is often hard to assess and to manage, for both students and tutors. While the benefits are clear for a self-motivated and harmonious group, the disadvantages of collaborative learning reveal themselves in dysfunctional groups that exert a disproportionate time and effort in their management or lead to disgruntled students who can sometimes bear grudges against their peers for the duration of their studies.

There is growing evidence of increasing volumes of collaborative assessment in undergraduate courses. This being the case, there need to be better ways of managing group work so that course aims can be met and more students are satisfied with its outcomes.

CHAPTER 3: TRANSPARENCY

This section reviews the literature on transparency beginning with a broad look at how it is viewed conceptually in various domains. The review then progresses to examining the conditions required for transparency to exist and the consequences, both positive and negative of transparency. Finally, it considers how transparency is applied to the area of collaborative learning, identifying various types of transparency and associated concepts such as visibility and awareness.

3.1 Defining Transparency

The term 'transparency' is defined by the OED as "The condition of being transparent, transparent being 'easy to perceive or detect'" and with origins in the latin 'transparentia', meaning 'shining through'. The term appears in many contexts including philosophy, science, computing, management policy and finance and in the most widely used context it is primarily understood as information sharing and increased disclosure of information for the purposes of accountability, openness and the generation of trust (Schnackenberg & Tomlinson, 2016; Curtin & Maijer, 2006). A software system is generally regarded as transparent when it evokes an easy-to understand system image in users (Preece et al., 2002) or when it is possible to look at it and immediately understand what it is doing and how (Raymond, 2003). Paradoxically, in the area of distributed computing, transparency refers to internal details of the distribution being hidden, rather than shared with users. These examples serve to highlight some of the different perspectives that can be applied to the term, making it a volatile and imprecise phenomenon and thus difficult to explore (Williams, 2005).

In their study of transparency in the context of management and governance, Albu & Flyverbom (2019) found that research can be divided into three dimensions, namely the conceptualisations of transparency, the conditions for transparency to exist, and the consequences and effects of transparency. They suggest that "Despite its pervasive presence in both scholarly work and organizational practice, transparency is rarely examined critically" (Albu & Flyverbom, 2019, p2).

3.2 Conceptualisations of transparency

As stated above, in most contexts, transparency is primarily understood as based on information sharing. Studies typically measure transparency as the frequency of information disclosure and conclude that full transparency will therefore require full disclosure of all relevant information in a timely manner (Berglund, 2014). The assumption is that information produces insight and insight creates accountability and better conduct (Christensen & Cheney, 2015). It is also generally agreed that information must be intentionally and openly shared for it to be considered transparent (Schnackenberg & Tomlinson, 2016) and that the information shared must be accurate (Wehmeier & Raaz, 2012). However, disclosure, alone, can defeat the purpose of transparency. It can obfuscate, rather than enlighten (Albu & Wehmeier, 2014).

Theorizations of transparency also consider the receiver of the information, with successful transmission taking place when the cognitive abilities and information processing requirements of both the sender and receiver are taken into account (Rasmussen, 1991).

In a wide-ranging review of definitions of transparency in the business arena, Schnackenberg & Tomlinson (2016) concluded that research covered in the body of work has conceptualised transparency in three main ways: disclosure, clarity and accuracy and that each dimension is a critical factor explaining a fundamental aspect of transparency.

Grimmelikhuijsen (2012) identifies three different viewpoints on transparency, held by optimists, pessimists and sceptics: to optimists transparency is ultimately something positive, holding organisations to account and stimulating a culture of openness. For optimists, any negative or perverse effect can be moderated by proper implementation (Hood & Heald, 2006); pessimists on the other hand claim that transparency is over rated and increasing it by a process of increasing the amount of information available to individuals can lead to information overload (Bamberger & Belogolovsky, 2017; Ejiogu, Ejiogu & Ambituuni, 2018), misinformation and the promotion of a 'blame culture' (Worthy, 2010); Finally the sceptics claim that transparency has no effect and its importance is overstated (Grimmelikhuijsen, 2012) .

Some challenge the notion of transparency as simply a matter of providing disclosure, clarity and accuracy by conceptualizing it as a form of 'visibility management' which has become

possible and more complex due to the availability of digital technology. This view entails not just looking at transparency as information provision but also examining the efforts to make it visible, which considers wider social processes and dynamics at work in transparency efforts (Flyverbom, 2016; Zhu, 2004). Schnackenberg and Tomlinson (2016) agree, arguing that transparency is most appropriately conceptualised as a *perception* of received information, as organisations have the capacity to influence that perception through their information-sharing behaviours; for example, information can be presented to different stakeholders at different levels of analysis or with different emphasis.

It has been suggested that transparency is "neither a unitary concept, nor merely an ambiguous term for multiple distinct concepts" (DeBoskey & Gillett, 2013, p1). Instead, it is made up of various underlying dimensions which can be distinguished by the subjects an organisation can be transparent *about* (eg process transparency, remuneration transparency, financial accounting transparency, etc). Thus, when investigating transparency in the collaborative learning arena, transparency will be applied to the subjects, processes or concepts involved in collaborative learning.

Despite the vagueness and different interpretations of the term, the concept of transparency has attracted increasing interest in recent years, as financial institutions, governments and educational establishments have embraced it as a general force for good, empowering individuals and allowing them to act as 'regulators' based on being able to access more easily available information. This mandates disclosure or dissemination of information in a form that is understandable to the target audience. If this condition is met then this disclosure of information can lead to better conduct and accountability (Albu & Flyverbom, 2019).

3.3 How to achieve transparency

From the above it is clear that any definition of transparency is based around information disclosure, which enables stakeholders to identify 'basic truths'. However, the information disclosed has also to conform to a number of requirements: It should be of the right quality and quantity (Christensen & Cheney, 2015); it should be understandable/comprehensible (McGaughey, 2002; Potolsky, 2008); it should be honest/truthful (Walumbwa et al, 2011); it should be clear and lacking distortion (Connelly et al, 2011); it must be timely (Jordan et al, 2000; Fung, 2014); furthermore, transparency requires an effective communication process that has reliable methods of transmitting information at a rate and level of detail that is

proportionate to the receiver's needs and cognitive capabilities. Blackburn (2007) also notes that for transparency to exist, the information transmitted should cause no changes in what it seeks to make visible, i.e., it should reflect existing realities.

Certain paradoxes arise with some of these properties: for example, requiring a focus on information clarity suggests that information might need to be processed in some way to ensure it is clear, which itself could introduce distortion or bias (and therefore, by definition, information that is not transparent). So, should all information instead be released in its 'raw' or 'untainted' form? If this were the case, the volumes of data being released in some situations might result in information overload and therefore require filtering or selection of data to make it 'understandable', again introducing potential distortion. Releasing information that is understandable could be problematic: one person's idea of 'understandable' may not match that of another person; in such cases should there be different representations of the same information to cater for different stakeholders?

Some observers note the possibility of different degrees of transparency arising from insufficient amounts of information being shared or insufficient quality of data being released, so that instead of being completely transparent, situations may be 'translucent' in some respects where information may only be partially shared, or 'opaque' (Lamming et al, 2001) or 'fuzzy' (Fox, 2007) where information released may not fully reveal how institutions actually behave in practice, or information that is revealed only nominally and turns out to be unreliable.

3.4 Visibility and Transparency

Visibility and transparency are often treated as synonymous terms; both are concerned with the ability to see: something is visible if it is capable of being seen, and something is transparent if it can be easily seen through. However, Stohl, Stohl & Leonardi (2016) stress that visibility is distinct from transparency, "first, in the sense that visibility is not a valued term in the same way transparency is, and second, visibility is an empirical phenomenon" (Stohl, Stohl & Leonardi, 2016, p125). The authors explore the link between visibility of information and transparency, considering the ease with which information can now be transmitted using digital technologies. Visibility is conceptualised as the combination of a) availability of information, b) approval to disseminate the information, and c) accessibility of

the information to third parties, and it is assumed that high levels of each of these leads to high visibility and therefore transparency.

In certain cases, higher levels of visibility can in fact decrease transparency, a situation which the authors refer to as the 'transparency paradox'.

3.5 Transparency in the context of collaborative learning

A review was undertaken of the academic literature to extract definitions of transparency in the context of CL. A search was made for publications in IEEE, ScienceDirect and GoogleScholar, using the key words 'collaborative learning' and 'transparency'; this was then expanded to 'transparency' and 'group work' and 'transparency' and 'cooperative learning'. While the searches revealed some papers, most gave no attempt at a definition of transparency and instead used it as a 'given'. The author was able to find two: Dalsgaard and Paulsen (2009) define transparency in the context of cooperative education as "students' and teachers' insight into each other's activities and resources. Transparency means that you and your doings are visible to fellow students and teachers within a learning environment". The authors further add that the purpose of transparency is "to enable students and teachers to see and follow the work of fellow students and teachers within a learning environment and in that sense to make participants available to each other as resources for their learning activities." (Dalsgaard & Paulsen, 2009, p2)

In an article focusing on transparency issues in education, Baltzersen posits that "Basically, the definition of transparency is quite simple. It means being open, frank or candid" (Baltzersen, 2010, p.792).

While there appears to be a dearth of concrete definitions of transparency in the context of CL, there is an implicit understanding that it is about providing information to make a group member's activity available to others for further activities to be coordinated between individuals. Put succinctly, transparency is expected to support "consciousness and awareness of the activities of others" (Dalsgaard & Paulsen, 2009, p1).

Taking DeBoskey & Gillett's (2013) view that it makes sense to examine transparency in terms of separate dimensions or aspects that an organisation can be transparent about, the examination of transparency in CL seeks to do the same, focusing on particular dimensions of collaborative learning. These are broadly identified as 1) identity transparency, relating to

the makeup of the group and identity of its group members; 2) interaction transparency, focusing on the interactions between group members; 3) content transparency, indicating the status of elements of the task being undertaken as part of the collaborative endeavour; and 4) process transparency, focusing on the processes used to bring the collaborative task to a successful conclusion.

Further to that, applying Schnackenberg & Tomlinson's (2016) conceptualisation of transparency, an additional question needs to be addressed, namely what is the information in each dimension that needs 'disclosure, clarity and accuracy' for transparency to exist?

Today it is common for teamwork in HE to be supported by digital platforms, including learning management systems (LMS) such as Blackboard and Moodle, or other specialised computer supported collaborative learning (CSCL) tools which can log and track interactions and postings made by individuals. Such systems are primary sources of information that can be disclosed to support aspects of CL transparency. Stuart et al (2012) identify 'social transparency' as an overarching type of transparency that supports the first three of the four dimensions identified above, based on "the availability of social meta-data surrounding information exchange" (Stuart et al, 2012, p451) so that participants and their activities are visible to one another.

3.5.1 Identity Transparency

Identity transparency relates to the extent to which members within a group know the identity of other group members, so that in sending information, the receiver knows who is going to be reading his/her message, and the receivers can see clearly who has sent the message. This kind of transparency may also be unequal, where only one of the parties possesses knowledge about the identity of the other, and overlaps with the concept of authentication, or verifiability of messages (Mackey, 2011). Stuart et al (2012) describe a continuum of identity transparency, variations in which influence "social inferences about similarity, reputation, relative status, and perceived credibility of an information source." (Stuart et al, 2012, p453). Senders and receivers of information change their behaviour depending on their position on the continuum. For example, team members who have provided their real names and accurate personal information to their group rather than using nicknames or personas will be at the highest level of identity transparency and are likely to take more care over the information that they disseminate, have a stronger sense of

accountability, and have greater concern for how others perceive their content. Dalsgaard & Paulsen (2009) point out that higher levels of identity transparency may also present privacy concerns and greater feelings of being monitored.

Identity transparency is higher in face-to-face collaboration where students cannot hide behind alternative personas or icons. Even if initially reticent to divulge personal information, social bonding inevitably occurs between individuals with increased physical presence, body language, facial expressions and informal interactions. This can promote better relationships and understanding between group members which impacts positively on their team cohesiveness and productivity (Papadopoulos & Papadia, 2022). Nevertheless, the degree of identity transparency in both face-to-face and online groups can vary significantly.

Identity transparency has two significant consequences:

- Information accuracy: increased perceived accountability results in greater accuracy in the information being sent as the sender knows that others will be aware of who has made the posting.
- Creativity: A disadvantage of increased identity transparency is that it can lead to a reduction in creativity and risk-taking by group members (Cable & Birkinshaw, 2017): because their identifies are known, people in strongly transparent groups are more likely to work harder at being civil and staying 'in synch' with what the group wants, and thus increase their conformity to group ideas and norms. This suggests that in some cases there may be good reasons for restricting identity transparency.

3.5.2 Interaction Transparency:

Interaction transparency refers to the degree to which social information is revealed about the exchange of information between people, their dependence on each other for information, and which individuals or groups are the main channels through which information flows (Stuart et al, 2012).

The second order effects of interaction transparency are:

- Popularity and herding: As popularity implies credibility, both popular information and popular individuals are significantly more likely to gain further popularity

(Salganik et al, 2006). The result may be increased tendencies for herding behaviour within collaborations as interaction transparency increases. Seeing what friends or team members are viewing may lead to limited access to novel information and promote the separation of information sharing based on group affiliations and ideology (Gentzkov & Shapiro, 2010).

- New information: Increased interaction transparency could make larger, more dispersed networks visible. If an individual discovers others who share comparable work or thoughts regarding comparable subjects, they are more inclined to actively search for and incorporate that material. Improved visibility could enhance the effectiveness of searching for new information by directing users towards individuals who share similar interests but were previously unknown to them (Guy et al, 2010).

- Interaction with Identity Transparency: The awareness of being monitored by external parties can cause members to be more careful when exchanging information, particularly in unfamiliar, uncertain, or hazardous circumstances. The transparency of third parties may influence how recipients react to information from sources. For example, receivers may acknowledge publicly conveyed information faster than privately transmitted content and give more feedback because they want to be seen as responsible in the eyes of the third party (Stuart et al, 2012).

3.5.3 Content Transparency

Another dimension of CL transparency is content transparency which refers to the visibility and provenance of the content being posted by members of a group in the process of undertaking and completing the group task. By allowing changes to be made that are visible to the rest of the group, group members can see how the content evolves over time, as well as gain a perspective on the coordination of the collaborative work. Transparency of the development of content can also reveal the roles of the individuals involved in its creation Stuart et al (2012).

A number of secondary consequences can be inferred from content transparency:

- Productivity improvements**:** Being able to see what additions and changes are being made to the content by group members has been shown to increase overall productivity through a 'social facilitation' process, which occurs then individuals are motivated to perform better when they know they can be compared to others (Guerin, 2010). Similarly, social comparison theory (Gerber, 2020) suggests that people tend to compare their work to others. As a result, the collective outputs of the entire group are also better.

  Increased content transparency can also provide feedback on whether the collaboration is proceeding on track, and if not, what needs to be done and by whom to get it back on track.

  It also results in enhancement of mutual knowledge and improvement in the accuracy of shared mental models (Bardram & Hansen, 2004) which can accelerate content development by reducing lags between iterations and by reducing social loafing (Hinds, 2005).

- Quality improvements: Dalsgaard & Paulsen (2009) identified three quality improvements: 'Preventative quality improvement' as a result of members knowing that colleagues have access to their work and contributions; 'Constructive quality improvement' which results from members being able to learn from others when they have access to their data and contributions; and 'Reactive quality improvement', that may arise from feedback from members when they have access to others' data and contributions. Making members aware of high quality work posted by others can have the effect of improving the overall quality of subsequent postings.

- Objective self-awareness**:** Individuals are made more aware of any discrepancy between their behaviour and that of the rest of the group, which may encourage them to adjust their behaviour (Mullen, Migdal & Rozell, 2003).

- Stress: One noted downside of content transparency is the potential for increased stress: If every group member is aware that every posting they make is being scrutinised by others it may increase their stress levels and induce evaluation

apprehension which can lead to mistakes and work of a lower quality (Thompson et al, 2009).

3.5.4 Process transparency

The final dimension of collaborative learning is the process or method employed to coordinate a learning activity. Process transparency has been found to have various meanings and levels of concreteness (Nussbaumer & Matter, 2011) but in the context of CL it refers to explicitly defining the underlying communication and cooperation processes involved in group work, or the extent to which a team member is enabled to see through and foresee the work process. It should provide answers to the questions: What task is to be done and why? When it is to be done? Where is it carried out? Whose responsibility is it to do the task and how will it be done (Cappelli, Prado Leite & Oliveira, 2007); A lack of process transparency can lead to coordination issues when the status of the group work relative to the overall process is not known (Kienle, 2006).

Some of the consequences arising from increased process transparency are:

- Productivity improvements: gained from having access to clear and visible processes, so that that time is not wasted on efforts to find information.
- Reduction in transaction costs, or the overall cognitive load that is exerted by members in the necessary inter-individual communication and coordination of tasks, when tasks are transparent and visible.

3.6 Awareness and Transparency

Transparency implies that the activities of a team member are made visible, and that other team members are made aware of them: In this way, transparency can exist (Dalsgaard, 2009). Providing visibility and awareness can therefore be thought of as the operationalization of transparency, allowing for the state of transparency to materialise. However, this association is more complex than the statement suggests, as the right kind of visibility and awareness needs to be delivered, and this depends on the context of the group activity and a myriad of other factors.

The concept of awareness has been investigated from many disciplinary perspectives (Carroll et al, 2006) and has received considerable coverage in the area of CSCL. One definition is given as “understanding of the activities of others, which provides a context for your own activity”

(Dourish & Bellotti, 1992, p107) but Schmidt (2002) highlights its ambiguous and unsatisfactory nature, which results in it being used in different and sometimes contradictory ways, for example, researchers using the term to conceptualize even the use of instant messaging systems where someone sending an off-topic message that interrupts the flow of activities of other actors is taken as an instance of 'awareness'.

Awareness information in collaborative environments plays a role in making an individual's activity or information visible to others (Dourish, 1997) in order to deliver transparency, and in the same way that transparency can be viewed through underlying dimensions corresponding to the subjects that can be transparent, awareness is also found to be a concept needing qualification to be useful. It does not make sense to think of awareness as a distinct entity and it is only meaningful if it refers to a person's awareness *of* something.

Gross, Stary and Totter (2005) have proposed two categories of awareness in relation to collaborative learning, group awareness and objective self-awareness.

Group awareness gives an overview of group members' roles, activities, movements and status in the collaborative process. Three types of group awareness can be distinguished, all crucial for effective collaborative learning: behavioural awareness, which provides information on the learners' activities in collaborative learning environments (Janssen et al, 2011); cognitive awareness, which reveals the knowledge level of the group members (Dehler et al, 2011); and social awareness, which reveals the functioning of the group, as perceived by the collaborators (Phielix et al, 2011).

Objective self-awareness is seen as being aware of oneself and one's actions: if group members are sufficiently aware of their actions and the outcomes of those actions, then they can more readily recognise a discrepancy between their current behaviour and the standard of behaviour which is relevant in that setting (Mullen & Goethals, 1987). This affects a group member's ability to self-regulate his or her behaviour in a collaborative learning environment.

Dourish and Bly (1992) define awareness as information that is being gathered passively, while other activities progress. As with transparency, this passive nature is considered significant; the information arises out of each person's activity, rather than having to be managed explicitly, in other words it does not have to be sought out (Dourish, 1997).

The significance of awareness in supporting collaborative learning is demonstrated by the emergence in the literature of a host of awareness types, each focusing on one or more aspects of collaboration, for example: social awareness (Mendoza-Chapa, Romero-Salcedo & Oktaba, 2000) relating to the awareness that students have about social connections within the group and who is available for collaboration; participation awareness (Janssen, Erkens, Kirschner, 2011) providing cognizance of group members' participation levels; task awareness (Gutwin, Stark & Greenberg, 1995), and so on. These various categories of awareness have spawned decades of research into developing awareness systems for CL environments. These aim to provide support for specific aspects of behavioural, cognitive, process and social context information on group members or their collaboration (Bodemer & Dehler, 2011), thereby supporting, with varying degrees of emphasis, the team's consciousness of the information that ultimately delivers transparency. The requirements of group awareness systems mirror those of transparency, namely that to be useful, information needs to be appropriate, timely and passive in nature.

3.7 Benefits and means of delivering CL transparency

Notwithstanding the lack of a formal definition of transparency in CL, ample benefits are claimed for transparency in this context. Studies indicate that transparency is an important driver for improved quality (Paulson, 2008) and a key factor in improving the outcome of collaborative projects. Transparency can improve communication, reduce conflict and enhance team performance by reducing the number of low-quality contributions from students and making high quality work more accessible as a model for others (Stuart et al, 2012). Moreover, transparency can facilitate a culture of continuous improvement and learning and encourage students to develop new ways of thinking and behaving in teams (Jassawalla et al, 2010).

As increased transparency is ultimately about the disclosure of targeted, relevant information, efforts into increasing transparency have focused on ways that this information can be made more accessible to stakeholders. One strand of activity has been the development of awareness systems, aimed at various dimensions of CL transparency and designed to increase the degree to which group members are cognizant of data that is available, or to present available information in more palatable, user friendly ways for easier interpretation. An increasing number of computer-supported cooperative work (CSCW)

based software systems, for example, provide group members with behavioural awareness information, creating visual representations of data relating to the presence, activities, and availability of members of the group. Such visual aids can enable transparency and help individuals collect and interpret crucial data for better collaboration (e.g., Jiang, Elen, & Clarebout, 2009; Kimmerle & Cress, 2009). Barros & Verdejo (2000) for example, describe an application targeting interaction and content transparency by providing graphical representations of information on three perspectives of group activity: group performance in relation to other groups, the individual member's activity in relation to other members of the group, and the performance of the group itself. Other software tools such as SNAPP (Bakharia & Dawson, 2011) allow users to visualize the network of interactions arising from discussion posts and replies from group members. Recently, data mining and AI approaches have also been employed to provide more focused information, for example using outlier detection to highlight group members with difficulties or unusual learning processes. Such awareness systems meet the requirement of gathering information passively as collaborative learning proceeds, but clearly are only possible for computer mediated collaborative activity, as manual approaches to collate and produce such data are not practical.

Another approach aimed at delivering transparency in CL has been to employ Web 2.0 technologies and tools that help improve communication between participants, encourage user participation, and enhance interaction transparency. This, in turn, can lead to greater trust and collaboration capabilities (Nedbal, Auingera, Hochmeier, 2013). Examples include social networking sites such as Facebook and Twitter, WhatsApp, blogs and wikis, and collaborative software such as Google Docs that allow for real-time collaboration and data sharing. For example, wikis allow any edit or modification made to a document to be recorded and attributed to a specific user, providing support for interaction and content transparency (Caple & Bogle, 2013). Studies have demonstrated that the transparency afforded by a wiki can reduce social loafing and free riding in groupwork (Abdekhodaee, Chase & Ross, 2017; Park, 2013). Interest has also been shown in using social networking platforms such as Facebook for CL, for their capacity to promote transparency and raise awareness among students (Dalsgaard, 2008), and there is mounting evidence that other social media platforms and Web 2.0 technologies are being utilized for this purpose (Giannikas, 2020).

Process transparency in a CL can be enhanced using online visual project or task management tools such as Trello, Asana and other applications which show the status of tasks that need to be completed and who is responsible for each task, providing a transparent picture of the team's progress. However, the use of these tools can be viewed as a piecemeal strategy for providing visibility and awareness of information in order to deliver one or more dimensions of CL transparency. An alternative strategy is to use overarching processes based on Agile frameworks that have been designed to invoke transparency (and which can incorporate the use of such tools). One such process is Kanban, which focuses on visualisation of work, limiting work in process, and maximising efficiency by using a Kanban board and continuously improving workflows (Oza et al, 2013). Another is Scrum which helps teams to structure and manage their work through a set of values, practices and guiding principles, one of which is transparency (Schwaber & Sutherland, 2017) and, although aimed at software development, is increasingly being used for collaborative projects in other domains making it suitable for investigation as a potential vehicle for delivering transparency in CL.

3.8 Conclusion

This chapter explored the interpretation and understanding of the concept of transparency in a broad context, before attempting to apply it to the domain of collaborative learning where the literature largely avoids any definition of transparency, implying that its meaning is obvious to all and therefore in no need of a definition.

In its broadest sense it is seen as disclosure or sharing of information, though disclosure on its own can have the result of defeating transparency, obfuscating rather enlightening it through information overload or disclosure that is not adequately targeted to the receiver of the information. Opinions on its status differ, from an intrinsic value to an underlying latent construct, to whether it should be considered as a unitary concept at all. It has been suggested that it is best viewed as being made up of various underlying dimensions which can be distinguished by the topics that one is being transparent about (DeBoskey & Gillet, 2013). In an overview of CL transparency, these dimensions were identified as identity transparency, interaction transparency, content transparency and process transparency.

The chapter considered a number of concepts relating to transparency as applied to collaborative learning (see Table 2).

Concept	Description
Transparency	A broad and vague concept concerned with information disclosure. Needs to be linked to a specific dimension of CL to be meaningful. Transparency is considered a desirable 'state'.
Visibility	A prerequisite of transparency: Making appropriate disclosed information visible to a specific stakeholder. Visible information needs to be of the right quantity and in the right format for a given stakeholder, to be effective
Awareness	A means of operationalizing transparency: Alerts the receiver or relevant stakeholder to information that has been made visible, for the state of transparency to materialise. Closes the loop of information disclosure → visibility of required information → awareness by stakeholders of required information = the state of transparency

Table 2: The relationship between transparency, visibility, and awareness

Transparency is considered a vague concept concerned with information disclosure that needs to be linked or applied to a specific dimension of collaborative learning to be meaningful. It can be perceived as a wishful 'state' which allows collaborative learning to progress in a positive way. However, too much of it can lead to a transparency paradox, potentially hampering learning.

Visibility is a pre-requisite of transparency, as unless appropriate information is made visible to an intended stakeholder, transparency cannot exist. Visibility of appropriate information can therefore be viewed as a condition for transparency to materialise.

Unless relevant stakeholders are made aware of the information that has been made visible, full transparency cannot exist. Awareness can therefore be viewed as a way of operationalizing transparency by making relevant information known to the stakeholders. A useful conceptualisation of visibility and awareness is from the perspectives of sender versus receiver, where visibility is about the sender making information available, whereas awareness is the degree to which the receiver or intended recipient is cognizant of the relevant information or data that that has been made available (Segijn et al, 2021).

Collaborative learning in HE is typically conducted as Computer Supported Collaborative Learning or as blended learning, undertaken either wholly or partially through online digital tools and platforms. Here, transparency of one or more dimensions of CL can be facilitated using awareness systems and Web 2.0 tools. In face-to-face collaborative environments, visibility, awareness, and transparency can be natural by-products of collaboration.

The next chapter will examine the transparency credentials of Scrum, in the light of the findings and issues raised in this chapter.

CHAPTER 4: SCRUM

4.1 Introduction

This section of the literature review examines Scrum which is used to deliver successful collaborative projects in commercial environments. The chapter outlines the general principles of Agile and how these principles have been adopted by Agile and Scrum-based educational initiatives. The review then investigates the transparency credentials of Scrum and examines its potential to deliver effective collaborative learning by examining its support for models of successful teamwork.

4.2 Agile methods and Scrum

Agile processes are becoming increasingly popular in the software industry, providing the potential to deliver value to a project at every phase, while remaining flexible and open to change. Traditional development processes are based on extensive planning and set methods whereas Agile processes are more flexible, relying on "people and their creativity" (Dyba & Dingsoyr, 2008) to manage requirement changes and continuous improvements. They are particularly targeted towards problems that involve change and uncertainty (Mishra & Mishra, 2011). The main principles are embodied in the Manifesto for Agile Software Development (agilemanifesto.org) which proposes:

> Individuals and interactions over processes and tools.
> Working software over comprehensive documentation.
> Customer collaboration over contract negotiation.
> Responding to change over following a plan.

These four principles form the bedrock of Agile, recognising the importance of the items on the right of each comparison but asserting the dominance of the ones on the left.

Of all the frameworks developed under the Agile philosophy, Scrum (Schwaber & Beedle, 2002) is the most popular (UK.GOV, 2016). Since its introduction, there are increasing number examples of its adoption as a project management tool in areas outside the software development field, including business (Vandersluis, 2014), space hardware (Garzaniti et al, 2019), new product development (Gerdes, Phaal & Lynch, 2021) and engineering and construction (Zender & de Soto, 2020). Its basic paradigms have even been applied to household management and raising of children (Feiler, 2013).

At its core are small, tightly knit, and self-directed teams, and project management processes that include ongoing collaboration, frequent feedback, and monitoring activities to ensure transparency and flexibility. Project development is broken up into fixed time periods called Sprints, between two and four weeks in duration, in which tasks or small increments of development known as user stories that need to be completed by the end of the Sprint and the team members responsible for these tasks, are identified and documented in a Sprint backlog. The Sprint backlog is subset of the product backlog, a prioritised list of the overall tasks required to fulfil the project which is put together at the start of the project. Four time constrained events are implemented: Sprint planning allows the team to plan what increments are going to be delivered in the next Sprint; a Sprint review is held at the end of each Sprint to assess what has been achieved during the Sprint; a Sprint retrospective is also conducted by the team to identify aspects of the Sprint that went well and aspects that could be improved, so that lessons learned from this can be incorporated into the next Sprint; finally daily stand-ups are short daily face-to-face meetings conducted by the development team to assess progress and to make any necessary adjustments to work schedules. The method also employs three Scrum roles: that of the Product Owner who represents the external stakeholder interests and is responsible for creating the project's initial overall requirements, as specified in the product backlog, the Scrum Master who oversees the Scrum process and ensures that the team follows Agile values, rules and practices, and the development team who are responsible for implementing the required functionality. A burndown chart shows the rate at which work is being accomplished (Schwaber & Sutherland, 2017).

Scrum is particularly effective in situations of uncertainty where it is difficult to plan ahead, due to its characteristics of frequent communication, feedback loops, and adaptation to change. The Scrum team is given full authority to plan, schedule, assign work to team members, and make collaborative decisions (Moe & Dingsoyr, 2008).

The success of Agile in commercial environments has led to moves to adapt Agile principles to an educational context, epitomised in the Agile Manifesto in Higher Education (Kamat, 2012). In recent years literature is starting to emerge on Agile Education, with studies claiming that it creates a learning environment favourable for the creation of responsible citizens, while improving the performance, satisfaction and motivation of students and educators (Lopez-Alcarria, Olivares-Vincente & Poza-Vilches, 2019). Agile methods, particularly Scrum,

are now being taught in computer science courses to equip students with practical skills necessary for the workplace. They have also been used as a project management tool to successfully develop small systems in capstone projects (Chen, 2017).

Further interest in the principles and advantages of Scrum have resulted in a move to develop a Scrum-based approach for educational purposes, embodied in 'eduScrum' (Delhij, van Solingen, & Wijnands, 2015) which aims to reposition traditional delivery of teaching and learning so that students learn through Scrum practices. This involves, for example, learners creating content and developing skills alongside tutors in a collaborative way, with emphasis on continual improvement, and tutor roles being centred on facilitation and guidance from an informed perspective. Learners become "self-directed, team-oriented, and individually lifelong learners" (Noguera et al, 2018, p112). EduScrum has a broad focus and is regarded as a pedagogical framework with great potential (Lopez-Alcarria et al, 2019), however publications referring to the application of Scrum or EduScrum in HE are still rare and mostly exploratory (Fernandes & Dinis-Carvalho, 2021).

4.3 Scrum support for transparency

At the core of Scrum is the concept of empiricism which asserts that knowledge comes from experience and making decisions on what is observed. Empiricism is supported by three pillars of Scrum: transparency, inspection, and adaptation. Scrum emphasises transparency, both in the sense of clarity and visibility, allowing each team member to track and understand what is going on in a project. Inspection dictates that progress towards agreed outcomes must be inspected frequently and diligently to detect potentially undesirable variances or problems, and adaptation recognises that where any undesirable variances or problems are detected, processes must be adapted and adjusted to bring the project back on track (Schwaber & Sutherland 2017).

Scrum's transparency is multi-faceted and is responsible for a number of positive outcomes. Kautz, Johansen & Uldahl (2016) demonstrate the influence of Scrum on process transparency in the context of information systems development projects, arguing that this is one of the areas that distinguish Scrum from other processes, but is deliverable only if "the process is at every point in time transparent both in the sense of clarity and openness as well as in the sense of visibility for everyone involved" (Kautz, Johansen & Uldahl, 2016, p117). This view is shared by Moe and Dingsoyr (2008) who emphasize the crucial relationship between process

transparency and team collaboration and effectiveness. Schwaber and Beedle (2002) stress the positive effect that Scrum practices such as Sprint reviews and retrospectives, and artefacts such as product backlogs and burndown charts, have on process visibility and the benefit of this visibility for conflict resolution when disagreements or misunderstandings arise. Enhanced visibility of task and process status also has an impact on efficiency as team members are constantly aware of their own and others' tasks and responsibilities and thus able to reduce wasted time (Sutherland & Altman, 2010). Daily stand-up meetings and retrospectives have among other purposes the objective to create transparency by ensuring that everyone in the team is aware of what is going on, on a regular basis. Daily stand-ups also make it difficult to conceal poor work efforts, as team members need to communicate and document their results openly to the rest of the team (Kautz, Johansen & Uldahl, 2016). Retrospectives are intended to support transparency and increase the productivity by the project participants' learning from their own and others' mistakes, so that they are not repeated in the next Sprint.

One critical view of Scrum in the context of transparency is that product and Scrum backlogs, by breaking jobs down into small tasks, can lead to a loss of total overview of the entire project, thereby poorer visibility and lower levels of overall transparency (Moe & Dingsoyr, 2008). However, this appears to be the only negative point to emerge from the literature.

Table 3 summarises the different types of transparency supported by Scrum, as revealed in published research. However, despite its many claims to transparency, very few empirical studies have been undertaken on the ability of Scum to support transparency. Rather, it seems to be taken as accepted wisdom by researchers in the field**.**

Type of Transparency	Supporting Mechanisms
Process transparency:	**Scrum Artifacts**: • Sprint/Product backlog which shows what needs to be done for the current Sprint, and what is left to do • Burndown chart: shows progress against plan **Scrum Ceremonies**: • Daily stand up: face to face meetings where individual team members bring the team up to date with what they have done on a daily basis • Sprint reviews: face to face meetings which discuss the outcomes of each Sprint • Sprint retrospectives: face to face meetings which identify 'what worked' and 'what didn't work' in the last Scrum and decide what working practices/good habits need to be taken forward or changed for the next Sprint
Identity Transparency:	**Scrum Ceremonies:**

	• Daily stand up, Sprint reviews and Sprint retrospectives are all face to face – the highest level of identity transparency (for those present).
Content transparency:	**Scrum artifacts:** • Sprint/Product Backlog: in Agile, documentation noticeably takes a back seat ('working software over comprehensive documentation'). The amount of content transparency will depend on the tools being used to record the outputs from the various processes; Typically Scrum projects will use a Kanban board or similar, to record which user stories or tasks are in progress or have been completed. **Scrum Ceremonies:** • All ceremonies will provide some elements of content transparency.
Interaction transparency:	**Scrum Ceremonies:** • These involve largely face-to-face interaction, providing information on who is exchanging information with whom, who is dependent on whom for information and which persons are the primary conduits for information, particularly evidenced in the 'daily stand ups'
Social transparency:	**Scrum Ceremonies:** • Social transparency is a natural side product of face-to-face meetings.

Table 3: Transparencies supported by Scrum

Transparency is one of the three pillars supporting Scrum, so by definition it must play a large part in the success of the methodology. Table 3 shows that, as a process that involves face-to-face and frequent collaboration among group members, Scrum supports many of the transparencies that have been identified as necessary for effective collaborative learning.

4.4 Scrum support for collaborative learning

To examine the suitability of Scrum for collaborative learning, we can investigate its support for the 'Big Five' factors for effective teamwork (Salas et al, 2005): team leadership, mutual performance monitoring, backup behaviour, adaptability, and team orientation. An overview of its coverage of these elements, along with the three coordinating mechanisms, shared mental models, closed-loop communication, and mutual trust, is shown in Table 4, summarised from a study by Moe and Dingsoyr (2008), which examined how the components of the 'Big Five' framework were addressed in a commercial project using Scrum.

Components:	Support through Scrum:
Team Leadership "Facilitate team problem solving. Provide performance expectations and acceptable interaction patterns. Synchronize and combine individual team member contributions. Engage in preparatory meetings and feedback sessions with the team".	**Scrum Roles:** • Scrum-Master: can be thought of as a coach, removing problems and facilitating the different Scrum ceremonies. • Team members: arranged as self-organising teams where team leadership is distributed. The team leadership coordinates and monitors tasks, ensuring that accurate mental models are developed.
Mutual Performance Monitoring "The ability to develop common understandings of the team environment and apply appropriate task strategies to	**Scrum Ceremonies:** • Daily stand-up meetings, Sprint reviews and retrospectives, all support mutual performance monitoring. **Scrum Artifacts:** • Burndown chart allows the team to gauge team performance against plan

accurately monitor team-mate performance".	
Backup behaviour "Recognition by potential backup providers that there is a workload distribution problem in their team. Shifting of work responsibilities to underutilized team members. Completion of the whole task or parts of tasks by other team members".	**Scrum Roles:** • The team is seen as multifunctional and self-organising: they are tasked with organising the delivery of tasks that they have committed to deliver, and must be able to adapt to changing conditions **Scrum Ceremonies:** • Daily stand-up meetings are the mechanism for checking on the status of tasks, whether help is needed in any area and whether work responsibilities need to be redistributed. **Scrum Artifacts:** • Product/Scrum backlogs allow easy reference to what has been completed/is outstanding allowing resources to be redistributed accordingly
Adaptability "Identify cues that a change has occurred, assign meaning to that change, and develop a new plan to deal with the changes. Identify opportunities for improvement and innovation for habitual or routine practices. Remain vigilant to changes in the internal and external environment of the team".	**Scrum Roles:** • Product owner acts as a conduit to the external environment. Any change in requirements from a customer is coordinated by the product owner and communicated through him/her to the team. • The product team is designed to be adaptable and to respond to unexpected changes. **Scrum Ceremonies:** • All ceremonies are designed to be able to respond to requirements for change through continuous planning and feedback. The Scrum retrospective allows for reflection on current processes and for the identification of opportunities for improvement and innovation in future practices. **Scrum artefacts:** • The burndown chart will alert the team to slippages in timescales, to allow for corrective action to be implemented.
Team Orientation "Propensity to take other's behaviour into account during group interaction and the belief in the importance of team goals over individual members' goals"	**Scrum roles:** • The self-organising team is central to the delivery of the project's goals and operates on team consensus which affirms the importance of team goals over individual members' goals. **Scrum ceremonies:** • Goal setting and any requirement for changes or modification to agreed goals, are set up and agreed during Sprint planning and daily stand-ups.
Coordinating Mechanisms:	
Shared mental models "Anticipating and predicting each other's needs. Identifying changes in the team, task, or team-mates and implicitly adjusting strategies as needed"	Supported through the product owner, focus on the overall project through planning required in putting together a backlog, retrospective meetings and daily stand-up which reinforce understanding of who is doing what, to identify any problems with the project. Every stakeholder is involved in this planning which is conducted as a face-to-face meeting. The Sprint and product backlogs describe what is to be developed.
Closed loop communication "Following up with team members to ensure message was received. Acknowledging that a message was received. Clarifying with the sender of the message that the message received is the same as the intended message"	Supported through daily feedback in the daily stand-up, as well as at the end of each Sprint, through Sprint reviews and Sprint retrospectives.
Mutual Trust "Information sharing. Willingness to admit mistakes and accept feedback"	Scrum does not have mechanisms to directly develop mutual trust but assumes that there is a culture of mutual trust in the team. Without mutual trust it will be difficult for the team to commit to the backlog and keep to the deadline.

Table 4: Scrum support for Sala et al's 'Big 5' components for effectiveness in small teams

(Summarised from Moe and Dingsoyr, 2008)

The analysis shows that Scrum supports, to a large degree, the Big Five components for effectiveness in group work, strengthening its potential as an effective means of conducting CL. Despite this, there are still few publications that empirically test this effectiveness in HE contexts.

4.5 Conclusion

This chapter has outlined the philosophy and structure of Scrum and its role in delivering successful projects in the domain of software development. Increasingly, the potential and benefits of the process are being recognised in other areas, with examples appearing of its use in construction and engineering projects and new product development. The principles of Scrum have also been embraced in Scrum-based educational initiatives, such as Eduscrum which gives students ownership of their learning, and provides them with a structured approach mirroring Scrum, in order to benefit from the main strengths of the process.

A review of the literature suggests a strong association between Scrum and transparency. Transparency is one of the pillars of Scrum, with various transparencies being enabled through its artefacts and events. The chapter also examined Scrum's support for Sala et al's Big Five model for successful teamwork, finding backing for each of components of the model. These findings suggest that Scrum is well suited for both running collaborative projects in an educational setting, as well as providing support for the transparency that students seek. The stage is set to test this through empirical research.

The next chapter describes the research design and methodology employed for the three empirical studies contained in this thesis.

CHAPTER 5: METHODOLOGY

5.1 Introduction

This chapter discusses the methodology adopted for the research. This includes revisiting the research questions, elucidating the research philosophy, and outlining the reasoning behind the chosen research approaches and methods. It will also provide an outline of the data collection methods used in the study as well as an overview of the methods used to analyse the data, their validity, reliability, and ethical considerations.

5.2 Aim and Research Questions

As outlined in Chapter 1 the aim of this research is to investigate the nature and role of transparency in improving the processes and outcomes of collaborative learning within Higher Education, and to investigate whether such transparency can be delivered through Scrum, a popular Agile process used for software development projects in industry.

The primary research question for the thesis is:

> Can the outcomes of collaborative learning in Higher Education be improved through transparency, and can Scrum be utilized to promote transparency and improve outcomes in this context?

This is investigated through the following sub-questions:

RQ1 What is meant by transparency as applied to collaborative learning? What do students mean by transparency in this context?

RQ2 Does a Scrum approach to group work increase collaborative learning transparency, compared with non-Scrum approaches?

RQ3 How and to what extent can transparency support provided through Scrum improve the outcomes of collaborative learning?

- RQ3a Does using Scrum improve student grades?
- RQ3b Are students more satisfied with their peers' performance when using Scrum?
- RQ3c Does using Scrum motivate students to use Scrum for collaborative projects in the future?

RQ3d Does using Scrum improve students' satisfaction with the overall collaborative learning experience?

5.3 Research Paradigm

A mixed-methods approach is considered appropriate for the thesis as the study will incorporate both qualitative and quantitative research and data.

Philosophical approaches underpinning mixed methods research fall into three areas (Hall, 2013). The first is an a-paradigmatic approach (Patton, 1990) which asserts that methodology is independent of epistemology that gives rise to it and therefore ignores paradigms.

The second, the multiple paradigm approach (Teddlie & Tshakkori, 2003), suggests that researchers can draw on multiple paradigms in their research, taking one of three forms: the complementary strengths theory, in which the methods remain separate in order to draw on the strengths of each (Morse, 2003); the dialectical theory (Greene, 2007) which states that understanding can be gained from mixing the values, assumptions and beliefs with which researchers approach their work; and multiple-paradigm theory (Creswell & PlanoClark, 2007) which expresses the belief that the mixed-methods design governs the suitability of specific paradigm choices, as some paradigms are more suitable for some designs, while others may not be.

The third research paradigm suggested for mixed methods research is the single paradigm approach which incorporates both qualitative and quantitative research methods, overcoming the problem in the multiple paradigm approach of difficulties in trying to merge paradigms based on fundamentally different assumptions (Hall, 2013). This approach is dominated by a pragmatic perspective (Johnson & Onwuegtbuzie, 2004; Morgan, 2007) and by a transformative perspective (Mertens, 2013). A transformative view suggests a framework for mixed methods that places social justice and human rights as overarching ethical principles in the research process, while the pragmatic view draws on using 'whatever works' in order to address the research problem and aims. This research takes the Pragmatism approach which Johnson et al (2017) suggest is the primary philosophy for mixed methods research.

Epistemologically, pragmatism is premised on the belief that research focuses on practical understandings of concrete, real-world issues and can by-pass metaphysical discussions

about the nature of truth and reality (Patton, 2005). Pragmatism is not confined to a single philosophy and reality; instead, reality is actively created by individuals, based on their experience, and is thus ever changing, and oriented towards solving practical problems (Frey, 2018).

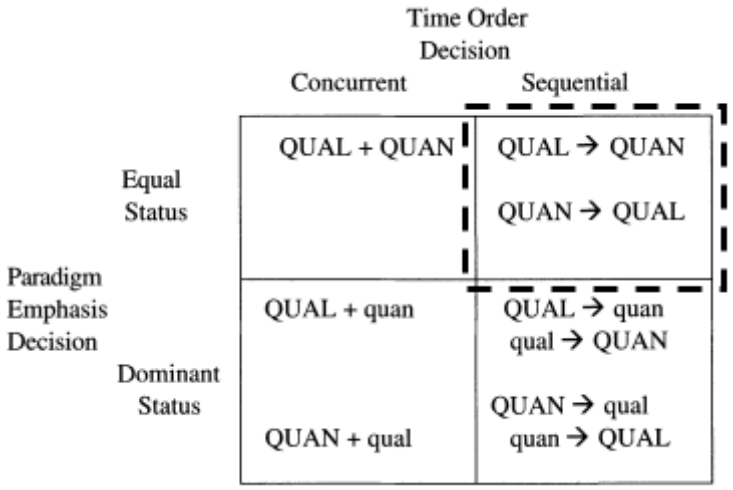
There are strong reasons for conducting mixed methods research for this thesis. This approach allows for between-method triangulation in which the bias that may be present in any data source, researchers, or method will be cancelled out when used in conjunction with other data sources, researchers, and methods (Denzin, 1978) leading to a convergence upon the truth about some phenomenon and providing researchers with more confidence in their results. It also allows for complementarity, allowing elaboration, enhancement, and clarification of the results of one method with the results of another (Greene, 2007). The research methods used in both quantitative and qualitative research have their own strengths and weaknesses, so that combining them allows the research to draw on the strengths of both. Mixed methods research may also lead to initiation (Jick, 1979) where inconsistent or contradictory results or paradoxes may promote new ways of thinking by researchers having to account for such contradictions. Another reason for conducting mixed methods research is exploration, where the researcher can complete in a first stage, an exploratory study to gain better understanding of a phenomenon and thus generate propositions which can be tested in a second stage on a larger or different sample (Creswell & Plano Clark, 2011).

In considering mixed methods research for this thesis, Johnson, Onwuegbuzie & Turner's (2007) broad interpretation of the word 'methods' as meaning 'methodology' has been used. This incorporates strategies around data collection methods (e.g. observations, questionnaires, interviews), methods of research (e.g. experiments, ethnography), and related philosophical issues (eg ontology, epistemology).

5.4 Research Design

Mixed methods research has been broadly classified into two types: Sequential and Concurrent (Cresswell and Plano Clark, 2011). A distinction can also be made between *mixed-model* research designs where qualitative and quantitative approaches are mixed within or across the *stages* of the research process, and *mixed-method* research designs that are distinguished by the presence of a quantitative *phase* and a qualitative *phase* in the overall design of the research study (Johnson and Onwuegbuzie, 2004).

Several designs are available to the researcher, as shown in Figure 2 where the decision to use a concurrent or sequential method, together with the relative emphasis on quantitative and qualitative approaches gives rise to a four-quadrant mixed model design matrix providing nine designs (Johnson and Onwuegbuzie, 2004).



Note: 'qual' stands for qualitative, 'quan' stands for quantitative, '+' stands for concurrent, '→' stands for sequential, capital letters denote high priority or weight, and lower-case letters denote lower priority or weight

Figure 2: Mixed-method design matrix (Johnson & Onwuegbuzie, 2004)

The current research follows a mixed methods research design with equal status paradigm emphasis, and quantitative and qualitative phases being conducted sequentially. This corresponds to the sequential, equal status QUAN →QUAL cell in the above matrix.

A graphic representation of sequential mixed model design used in the study is shown is shown in Figure 3.

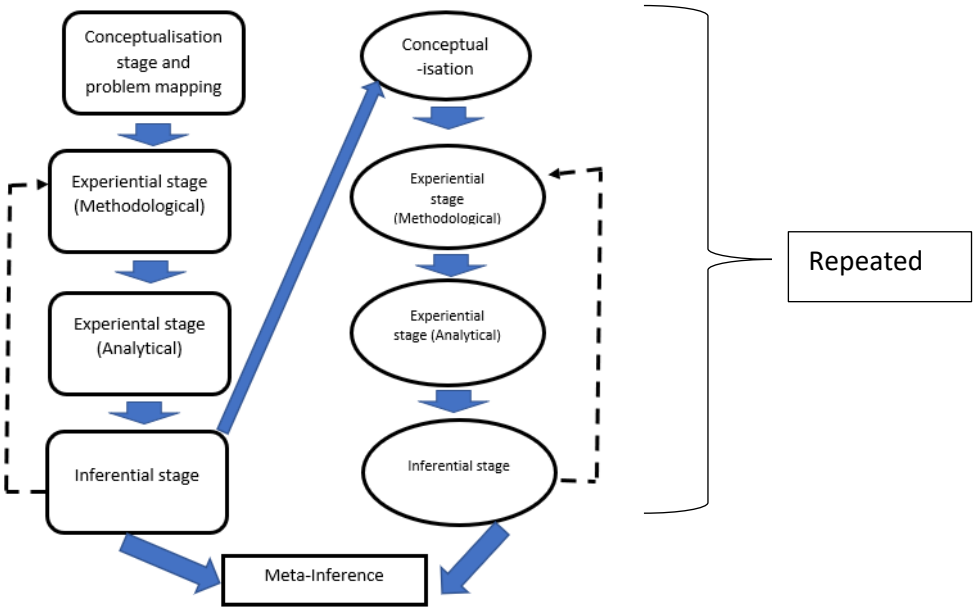


Figure 3: Sequential Mixed Design for Scrum studies (after Teddlie and Tashakkori, 2003) with stages on the left denoting quantitative strand, those on the right qualitative strand.

The operationalisation of this design for the current research is as follows:

Conceptualisation stage and problem mapping: This seeks to frame the problem and relate it to the world or practice to create an understanding of the more specific feature under investigation. This involves an examination of theories and empirical studies based on investigating transparency, with a view to identifying and bringing together various strands of past investigation, to investigate any contradictions and to build a deeper understanding of the relevance and boundary of the problem that is to be investigated. Here problems of collaborative learning are investigated to reach an understanding of key challenges from the viewpoint of students and teaching staff; transparency is conceptualised and examined against the capabilities of Scrum and research questions are formulated.

Quantitative Experiential stage: (Methodological): Here the first empirical study of a cohort of students undertaking Scrum and non-Scrum assignments provides quantitative data relating to grades achieved, including peer assessment grades. A student questionnaire also generates quantitative data on student perceptions of Scrum for cross referencing against grade data. Historical data is also made available from a comparable assignment from a previous academic year.

Quantitative Experiential stage: (Analysis): Student grade data and peer assessment scores are analysed using standard statistical analysis to identify any significant trends or differences

between Scrum and non-Scrum grades. The quantitative data on students' perception of Scrum/non-Scrum is also analysed.

Quantitative Inferential stage: Inferences are made from the results of statistical tests and questionnaire. Areas that are unclear or are of particular interest are highlighted for further investigation and passed to the conceptualisation stage in the 'Qualitative' strand of the sequential mixed design method.

Qualitative Conceptualisation: This involves further conceptualisation and clarification of issues emanating from inferences made in the quantitative inferential stage.

Qualitative Experiential: (Methodology): A focus group is run in order to probe issues identified in qualitative conceptualisation stage.

Qualitative Experiential stage: (Analytical): This stage employs content analysis involving inductive and deductive analysis of transcripts of the focus groups discussions to investigate predetermined themes and uncover any significant new ones.

Qualitative Inferential stage: This stage makes inferences from the analysis received from the previous step.

The above cycle will be repeated for a second empirical study of students using Scrum for collaborative learning.

In addition to these two studies, an investigation will be carried out to assess students' views of transparency using means-end analysis, a QUAL → QUAN research tool which collects qualitative data through one-on-one interviews and then uses 'laddering' techniques associated with means-end analysis (Gutman, 1982) to cross over from qualitative data gathering to quantitative data treatment.

Meta-Inferences: The final stage in the design will cross-triangulate inferences from both qualitative and quantitative research strands to provide answers to the research questions posed in the thesis.

5.5 Data Collection

Underlying research paradigms often dictate the way that mixed methods research is justified and carried out (Sommer Harrits, 2011) and this strongly influences the types of data that are

going to be collected. The study involves conducting research from the standpoint of positivism (carrying out questionnaires and analysing grade and interaction data) to draw out some initial observations and propositions while also conducting research from the standpoint of constructivism (eg focus group discussions) to verify the initial observations, seek associations between the data, and guide further data collection and analysis.

Data collection is based on case studies of students undertaking collaborative learning in courses offered within the University of West London's Computing school, which can be considered typical of collaborative learning within HE. Data collected can be aligned with the characteristic features of case studies as descriptive and highly subjective. Although the study is data driven and interpretative, it aims to investigate and provide a plausible explanation of student outcomes and satisfaction levels resulting from transparency in CL in general, and more specifically transparency delivered through Scrum, rather than providing a detailed descriptive account of the observed behaviour to add to any empirical studies in this area.

Data used in this research was obtained from a number of sources:

Focus Groups

Focus groups are used to obtain qualitative data in two of the empirical studies. They have been described as "carefully planned discussion designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment" (Krueger, 2014, p6). Participants answer open ended questions prepared by the researcher which are designed to promote open discussion and encourage participants to interact with each other. The interaction within the group motivates participants to discuss and refine their personal and collective viewpoints, producing data that represents individual perspectives as well as unique group insights that are not reducible to individual participants (Hyden & Bulow, 2003).

The processes used for running focus groups were informed by COREQ (Consolidated criteria for reporting qualitative studies) guidelines (Tong, Sainsbury & Craig, 2007). Each focus group was made up of 6 students and represented, as far as possible, a sample from a number of groups as well as varying demographics. No student was a participant in more than one focus group. Each focus group discussion lasted approximately one hour, and conversations were recorded and then later transcribed by the researcher.

Questionnaire Surveys

Quantitative data was obtained through two Likert style questionnaires, widely regarded as appropriate for measuring students' attitudes towards various educational interventions. Surveys also contained some open-ended questions to collect qualitative comments from respondents.

Assignment Grade data

Groupwork, individual student, and student peer assessment grades were collated for quantitative analysis.

Interviews

A series of one-on-one interviews were undertaken as part of the Laddering study reported in the thesis. These were conducted by the researcher either face-to-face or by telephone with participants over a ten-week period. Interviews were recorded and then transcribed for later analysis.

Other sources

Other methods such as direct observation (e.g., observing teams in group meetings), document analysis (e.g., student feedback, peer assessment) and informal conversations were also considered in the research studies, although with less attention.

5.6 Data Analysis

5.6.1 Quantitative Data

Excel and SPSS were used to run statistical analyses on the quantitative data. Various views can be found in the literature on whether Likert values contained should be treated as interval or ordinal, and therefore how they should be analysed. In defence of ordinal, many point out that Likert categories have a rank order but the intervals between values cannot be assumed to be equal. Clason & Dormody (1994) make the distinction between Likert-type items and Likert scales in choosing an appropriate tool for analysis. The authors identified Likert-type items as single questions that use Likert response alternatives, but while multiple questions may be used in a survey, responses are not designed to be combined into a composite scale, rather the questions are treated as 'stand-alone'. However, a Likert scale is made up of a number of Likert-type items that are merged into a single composite score during the data

analysis process. When merged, they are used to provide a quantitative measure of the attitude or trait that is being investigated. Each of these approaches require different analysis techniques (Boone and Boone, 2012). In the case of Likert-type, each measure in a scale represents a "greater than" relationship, but how much greater is not clear. Due to this, Likert-type items fall into the ordinal measurement scale. Likert scale data, on the other hand, is analysed at the interval measurement scale as scale items are created by calculating a composite score from a number of Likert-type items (Boone and Boone, 2012). Wu & Leung (2017) suggest that the controversy in using interval measurement can be ameliorated by increasing the number of points in the scale.

The recommended data analysis procedures for each are shown in table 5.

	Likert-Type Data	Likert Scale Data
Central Tendency	Median or mode	Mean
Variability	Frequencies	Standard deviation
Associations	Kendall tau B or C	Pearson's ***r***
Other Statistics	Chi-square	ANOVA, t-test, regression

Table 5: Suggested Data Analysis for Likert-type and Likert Scale Data (Boone & Boone, 2012)

This research uses both individual Likert-type questions as well as overall Likert-scale data and will therefore generally follow the recommendations in table 5.1, presenting mode, median or frequency of responses when reporting Likert-type questions, and means, standard deviations and appropriate inferential statistics for Likert-scale items. However, in line with other researchers, the writer reserves the right to use an alternative data analysis type if it will aid understanding of the data presented.

5.6.2 Qualitative Data

Focus group data and data from open ended questions was analysed using the six-step framework for thematic analysis proposed by Braun and Clarke (2006). This comprised an inductive approach of transcribing the group discussion recordings, then reading and re-reading the transcriptions to become familiar with the data, before generating initial codes and an overall coding framework. Coding was done manually, and coded sections of data were then collated to produce overall themes. These themes were then reviewed to ensure they covered all the coded data, before the findings were written up in the thesis.

The interviews conducted as part of the Laddering Study used open and axial coding which involved a greater degree of analytical induction to define the elements that emerged from one-to-one discussions with the sample participants. The resulting coding framework was then reviewed by a second coder and underwent a number of iterations before being applied to the data independently by the two coders and reaching a satisfactory level of inter-rater agreement.

Figure 4 summarises the data collection stages and analysis.

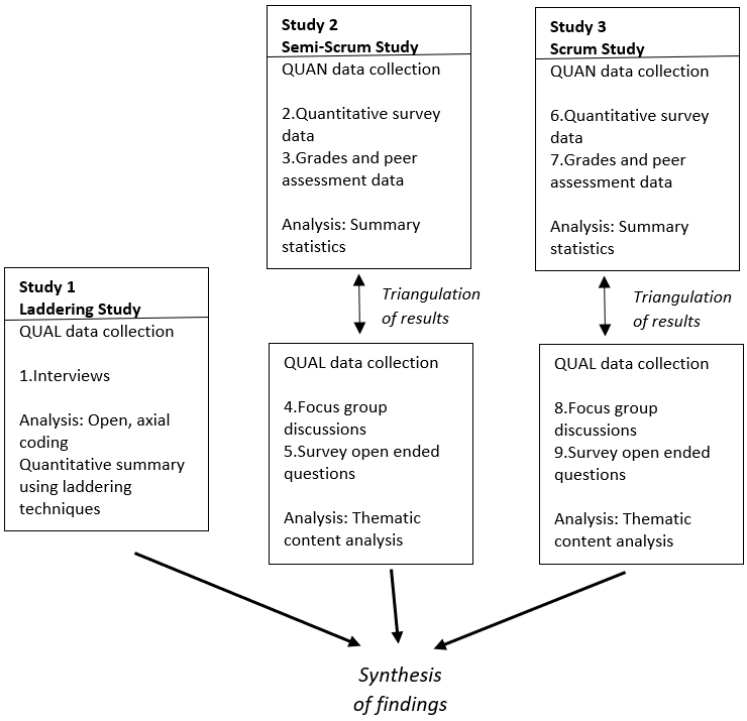


Figure 4: Summary of data collection stages and analysis

5.7 Ethical Issues

The study was conducted in accordance with the University of West London's published ethical policy for research involving human participants. Prior to completing questionnaires, each participant was informed of the purpose of the study, that participation was voluntary and that they could withdraw at any time without giving a reason for doing so. Participants were informed that answers provided would be used only for the purposes of the research and that any published results would not identify any individual.

Because students participating in focus groups interact with each other as well as the researcher and the researcher does not have control over what the participants may disclose in the meeting, protection of confidentiality is a major ethical concern (Smithson, 2008).

Students were informed of the purposes of the meeting and instructed at the outset that anything they might say or hear should remain confidential. In addition, they were informed that the notes and recordings of the focus group discussion would be taken purely for the purposes of the research and that individual comments would not be identifiable in any analysis or findings. They were also assured that there were no 'right' or 'wrong' answers, to curb any concerns they may have had relating to their ability to answer questions.

5.8 Reflexivity and integrity of research methods

It is recommended that prior to starting any qualitative research, researchers should examine their pre-conceived ideas, motivations and interests in the study to be conducted, as a precursor to recognising factors that might skew the research in particular directions. Such reflexivity is one of the ways that qualitative researchers can ensure quality and rigour in their work (Dodgson, 2019).

The author has worked in HE for over 20 years and during that time has run dozens of CL assessments and experienced the highs and lows of collaborative learning from a tutor perspective as well gaining views from learners who have always been generous with their opinions and criticisms. Years of experience and feedback have highlighted diverse reasons for students' lack of engagement in groupwork, but this has only strengthened the resolve to find something that works. She has maintained an optimistic view of CL, having been struck by the testaments of learners who have derived positive and, in some memorable instances, almost life-changing benefits from groupwork. Practical reasons such as reducing the amount of marking for large cohorts have never featured as a prime reason for conducing CL; instead, the belief that students should complete CL projects feeling enthusiastic and self-assured about working together with others in team settings and derive social advantages from expanding their friendship groups which could enhance their university experience, has been paramount.

The research was therefore approached with an underlying motivation to improve groupwork in some way to make it more palatable to all students, and a belief that this was ultimately possible.

Having acknowledged this viewpoint, it was therefore important to ensure a neutral stance during the study in order not to influence students or to bias any findings by subconsciously

projecting the researcher's optimistic outlook onto students or academic staff. This was particularly important during the focus group discussions which were facilitated by the author. Here, care was taken to ensure that the probes used to initiate discourse were objective and phrased in a neutral way, and that no opinions were voiced by the researcher during the discussions.

The researcher was also a participant in the research in other ways, being one of a team of tutors teaching on the modules which were the subject of the Scrum studies. To avoid bias, a third party was used to conduct all the questionnaire surveys and to mark or double mark student assignments. In addition, neither students nor academic staff teaching on the modules were made aware that the CL projects undertaken were the subject of research until the questionnaire surveys were run, so were able to conduct their teaching and learning activities in a natural setting.

5.9 Summary

This chapter discussed the rationale for the mixed methods approach chosen for the study, along with its practical implementation.

In deciding on an approach, the author followed the advice that "the bottom line is that research approaches should be mixed in ways that offer the best opportunities for answering important research questions" (Johnson & Onwuegbuzie, 2004, p16). A sequential mixed methods approach was selected to combine quantitative evidence relating to students' experience and outcomes from using Scrum, with qualitative investigation of their experience and perceptions of the process and its support for transparency. Mixed methods research incorporates the strengths of qualitative and quantitative approaches, allowing triangulation of results which can strengthen the validity and credibility of analysis, presenting a more accurate picture of findings and leading to greater confidence being placed in the overall research conclusions.

Data was drawn from multiple sources including questionnaires, student grade data, peer assessments and focus groups for the two studies investigating the use of Scrum. A further study used established techniques of means-end analysis and laddering, for an in-depth investigation of what students perceive to be the attributes of transparency, the results of which were then used to inform the final Scrum study.

The chapter outlined the data analysis associated with the different sources of data obtained through the research instruments, as well as summarising the ethical considerations guiding the study.

CHAPTER 6: THE LADDERING STUDY

6.1 Introduction

This chapter aims to investigate the meaning and significance of the concept of transparency in the context of collaborative learning from a student point of view, a view that is noticeably missing from the literature. Given that previous investigations revealed that it is something that students appear to value and desire, this investigation attempts to uncover the features or attributes of transparency, as identified by students, and determine why these attributes are important to them. The approach is novel as it attempts to unpick the meaning for students of the abstract concept of transparency in a CL context, and to establish its overall significance by adopting means-end analysis and laddering, a method of investigation that originated in consumer research.

6.2 Means-End theory

Means-end theory was originally developed by marketing researchers (Gutman, 1982; Reynolds and Gutman, 1988) to better understand decision-making by consumers and has since been used in a wide variety of other research domains including food choices (Brummer & Zander, 2020), Politics (Bagozzi and Dabholkar, 2000), business research (Inoue, Funk & McDonald, 2017), technology acceptance (Mol, Machado & Ishitani, 2022), Covid and event management (Boo & Kim, 2022) and HCI (Abeele & Zaman, 2009). Examples of its use in educational settings include examination of students' expectations of service quality in education (Voss, Gruber & Szmigin, 2007), a study of desired teaching qualities of lecturers in HE (Voss & Gruber, 2006), student views on games simulation (Lin & Tu, 2012), perceptions of pre-school preferences for library activities (Wang, Xu & Wu, 2019), rapid technology adoption in education during the Covid pandemic (Apostolidis, Devine & Jabbar, 2022), investigating professionalism in medical education(Miles & Leinster, 2010), effectiveness of outdoor education (Goldenboerg & Soule, 2011; Zygmont & Naidoo, 2018) and assessing American values and their effect on HE choices (Polak, 2018). Although there is ongoing interest in means-end theory in the broad area of education, a review of the literature did not reveal any studies of its application to collaborative learning or transparency.

The underlying premise of means-end theory is that the decisions that individuals make are driven by personal values or 'end-states of existence' that they strive for in their lives (Gutman, 1982). The theory suggests that people think about the services or artifacts that

they use or experience at three levels: 1) attributes, which are the features of the service or artifact in question, 2) consequences that represent the benefits or outcomes that arise from these attributes as well as undesirable outcomes or risks to be avoided, and 3) personal values that represent what a respondent ultimately wants or strives for in life. These values are assumed to be reached through the consequences.

6.3 Laddering

Personal values are uncovered by the technique of laddering, a method that was originally developed by Hinkle (1965) and is based in Kelly's (1955) Personal Construct Theory. This employs in-depth interviews which first extract salient attributes that are identified by the respondent, and then use a series of "why is this important to you" questions, with the response to each question being used as the basis for another probing question. This gradually teases out the personal values that are ultimately associated with the attributes of the concept or artifact under examination. The goal of laddering is to identify and understand the linkages between key perceptual elements across the range of attributes, consequences, and values (rather than simply obtaining a list of the attributes, consequences or values mentioned), exposing the association networks between the three levels. Through this insight into the relationships between attributes and values, researchers can recognise the meaning that attributes bring to users.

The strength of the laddering technique is that it allows crossing over from qualitative data gathering to quantitative data treatment: as well as delivering rich qualitative data through the interview 'probing' technique, it also stipulates quantitative analysis techniques to be used on that data, outlined in the steps below:

Step 1: Identification and coding of the core elements from the interview transcripts. This uses open coding, axial coding, and other methods from qualitative research methods to define and code the recurring elements (attributes, consequences and values) that are contained within the interviews.

Figure 6 illustrates the structure of attributes, consequences and values and emphasises the association between them and the directionality of the associations. Attributes can be categorised into concrete attributes that are perceptible physical characteristics, and abstract attributes that refer to relatively intangible features; consequences can be functional (for

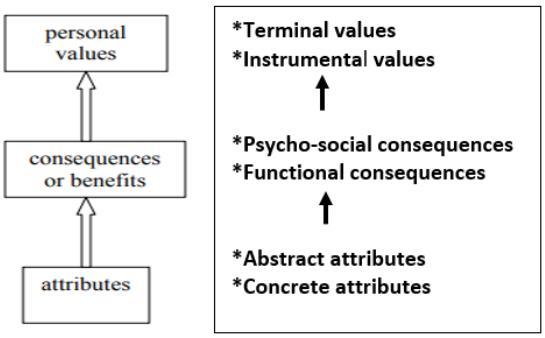


Figure 5: Categories of laddering elements (Olson & Reynolds, 1983)

example, developing social skills, becoming a better public speaker) and psycho-social which build on functional consequences (for example, having more self-confidence, making more friends); values can be viewed as instrumental or terminal, terminal values referring to the end-states or goals that interviewees would like to achieve during their lifetimes, such as self-respect, a sense of accomplishment, family security; and instrumental values referring to preferable modes of behaviour or means of achieving the terminal values (Lin, 2002). Various taxonomies of values exist including the Rokeach (1979) Values Scale (RVS) which was developed through contributors from a broad range of disciplines including sociology, philosophy, communications and management, and Kahle and Kennedy's (1989) List of Values (LOV) scale which is based on RVS and Maslow's needs hierarchy (Maslow, 1943). LOV contains nine values: self-respect, a sense of accomplishment, excitement, security, a sense of belonging, self-fulfilment, warm relationships with others, being well-respected and fun and enjoyment of life. While these are two of the best-known categories of values, the list of values elicited from a laddering study varies according to each study and is influenced by the research domain (Russel et al, 2004; Nunkoo & Ramkissoon, 2009).

Step 2: The individual coded attribute → consequence → value sequences (known as ladders) are extracted from the interview transcripts and a list of the entire set of coded ladders is produced.

Step 3: From this, each ladder is examined and the number of links between all possible pairs of elements are counted. A link shows that one element was mentioned in the same ladder as another element.

Step 4: The links are then aggregated over the whole of the data set and recorded in an implication matrix (IM). Dominant chains, representative of a larger group, are then extracted from the quantitative data. To do this, a specific cut-off level needs to be chosen. This represents the minimal number of links that need to exist between two elements for the link to be considered for inclusion in the end goal, the Hierarchical Value Map (HVM). Any links below the cut-off will be ignored.

Step 5: Finally, a HVM is constructed from the remaining chains to display the dominant perceptual orientations in the population sample. The HVM provides a visual picture of which attributes connect to which consequences and values based on the number of direct and indirect links extracted from the complete set of ladders.

The laddering technique offers the potential to clarify meanings, explanations, goals and values, hence this interpretative research method was considered an appropriate approach for probing the question of what constitutes transparency in group work and ultimately why this is important for students.

6.4 Design of the laddering investigation

The approach of this study was to treat transparency as a 'service' that students use and to employ means-end theory to attempt to identify the attributes they associate with transparency, the consequences generated from these attributes and ultimately the underlying values they associate with those attributes. This should contribute to an understand of the motives that students have for desiring transparency in group work. Discussions with students prior to the start of the thesis yielded some views on what students thought of transparency in group work (e.g. 'it's a good thing'), but not what they thought transparency *was*. This line of enquiry attempts to use means-end theory and laddering to address the question of 'what comes to mind when you think of transparency' rather than 'what do you think about transparency'. This approach is consistent with the associational nature of 'brand image' in that it focuses on what students associate with the concept of transparency in CL, rather than just what they think of it, thus attempting to expose the network of links between the cognitive and emotional elements invoked by the term.

A review of the literature reveals that laddering needs to be tailored to a specific research aim within a particular domain (Abeele & Zaman, 2009). For example, in the classic realm of

consumer research where the prime end purpose of laddering is to target customers and better position products within the market place, Reynold & Gutman's (1988) generic three level model (identifying Attributes-Consequences-Values) may suffice, whereas in User Experience domains where the aim is typically to understand underlying motives for using products and to recommend designs, an increased number of levels are more applicable, particularly to make a distinction at the attribute level between concrete and abstract attributes as the design of more effective UX can only be proposed if information about concrete attributes is available (Abele & Zaman, 2009). The current study was an exploratory investigation considering a novel domain for means-end analysis and was therefore open ended and flexible with no pre-conceived expectations of attribute or consequence levels.

6.4.1 Laddering interviews and implementation process

The study followed general guidelines of grounded theory (Corbin & Strauss, 1990). Prior to the conducting laddering interviews the researcher spent some time in training, carrying out mock interviews and gaining experience of the interview technique, which requires certain expertise to move the interview discussion from attributes to consequences and then values.

A series of one-on-one interviews was then conducted (face to face and by telephone) in a 10 week period with 43 students aged between 19 and 36 years (the average age was 22.8 years). Guidance on laddering methods suggests that a sample size of between 30 and 60 is acceptable for means-end chain research (Reynolds and Gutman, 1988). The sample was made up of students from a cross section of undergraduate course, and participants ranged from first year to final year cohorts to provide representation from students with limited experience of collaborative learning through to students with more extensive experience. All first-year students confirmed they had been involved in fewer than three group work assignments or projects at university, whereas second and final year students had been involved in three or more collaborative learning events. Convenience sampling was used, and students took part on a voluntary basis. Figure 6 shows the interview process.

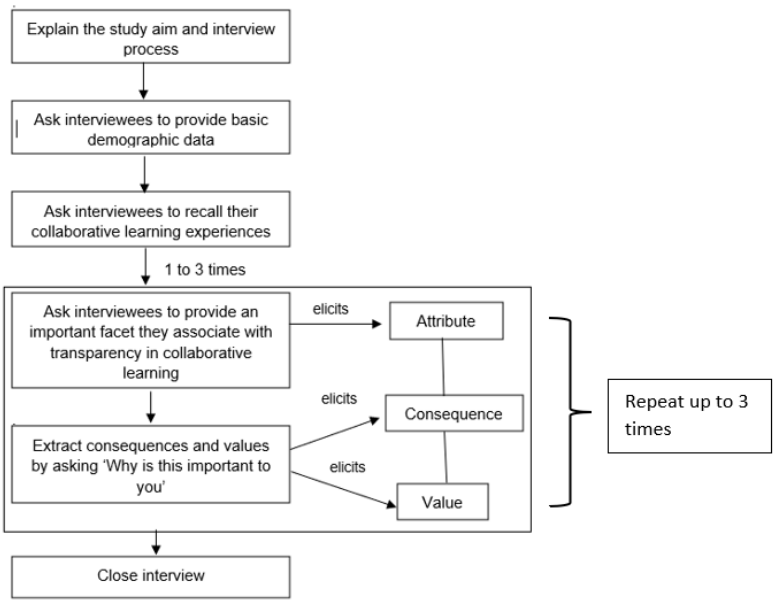


Figure 6: The laddering interview process

A description of the research was provided together with the standard preamble explaining confidentiality of the results, and respondents were then able to ask any questions for clarification. The start of the laddering process involves eliciting salient attributes for which grounding in context is important (Reynolds and Olson, 2001). In consumer research this is typically achieved by showing images of products, however this research relied on a situational context truly experienced by students, i.e. students who took part in the research confirmed they were involved in group work in the course of their studies and that they considered transparency to be a significant factor in collaborative learning, whether positive or negative.

Following guidance on how to conduct laddering interviews, respondents were told there were no right or wrong answers and that some of the questions might seem a little obvious or even bizarre (Saaka et al, 2004) to put them at ease with the line of questioning. Interviews were recorded and then transcribed. The average length was 21 minutes.

Participants were first asked to think about their collaborative learning experiences and the role of transparency in those learning experiences. The laddering interview then started with some version of the general question, "what attribute or property do you think of when I mention 'transparency', in the context of your collaborative learning?". A series of "why is this important to you" questions was then be posed to elicit more in-depth responses. This was repeated until the student was unable to answer the "why is this important to you"

question any further, at which stage the linkage between attributes, consequences and values had been completed. This line of questioning was repeated up to three times to elicit three attributes, but respondents were not pushed to provide an answer if they could not think of one and a number of respondents stopped at two, or in some cases even one attribute.

During the interviews students sometimes gave 'forked answers' where probes resulted in a number of consequences being linked to a single attribute. According to Grunert and Grunert (1995) this occurs most often with respondents who have thought thoroughly about a certain preference or decision and consequently have an extensive meaning structure in the area concerned. Although students were not given any in-depth information about the interviews ahead of time, it is possible that some had gleaned information from other respondents and had prepared themselves in advance for the line of questioning.

The laddering interviews yielded a total of 103 ladders, giving an average of 2.37 per respondent. The average ladder length was 4 elements.

6.4.2 Laddering analysis and coding

The ladders derived from the interview data were examined for completeness and a set of numbered codes were developed to cover attributes, consequences and values, applying standards and recommendations for the inductive process of abstracting and categorising data (Elo & Kyngas, 2008) as well as open and axial coding, as recommended in grounded theory (Corbin & Strauss, 2008). The overall aim was to nest similar meanings under the same code and the coding system went through several iterations before undergoing intercoder reliability checks. The intention was on the one hand to achieve broad enough categories to get replications of more than one interviewee saying that one element leads to another, while on the other hand ensuring that the final categories were not so broad that much of the meaning was lost.

Generation of codes and coding reliability is of paramount significance in laddering studies where qualitative data is transformed into a form that allows it to be analysed quantitatively. The method is reliant on accurate interpretation of participants' narrative and a set of reliable codes that are tested and agreed by at least two coders, as expressed in reliability coefficients. Coding the participant dialogues responses involves some degree of subjectivity as the code given will depend on the rater's interpretation of the construct. The task of agreeing

interpretations and training scorers in how to apply the codes imposed some level of objectivity onto the scoring process. There is no consensus on what an acceptable level of agreement is, with appropriate coefficients ranging from 0.90 to 0.667, but a typical guideline found in the literature is that it should be 0.70 or greater (Stemler, 2004). The inter-rater index of reliability was 0.88 which exceeded this guideline.

Attributes	Consequences	Values
1. Open communication	10. Maximising team skills	21. Self-esteem
2. Visibility	11. Identifying/reacting to problems	22. Fairness/justice
3. Honesty	12. Good grades/outcomes	23. Cooperation/friendship
4. Accountability	13. Working efficiently	24. Hedonism/easy life
5. Respect for others	14. Building trust	25. Accomplishment
6. Backlog	15. Doing fair share	26. Intellectual growth
7. Face to face meetings	16. Inclusivity/collaboration	

Table 6: Coding system used for analysing ladder content

The final list of codes is shown in table 6. Some of the elements were initially proffered at all three levels of abstraction – for example, honesty was quoted as an attribute of transparency; further down the interview process, 'acting honestly' was cited as a consequence of the attribute visibility, and honesty/integrity was also considered by some as an 'end' value. This highlights some of the difficulties associated with the coding of elements. It was decided to keep honesty at attribute status because of the high frequency with which students used it to start their ladders (n = 20).

Four other abstract attributes were identified in addition to honesty, some of them providing a degree of potential for overlap, so that linking content to category was sometimes contentious. 'Open communication' was cited by a number of respondents and under this category came comments such as "sharing thoughts without any fear of repercussions", "allowing everyone to voice their opinion on things" and "giving real time and frequent feedback on tasks". Visibility included comments such as "seeing what everyone's up to", "full visibility at all times", "awareness of status quo", "evidence of interactions", and "full disclosure". Accountability covered content such as "taking responsibility for your tasks", "clear role assignment" and "team members doing the work assigned to them". 'Showing respect for others' was quoted by a number of students as a necessary attribute for transparency, perhaps emphasising the idea that being respectful to everyone, even if individual contributions were flawed, would produce positive outcomes and encourage

everyone to continue to share their outputs and efforts. Conversely, disrespectful actions could shut off transparency. 'Showing respect for others' covered comments such as "active listening", "being considerate to other members" and "not mocking any efforts".

The interviews also revealed two concrete attributes, the first being 'Backlog' which reflected some students' use of Scrum backlogs in previous group assignments. Backlogs, it was suggested, provided a physical record of 'who was doing what'. The second was 'face to face meetings' which some students considered to be central facet of transparency. These concrete attributes then led to identification of abstract attributes such as 'open communication' and 'accountability'.

The "why is that important to you" questions directed at the attributes then elicited a number of consequences, again requiring extraction and coding into a manageable number of categories (numbered 10 to 16 in table 6). Finally, six end values (numbered 21 to 26 in table 6) emerged at the end of the questioning. Again, both the consequence and end values codes were finalised after a number of reviews and revisions by the coders.

The end value codes contain some categories from the LOV scale, including self-esteem, a sense of accomplishment, cooperation/friendship and fun and enjoyment of life (hedonism/easy life). The rationale for inclusion of the latter was that transparency "allowed things to be done faster and more efficiently so that there's more time for fun and enjoying yourself". Other end values identified were ensuring fairness and justice, and intellectual growth. Intellectual growth was separated from the general sense of accomplishment. Accomplishment covered achievement of the given task of completing the project successfully ("getting the job done", and "successful completing the assignment"), whereas comments that mentioned growing academically were coded as 'intellectual growth' (incorporating "learning new skills", "expanding knowledge", "learning from others").

The numbered codes were then applied to every element in each ladder and a spreadsheet was produced showing the overall coded instances, with each row in the matrix representing an individual ladder and the columns representing sequences of elements within the ladder (see Appendix 3). The maximum number of elements in a single ladder was 6 (shown as A to F in the matrix in Appendix 3), the minimum 3. The construction of these ladders helped to identify conceptual pathways between attributes of transparency and a respondent's

personal values. An implication matrix was then created (see Figure 6.4) to represent the ladders in aggregated form. This displays a two-part value for each element, showing the number of times it precedes (both directly and indirectly) every other code. For each value in a cell in the implication matrix, the figure to the left of the colon shows the number of times the row attribute directly led to the column code, and the figure to the right of the colon shows the number of times the row attribute indirectly led to the column code.

Finally, a Hierarchical Value Map (HVM) was constructed to give a graphical display of the aggregated data, showing dominant chains, or sequences of elements. The HVM was gradually built up by connecting all the chains that are formed by considering the matrix of relations among elements. Advice suggests that cut off values should account for approximately 70% of implicative connections in the data to avoid smaller, infrequent connections that are viewed as idiosyncratic (Gengler and Reynolds 1995; Reynolds and Gutman 1988), so the choice of cut off was critical.

6.5 Results

This section describes the characteristics of the participant sample and the overall results obtained from the laddering exercise.

6.5.1 Sample characteristics

The characteristics of the student sample is shown in Table 7 below. Approximately two thirds were male students. The sample was evenly split between First year and Second and Third year students, with the majority being Computing undergraduates.

Category	Type	Number of participants
Gender	Male	28
	Female	15
Study Level	First year	20
	Second/Third year	23
Age	18-22	25
	23-29	13
	30+	5
Major	Computing	30
	Business	7
	Social Science	4
	Arts	2

Table 7: Characteristics of respondents and ladders produced by each group

6.5.2 Coding

The coding process resulted in 20 categories made up of 7 attributes, 7 consequences and 6 values (see Table 8). The 43 participants generated a total of 428 elements, averaging approximately 10 elements per participant (9.95).

Most of the attributes mentioned were abstract attributes (see Table 8), with open communications cited most frequently (n=27), and visibility (n=20), honesty (n=20) and accountability (n=17) placed second, third and fourth. The abstract attribute of respect for others was mentioned least often (n=6). The two concrete attributes elicited from respondents, namely face-to-face meetings and backlogs scored a total of 10 and 7 responses respectively.

Element	Frequency	% of total
Attributes:		
1. Open Communications	27	6.31
2. Visibility	20	4.67
3. Honesty	20	4.67
4. Accountability	17	3.97
5. Respect for Others	6	1.40
6. Backlog	7	1.64
7. Face to face meetings	10	2.34
Consequences:		
10. Maximising Team Skills	25	5.84
11. Identifying problems	25	5.84
12. Good grades/outcomes	41	9.58
13. Working Efficiently	48	11.21
14. Building Trust	34	7.94
15. Doing Fair Share	13	3.04
16. Inclusivity/Collaboration	34	7.94
Values:		
21. Self-Esteem	11	2.57
22. Fairness/Justice	19	4.44
23. Cooperation/Friendship	33	7.71
24. Hedonism/Easy Life	6	1.40
25. Accomplishment	24	5.61
26. Intellectual Growth	8	1.87

Table 8: Coding system and frequencies

The most frequent consequence noted within the collection of ladders was 'enhanced efficiency' (n=48) followed by 'good grades/outcomes' (n=41). 'Building trust' and 'fostering inclusivity/collaboration' both had frequencies of 34, followed by 'using team skills to best effect' and 'identifying problems', both with frequencies of 25. The least mentioned consequence was 'doing fair share of work' (n=13).

Value codes were partly based on the LOV scale with the addition of 'intellectual growth', which participants who proffered that element stressing that it was, for them, an end value in itself, rather than a consequence. Two values stood out, namely 'Cooperation/Friendship' (n=33) and 'accomplishment' (n=24). These were followed by 'fairness/justice' (n=19), 'self-

esteem' (n=11) and 'intellectual growth' (n=8). The attribute 'Hedonism/easy life' (n=6) was mentioned least often (see Table 8).

6.5.3 Implication matrix

Table 9 shows the implication matrix arising from the summary of all the individual ladders. Each cell shows the frequency with which a particular element is followed by another element, aggregated across all the ladders. The value in each cell (intersection of a row and column element) shows, to the left of the colon, the total number of direct associations of the row element with the column element, and on the right of the colon, the total number of indirect associations with the column element i.e. when the column element appears somewhere further along a ladder containing the row element, but is separated by other intermediary elements. For example, the first cell in the matrix, containing the value 7.01, shows that the row element 'open communication' is directly followed by 'maximising team skills' in seven ladders and is indirectly followed by 'maximising team skills' in one ladder.

Element	1	4	10	11	12	13	14	15	16	21	22	23	24	25	26	Out Degree
1.Open communications			7:01	4:02	0:13	09:10	1:00	0:02	1:07	0:03	0:02	0:09	0:01	0:07	0:01	22:58
2.Visibility			1:02	7:01	0:07	3:03	5:02	2:02	1:02	0:01	0:08	0:03		0:05	0:02	19:38
3.Honesty			6:00	6:00	0:12	1:04	5:04	1:00	1:07	0:05	0:02	0:07	0:01	0:02	0:02	20:46
4.Accountability			1:01	2:00	0:04	6:03	5:01	1:02	1:05	0:01	0:04	0:07	0:01	0:02	0:01	16:32
5.Respect for others					0:01	0:02	5:00	1:00	0:04	0:01	0:02	0:03				06:13
6.Backlog		1:00	1:00	1:00	0:02		4:02		0:01				0:03	0:04		07:12
7.Face to face meetings	4:00		0:04	2:00	0:01	1:03	1:00	0:02	2:02		0:01	0:05		0:02	0:01	10.21
10.Maximising team skills					8:06	3:03		6:00	5:00	0:01	1:05	1:06		0:09	1:01	25:31
11.Identifying problems			2:00		5:09	11:00	4:01	1:00	2:02	0:06	0:01	0:06		0:06	0:04	25:35
12.Good grades										9:00		14:00		14:00	2:00	39:00
13.Working efficiently			2:00	2:00	15:04		3:00		4:01	1:05	3:01	8:12	4:00	3:07	1:00	46:30
14.Building trust					5:03	3:01		0:01	16:01	0:02	1:06	3:12	2:00	2:04	2:01	34:31
15.Doing fair share						3:00	1:00		1:01	0:01	5:03	1:00		2:01		13:06
16.Inclusivity/cooperation			1:00	1:00	8:01	3:01		1:00		0:01	9:00	7:06		2:03	2:03	34:15
Values:																
21.Self-esteem																
22.Fairness/justice																
23.Cooperation/Friendship																
24.Hedonism/Easy Life																
25.Accomplishment																
26.Intellectual growth																
In Degree	04:00	1:00	21:08	25:03	41:63	43:30	34:10	13:09	34:33	10:27	19:35	34:76	6:06	23:52	08:16	

Table 9: Implication matrix for attributes, consequences and values associated with transparency

The method applied the commonly held rule that if the same respondent identified the same association between two elements in different ladders, then each occurrence of this link was counted in the implication matrix.

The out-degree column shown in Table 9 represents the row sum in the index, showing the number of times the element is the source or origin of a connection with other elements, aggregated over the entire set of ladders. The in-degree of an element is the number of times that the element is the receiver of a connection with other elements, aggregated across the entire set of ladders. This is shown as the column sum on the implication matrix. Table 9 shows for example that 'maximising team skills' (element 10) has an in-degree of 21:08 (i.e., received 21 direct connections from other elements, and 8 indirect connections from other elements), and has an out-degree of 25:31 (i.e., was the direct origin of 25 connections and indirect origin of 31 more).

Several indices can be calculated from the implication matrix (see Table 10). First a decision must be made on whether to base the calculations on direct, or direct plus indirect connections. This question also needs to be addressed when constructing the HVM (see section 6.5.5). The matrices shown are based on direct connections only, as is common in the empirical studies the author accessed. Abstractness of an element ranges from 0 to 1 and is defined as the proportion of in-degrees over in-degrees plus out-degrees of the element. The higher the index, the larger the proportion of an element's connections with other elements in which the element is the destination rather than the source (Pieters et al, 1995). Elements with a high abstractness score are predominantly ends, while elements with low abstractness scores are predominantly means. Thus, the scores of 1 for element numbers 21-27 confirms their status as end values.

Element	Centrality	Prestige	Abstractness
Attributes:			
1. Open Communications	0.08	0.01	0.15
2. Visibility	0.06	0.00	0.00
3. Honesty	0.06	0.00	0.00
4. Accountability	0.05	0.00	0.06
5. Respect for Others	0.02	0.00	0.00
6. Backlog	0.02	0.00	0.00
7. Face to face meetings	0.03	0.00	0.00
Consequences:			
10. Maximising Team Skills	0.15	0.07	0.46
11. Identifying problems	0.16	0.08	0.50
12. Good grades/outcomes	0.25	0.13	0.51
13. Working Efficiently	0.28	0.14	0.48
14. Building Trust	0.22	0.11	0.50
15. Doing Fair Share	0.08	0.04	0.50
16. Inclusivity/Collaboration	0.22	0.11	0.50
Values:			
21. Self-Esteem	0.03	0.03	1.00
22. Fairness/Justice	0.06	0.06	1.00
23. Cooperation/Friendship	0.11	0.11	1.00
24. Hedonism/Easy Life	0.02	0.02	1.00
25. Accomplishment	0.07	0.07	1.00
26. Intellectual Growth	0.03	0.03	1.00

Table 10: Status of elements in the implication matrix and correlations among positional indices

Centrality of an element is defined as the proportion of in-degrees plus out-degrees for that element, divided by the sum of all cell-values in the implication matrix (Knoke and Burt, 1982). The higher the value, the larger the percentage of connections that run through the element. A score of 1 for a given element would mean that all connections in the implication index run through that element. Table 10 shows that working efficiently (0.28) is the most central element in the implication matrix, followed by good grades/outcomes (0.25) and building trust (0.22).

Prestige of an element is defined as the proportion of in-degrees of a given element divided by the sum of all cell values in the implication matrix (Knoke and Burt, 1982). The higher the value, the more frequently is the element the destination of connections with other elements. Table 10 shows that working efficiently has the highest prestige (0.14), followed by good grades/outcomes (0.13), then 'inclusivity/collaboration' and 'building trust' (0.11).

Centrality and prestige are both indicators of the significance or prominence of an individual element, highlighting the degree to which is it involved in connections within the body of ladders, either as a source (centrality) or as a destination (prestige). The results highlight the dominance of the consequences 'working efficiently' and 'good grades/outcomes'.

6.5.4 The Hierarchical Value Map (HVM)

The aggregated associations between attributes, consequences and values are show in the hierarchical value map (see Figure 7). A cut off level of 4 was chosen to remove incidental and redundant linkages in order provide a diagram that was comprehensible and focused on the dominant means-end chains. At this level the diagram accounted for over two thirds (73%) of linkages, which is consistent with guidelines in previous studies (Reynolds and Gutman, 1988). The width of the arrows that connect each element are proportional to the number of connections made between the elements.

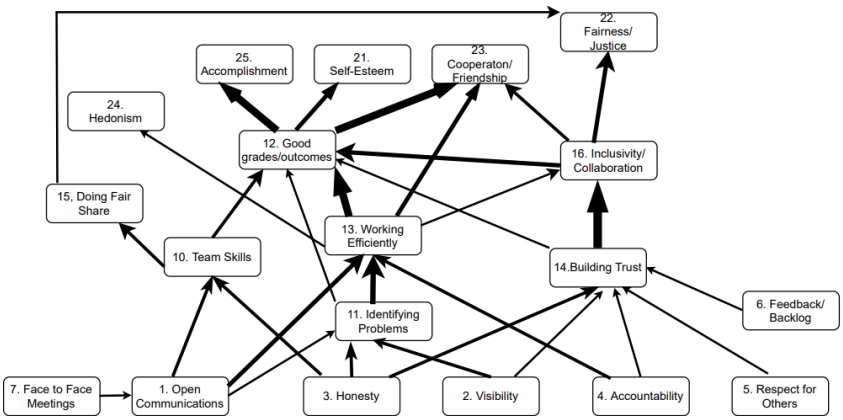


Figure 7: Overall Hierarchical Value Map with cut-off of 4

6.5.5 Dominant Means-End-Chains (MEC)

A number of Means-End-Chains can be extracted from the HVM, aided by information provided in the indirect links shown in the implication matrix.

Figure 8 shows a dominant MEC based on the open communication attribute which leads to consequences of working efficiently, then good grades/outcomes. This is then associated strongly with two end values, accomplishment and cooperation/friendship.

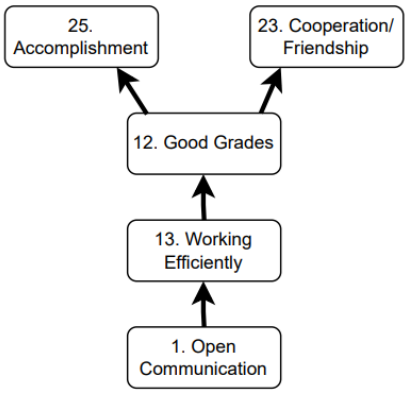


Figure 8: Dominant MECs based on the attribute of 'open communication'

The visibility attribute generates an MEC (Figure 9) based on the link between visibility and the ability to identify problems in group work. This then allows the team to work efficiently, leading to the positive consequence of good grades/outcomes which generate end values of accomplishment, self-esteem and cooperation/friendship.

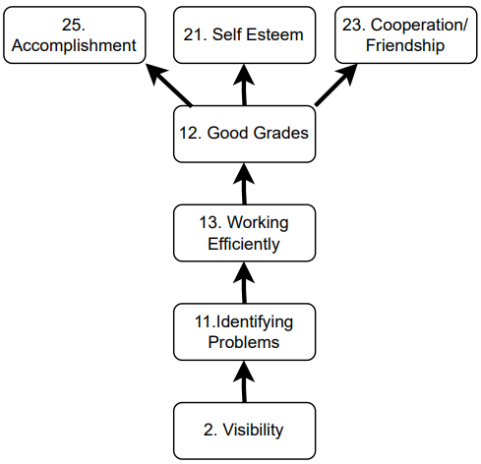


Figure 9: Means-End Chain based on the attribute of 'visibility'

The attribute of honesty shows a strong link with building trust, leading to inclusivity/collaboration and terminating in the value of fairness/justice. A second chain from honesty leads to identifying 'problems, working efficiently, to provide good grades/outcomes, and culminating in the end states of accomplishment and cooperation/friendship (Figure 10)

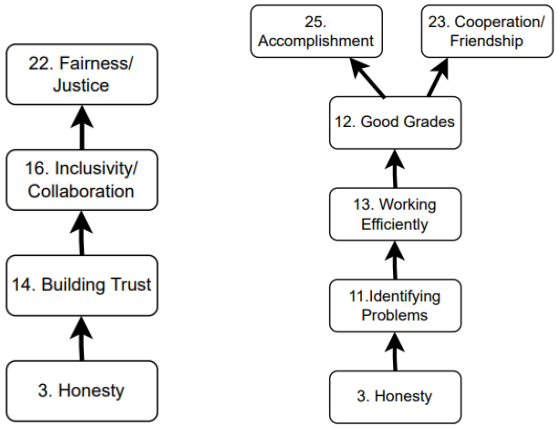


Figure 10: MECs based on the attribute of honesty

Finally, a clear MEC can be identified originating from the accountability attribute. This leads to the consequence of working efficiently, which results in good grades and terminates in end values of accomplishment and cooperation/friendship (Figure 11).

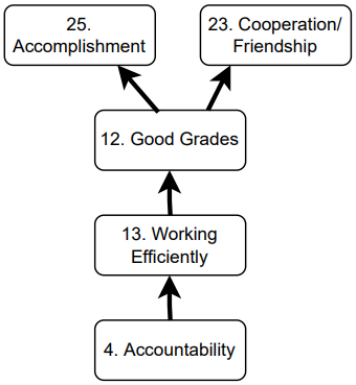


Figure 11: MEC based on the attribute of accountability

6.6 Comparing results from first year and second/third year students

Separate analyses were undertaken based on the study level of students, to establish whether longer exposure to group work had any effect on overall perceptions of transparency and end values.

6.6.1 First year students

Ladders generated by first year students were extracted, an implication matrix was calculated and a HVM was constructed based on a direct cut-off of 3 (direct associations). This lower cut-off rate was chosen as the sample size was lower and yielded fewer associations. Keeping the cut-off at 4 would have resulted in a diagram with an overall coverage at less than the recommended guidelines (Reynolds and Gutman, 2001). At a cut-off level of 3 the diagram accounted for over two thirds (73%) of linkages, which is consistent with guidelines found in previous studies.

The HVM (Figure 12) shows a smaller number of attributes. 'Respect for others' has been removed and neither of the concrete attributes, 'face-to-face meetings' nor 'backlog', are featured. Although caution should be applied when drawing any conclusions from this small sample, it would appear that these attributes are associated with longer exposure to group work, and, in the case of 'backlog' this requires concrete experience of Scrum, which is unlikely to apply to many first year students or to students outside the Computing school.

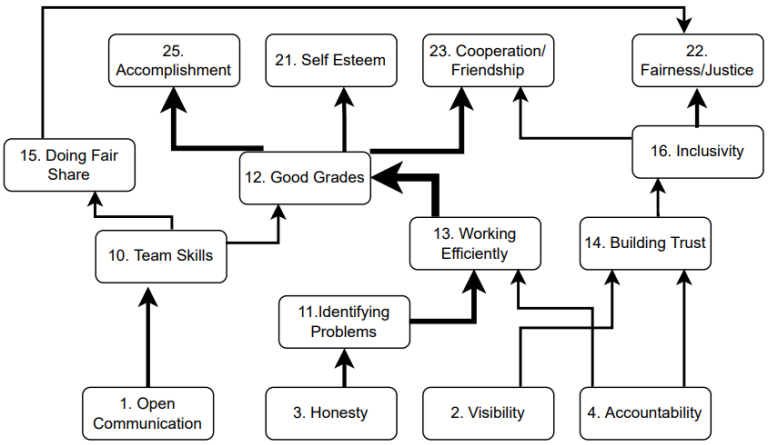


Figure 12: Hierarchical Value Map based on ladders provided by first year students

The end values include all those found in the original HVM except for hedonism, and three dominant MECs were extracted, one based on the attribute of honesty (Figure 13) and two based on open communication (Figure 14).

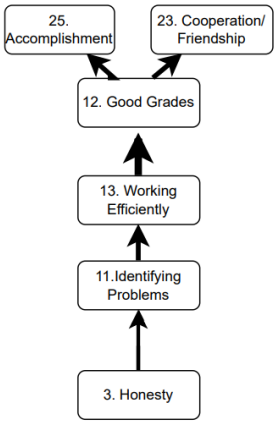


Figure 13: Year 1 sample: MEC based on the attribute of honesty

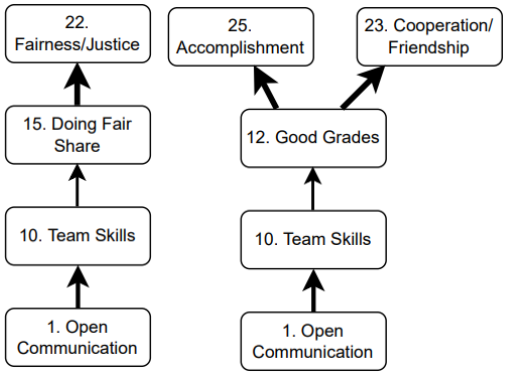


Figure 14: Year 1 sample: MECs based on the attribute of open communication

7.6.2 Second and final year students

The hierarchical value map for second/third year students is shown in Figure 15. This was again constructed using a cut off of 3 links (which accounted for 64.4% of all linkages).

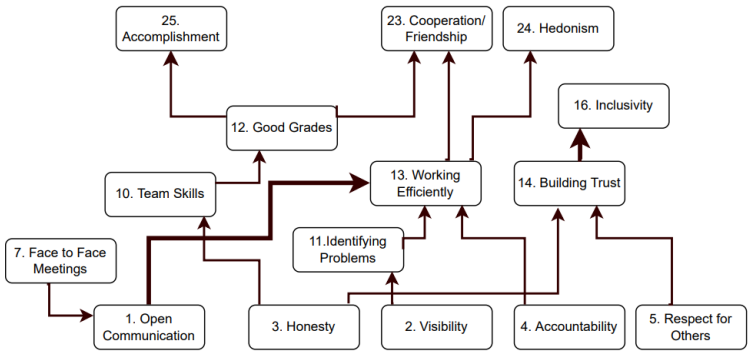


Figure 15: Hierarchical Value Map based on ladders provided by 2nd and 3rd year students

Comparing the HVM for the second/third year students with that of first year students sees the emergence of the concrete attribute 'face to face meetings' and the abstract attribute of 'respect for others'. This suggests that over time, students may better appreciate the role that face-to-face meetings play in transparency, and perhaps, with greater experience and maturity, value 'respect for others' in this regard.

Only two of the end values found on the first year HVM are featured, namely 'accomplishment' and 'cooperation/friendship', with the introduction of 'hedonism' as an end value. There is no clear reason for why 'self-esteem' and 'fairness/justice' should have disappeared, and indeed why 'hedonism' should have re-appeared for this group other than that, over time, students may increasingly value their free time and have designed strategies to ensure that this is maximised.

The dominant means-end-value chain identified for this group was based on open communication (Figure 16).

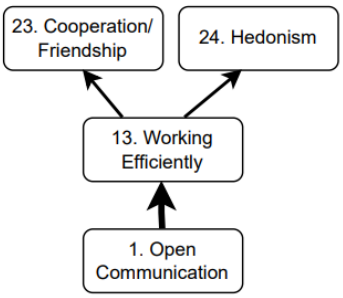


Figure 16: MEC based on the attribute of open communication, for 2nd and 3rd Year students

Although it is tenuous to read too much into results from a small sample of students, there do appear to be noticeable difference between the two cohorts, due to what can be assumed is increased experience of collaborative projects and therefore longer exposure to collaboration. Does the introduction of face-to-face meetings represent growing wisdom from practical experience of their efficacy for promoting transparency?

6.7 Negatives of transparency

The summary of the laddering process and outputs is focused on the positive consequences and end states of transparency. However, the interviews also elicited a small number of negative elements, though cumulatively these did not reach the threshold for incorporation into the HVM. One example was a ladder which identified a negative consequence of 'visibility', namely "taking advantage" which led to "bad feelings towards peers". Another respondent proffered 'over-sharing' as an attribute of transparency, leading to consequences of "reducing effort" and "poor group dynamic". These echo studies from the literature which have identified negative second order effects of transparency (eg Cable & Birkinshaw, 2017).

6.8 Discussion and evaluation of laddering study results

The purpose of the laddering study was to allow students to unpick the concept of transparency by identifying attributes of transparency that they deemed significant and uncovering the ultimate motivation or higher order values for wanting transparency in collaborative learning.

The abstract attributes that came to light, in order of centrality, were open communication, visibility, honesty, accountability and respect for others. Two additional concrete attributes were identified - face to face meetings and backlog, the latter reflecting the fact that some students had experienced Scrum during their studies. A superficial examination of these

attributes might conclude that there are overlaps in these concepts. For example, open communication implicitly assumes visibility, honesty and mutual respect in the course of that communication. However, speech can be seen as open communication, but it is ephemeral and not visible unless it written down (or signed), nor it is always honest! Someone can have mutual respect for another person and not divulge information that may be harmful or distressing to hear (i.e., not be honest). These subtle differences had to be negotiated while coding the interview data.

The ultimate higher order values obtained from the study were, in order of prestige, cooperation/friendship, accomplishment, fairness/justice, self-esteem, intellectual growth and hedonism. Cooperation/friendship has a significantly higher prestige than all the other attributes, highlighting its importance to students. This finding is significant and rather at odds with anecdotal evidence that suggest that students are only interested in grades and willing to do anything to get good grades. On the other hand, this positive finding could also be attributed simply to interviewees wanting to appear in a more positive light to their interviewer.

The analysis of the laddering findings has concentrated on attributes and dominant end-means chains to reveal the lofty higher order states that students can ultimately enjoy and aspire to from engaging in transparency. But it is also worth reflecting on the consequences identified in the laddering interviews. When examined as a whole, they represent for students, more down to earth, immediate, and mostly tangible advantages of transparency. Examining the consequences in order of prestige, transparency can result in groups working more efficiently and getting good grades and outcomes as a result. Transparency will build trust within the group and promote inclusivity and collaboration. Transparency will also allow problems to be identified and addressed more easily. Finally, transparency will allow teams to have a better insight into what team members are doing and to maximise team skills and promote doing a fair share of the workload.

The analysis also attempted to examined differences between two groups of students based on their experience of collaborative learning which seemed to indicate a greater appreciation of face-to-face meetings in more experienced students. It also seems logical to assume that other student differences such as personality, cultural background, etc., could affect the results at a micro level, but this would be difficult to study and would require a larger sample

of students. As such, the results of the study show the application of means-end theory for delivering an understanding of overall student behaviour and values which can be used for further analysis of transparency.

6.9 Limitations

A number of observations can be made on the technique. To a large extent coding is crucial and can significantly determine the outcomes of the research. Agreeing and assigning codes is a cumbersome step in means-end chain analysis. Broad coding reduces the number of constructs to manageable proportions but results in loss of meaning whereas narrow coding preserves meaning but results in high numbers of constructs that are cut-off and lost later in the process (Reynolds & Gutman, 2001). The processes employed in the coding and analysis of the data attempted to follow advice provided to researchers, that they "are aware that 'coding' responses given in own words into common denominators is different than 'condensing' responses in a superordinate denominator, know the consequences of condensing on their results, make informed decisions, and apply a consistent level of condensation on their data set" (Kilwinger & Van Dam, 2021, p1518). However, it needs to be acknowledged that coding is a complex and often frustrating procedure. In carrying out the analysis, the researcher had a sense that at times some of the finer details of the interviews were being removed in the process of being subsumed under a single coded attribute. On the other hand, the ability to summarise qualitative data and to provide some measure of quantitative analysis of the one-to-one laddering interviews is one of the strengths of the laddering process, even though it places significant responsibility on the researcher to ensure the coding system is robust and does not lead to erroneous outcomes. The current study attempted to ensure valid results by a robust process of inter-rater agreement and consistency on the coding system and its application.

The method also has the advantage of enabling respondents to define personally relevant constructs in their own words rather than forcing respondents into predetermined categories and therefore is considered more suitable for research in cross-cultural settings compared with traditional survey approaches (Watkins, 2010).

Having had no previous experience of conducting laddering interviews, the researcher undertook extensive training and conducted practice interviews to familiarise herself with the technique prior to starting interviews with the student sample. However, it is always possible

that lack of experience in conducting the specific type of interviewing technique required for the elicitation of laddering constructs could have affected the findings.

6.10 Conclusion

The study aimed to understand student experiences with and value perspectives on transparency and to identify the salient factors that students consider when evaluating transparency. Being able to construct MECs for a student sample provides a means of uncovering the connections as to why lower-level attributes are important for students. If these are identifiable, then it is also possible that appropriate systems can be set up to support them. The combination of the meanings and the connections provide additional insights into the motivation of students for wanting transparency in collaborative learning.

CHAPTER 7: SEMI-SCRUM STUDY

7.1 Introduction

This chapter reports on an initial exploratory study undertaken to investigate students' use of Scrum. The chapter explains the motivation for conducting the study, the study design and research instruments used to obtain data. This is followed by an analysis of the results from the different data collection methods.

7.2 Study Motivation

The literature review and laddering study confirmed the importance of transparency for collaborative learning and suggested that the concept of transparency is linked closely with the concepts of visibility and awareness of information. It also suggested some means by which transparency might be gained, which included the use of tools broadly aimed at increasing awareness of information, and processes that are heavily premised on delivering transparency. As noted, transparency is an acknowledged characteristic of Scrum, though to the writer's knowledge no empirical studies appear to have been carried out to test to what extent this is true of Scrum used in a HE setting. This exploratory study was therefore undertaken to investigate the benefits of using Scrum in collaborative learning by introducing it halfway through an undergraduate module running a two-part group assessment to see how it would affect the collaborative experience and outcomes. This approach aimed to provide a comparison between collaboration that was carried out during the first half of the module which did not use the Scrum approach and that which was carried out in the second half which did, using the same student sample.

7.3 Research Questions

The overall aim of the study was to compare the use of Scrum with non-Scrum collaborative work, particularly in the degree to which both methods provided transparency in collaborative learning and led to positive outcomes. Specifically, the research questions to be investigated were:

> RQ1: Would students think that the Scrum approach to groupwork provided more transparency compared with non-Scrum methods?

RQ2: Would students think Scrum was a more effective method for conducting group work?

RQ3: Would using Scrum improve student grades?

RQ3: Would students be more satisfied with their peers' performance when using Scrum?

7.4 Description of process and task

The collaborative learning under investigation was conducted in a first year undergraduate module, Information Systems and Databases, normally taken by all undergraduate Computing students in the second semester of their first year of study. The assessment was group based, and was assessed using two elements, both weighted at 50%. The first assignment element (A1) required groups to analyse a business case scenario to produce a database design, functional requirements and associated database documentation, while the second (A2) required students to implement the design following feedback from tutors, namely to set up database tables, design test data, implement functional requirements, research other information systems that might be applicable for the scenario, and then prepare and deliver a 15 minute presentation of their results, including an overview of their team working experience. Research on group versus individual learning has shown that group learning is superior to individual learning for relatively complex problem-solving tasks (Laughlin et al, 2002) and that expecting students to work together on low-complexity tasks can hinder student learning or cause students to stop collaborating altogether (Kirschner et all, 2009). The assignment (Appendix 1) used a substantial, complex case study mirroring a real word problem that would be challenging and thus sustain the cognitive capacity of a group of learners.

The deliverables for A1 comprised a report documenting business rules and assumptions covering the database design, functional requirements, and a fully documented database model covering the case study requirements. For A2 groups needed to submit a group report, a database implementation using Oracle SQL Developer software, and a 15-minute presentation of their research findings. Individuals also had to submit a confidential peer assessment form at the end of each element of assessment. This required students to rate each member of their group (including self) based on criteria agreed by the group at the start

of the module. Tutors used the scores from the peer assessments to moderate the group mark given for the assignment. This meant that although a group grade was assigned to each group, individual marks within a group could vary quite considerably. Groups were given approximately six weeks to complete each element.

The study involved a cohort of 106 students split into 27 groups of four students (though groups of three or five students were sometimes unavoidable). Comparisons were also made, where available, with the previous year's cohort of students consisting of 93 students divided into 20 groups. Most students had participated in at least one group work assessment in the previous semester. As far as the researcher was aware, no students had used Scrum previously.

Students were grouped randomly by their tutors so that in many cases students in a team did not know each other prior to the start of the assignment. The teaching team considered various means of assigning groups, each with their relative advantages and disadvantages (eg Pociask, Gross & Shih, 2017) before deciding on a random grouping. The rationale for this was threefold: firstly, in the first semester of undergraduate study there is a tendency for students to form friendship groups early on which tend to perpetuate throughout the year and can result in excluded students. A conscious decision was made to mix up the student cohort to give students the opportunity to develop wider friendship groups. Secondly, allowing groups to self-select their members can result in a lack of a more appropriately varied group skills set (Tuckman 1965). The third reason was that tutors felt that in the real world, team members often have no say on who they are to work with, so students need to develop skills to be able to work effectively as part of any group to which they are assigned, not just groups consisting of their preferred friends.

The assignments required true collaborative learning: although students could divide tasks up amongst themselves, the tasks were interrelated and required team members to check each other's work to ensure that the solutions they provided were consistent with elements of work produced by others. In short, a simple 'divide and conquer', cooperative approach could not be employed.

The Blackboard VLE was used to set up group facilities for each team. These consisted of a discussion board, blog and file exchange facilities. Students were told that they could use

whichever features they preferred to document their interactions, work-in-progress, and deliverables.

Student groups were free to adopt whatever group management strategy they were comfortable with for A1. None of the groups employed Scrum, even though a small proportion of students had been introduced to it in a semester 1 module as part of a lecture on systems development. At the end of A1 students were required to submit the first of their (confidential) peer reviews which highlighted some dysfunctional groups.

In a break with previous versions of the module, it was decided to introduce Scrum as a process for managing the second part of the assignment (A2), to see what difference this would make to the group work experience, group transparency and outputs. Students were given a short introduction to Scrum. This comprised a one-hour lecture highlighting the main principles of Scrum and the impact it was making on systems development projects in the real world, stressing the advantages to be gained from having experience of this process. It was hoped this would improve students' affective attitude and motivation.

Table 11 shows Scrum ceremonies and artifacts, and their proposed implementation in A2.

Element	Description, as used in Scrum	Implementation in A2
CEREMONIES		
Sprint Planning	Conducted before the start of a Sprint, to agree the scope of work and user stories (elements of work) to completed in the Sprint.	Set at once every two weeks, either at the start of a timetabled workshop session or at other times agreed by the team.
Daily Stand Up	Time constrained (15 minute) daily meetings where team members discuss what they did the day before, whether they have any problems, what to do next	10-minute stand-ups at the start of the module's weekly timetabled seminars
Sprint Review	A review of what has been achieved at the end of the Sprint, and decision taken on user stories to be covered in the next Sprint	Set at once every two weeks, either at the end of a timetabled seminar or at other times agreed by the team.
Retrospective	Conducted at the end of the Sprint, designed to highlight things that went well and should be continued, and things that went badly and should be discontinued for the next Sprint.	Conducted at the end of each Sprint review.
ARTIFACTS		
Product Backlog	A list of the prioritized user stories (elements of work) that need to be implemented as part of the product development.	Itemised tasks listed on a spreadsheet that needed to be undertaken for the assessment to be completed successfully. These included research and review of other group members' work.
Sprint Backlog ,	A list of user stories or elements of work that the team agrees to complete by the end of the Sprint.	Tasks that were required to be undertaken in the next two-week Sprint, highlighted on the product backlog spreadsheet

Burndown chart	A chart showing performance against the project plan.	Not implemented. Students were instead asked to concentrate on keeping the backlog updated to show what progress had been made against plan.
Potentially Shippable product	The sum of all the backlog items completed during the Sprint, ready for deployment	A collection of all the tasks that were completed during the Sprint, uploaded to the group's file exchange area.
ROLES		
Product Owner	The owner of the product/system to be developed.	The tutor. Students were given a two-page description of the scenario to be used for the development and told that they could speak to their tutor for any clarification, or they could document any assumptions they made from the case study.
Scrum master	The team member who coordinates the overall work and oversees meetings.	Students could rotate the Scrum master for each Sprint or use one team member for the whole development.
Team members	The 'self-organising' groups of diverse specialisms who are assembled to carry out the work.	Comprised the same groups and team members as used for A1

Table 11: Scrum organisation for the A2 assignment

Sprints were set at two weeks duration so that the assignment would require three Sprints, and groups were asked to agree and publish a time for one additional weekly meeting in addition to their timetabled class practical. Students were instructed to conduct their daily stand up at the start of their weekly timetabled class and other Scrum meetings every two weeks.

The focus was on the need for groups to construct and maintain a Product/Sprint backlog and to document their outputs on the Blackboard VLE. Where necessary, tutors worked with seminar groups to tease out various generic tasks necessary, students then discussed these, refined the list by relating them to their own development scenario, and produced a Product Backlog, which listed the tasks that needed to be completed, to whom the task was assigned and the date it was due. A single task could be assigned to all members of the team, with the same due date given, and a subsequent task provided for members to review each other's efforts. All this was recorded in a spreadsheet uploaded to the File Exchange area on Blackboard. Students were left to choose which tasks they wanted to take on, in keeping with the philosophy of Scrum for self-organising groups.

Sprints were conducted every two weeks: tasks that needed to be finished in that time period were identified the start of the Sprint, and at the end of the Sprint the product backlog was updated to show which tasks had been successfully completed, which tasks needed to be re-assigned to other group members because a student charged with implementing the task had

not uploaded it (and had not asked for a time extension), and which new tasks needed to be added (or deleted) for the next Sprint. A2 was run over 6 weeks, at the end of which students again conducted a peer review exercise using the same criteria and process as was undertaken at the end of A1.

Scrum is typically supported by tools to facilitate project management. Examples are a Kanban board which provides a visual representation of project's progress using sticky notes on a whiteboard, or online versions of this such as Trello or Jira. However, there was no time to introduce any of these and tutors decided against overburdening students by introducing new systems halfway through the module. This meant that students continued to document their progress using Blackboard group tools, as they had been doing for A1; the main change was the need to maintain and update the product backlog spreadsheet at the start and end of each Sprint and to document that they had completed the tasks assigned to them by uploading the results to Blackboard using the File Exchange facility.

7.5 Research Instruments

A number of methods were used to obtain both quantitative and qualitative data for analysis.

7.5.1 Assignment grades

Grades for A1 and A2 were compared to see if there were any significant differences between them. Student grades for A2 were also compared against A2 grades for a cohort of students who had completed the same module the previous year but without using a Scrum approach.

7.5.2 Student questionnaire

A short questionnaire was completed anonymously by students at the end of the module to obtain their views on using Scrum for A2 (See appendix 2). The questionnaire consisted of nine questions requiring students to rate statements using a 5-point Likert scale ranging from 'Strongly Disagree' to 'Strongly Agree'. Questions 3 and 4 relating to awareness were based on research conducted by Convertino et al (2004) and were modified to suit the study. Other questions were self-devised and aimed at establishing the perceived levels of transparency and efficacy of the Scrum and non-Scrum elements of the assignment. Two questions were directed at establishing the means of group communication used by students, to investigate their possible effect on transparency. The questionnaire also contained two open ended questions, the first asking students to state which method of group communication they

prefer to use for collaborative assignments and the second prompting students to provide any comments or suggestions for improving the group work experience.

Students were informed that their participation was voluntary and that data would be collected for research purposes only and would not affect assessment grades in any way. The questionnaire asked respondents to provide their group number if they wished to.

A total of 74 completed questionnaires were received (61% response rate) from 23 groups, with 68 respondents identifying their group number.

7.5.3 Student peer assessments

Each student was required to submit two peer assessments rating each team member's performance (including self) on a scale of 1 to 5 based on criteria agreed by the team at the start of the module. The first was conducted at the end of A1, prior to the group mark for the assessment being released, and the second was conducted at the end of A2, again before the group mark was known. Students were advised to carry out the peer assessment in confidence, without discussing their scores with their group members beforehand.

7.5.4 Student Focus Group

Following analysis of the questionnaire responses, students were contacted randomly and asked if they would like to volunteer to be part of a focus group to examine findings from the questionnaire. The researcher's aim was also to gather student insights into aspects of transparency and collaboration awareness which could not be covered in the short questionnaire, as well as probe some of the results from the questionnaire. A focus group consisting of six students was run two weeks after the completion of the module. The six students comprising two females and four males, represented five groups (two students were from the same group).

Group discussions were recorded and transcribed, and then analysed in accordance with standard guidelines for thematic analysis (Braun & Clarke, 2006).

7.6 Results and Analysis

The research questions were addressed by examining the data from the student questionnaire, focus group, assignment grades and peer assessments. A deductive approach was adopted for data analysis, with the research questions used to group the required data and discover the main findings. Questionnaire and assessment grade data was analysed using

standard quantitative methods, and thematic analysis was conducted to evaluate data from the focus group discussions using. The data obtained from surveys and grades were also triangulated with the results from the focus groups. The questionnaire consisted of five Likert scale questions (range from 1=strongly disagree to 5 =strongly agree). Cronbach's Alpha was .767, showing a satisfactory level of reliability.

7.6.1 Did Scrum provide more transparency compared with the non-scrum process?

The questionnaire posed two questions in relation to transparency. The first asked students to rate the statement 'It is important to have total transparency within the group'. The scores for this showed strong agreement from students, with 95% either agreeing or strongly agreeing with the statement (median=5; mode=5). The second question, 'The use of Scrum improves transparency in group work' again elicited strong agreement, with 66% of respondents agreeing or strongly agreeing with the statement (median=4; mode=5). Two more statements endeavoured to establish the degree of awareness of peer activity during A1 (non-Scrum) and A2 (using Scrum): 'I felt I knew what each group member was doing throughout the first assignment' and 'I felt I knew what each group member was doing throughout the second assignment'. The results (see Figure 17) showed that that 45% of respondents agreed or strongly agreed with the first statement, with the majority in the 'neutral' band (median=3; mode=3). This contrasted with 70% of respondents agreeing or strongly agreeing with the latter statement (median: 4; mode=5), with most responses in the 'strongly agree' category.

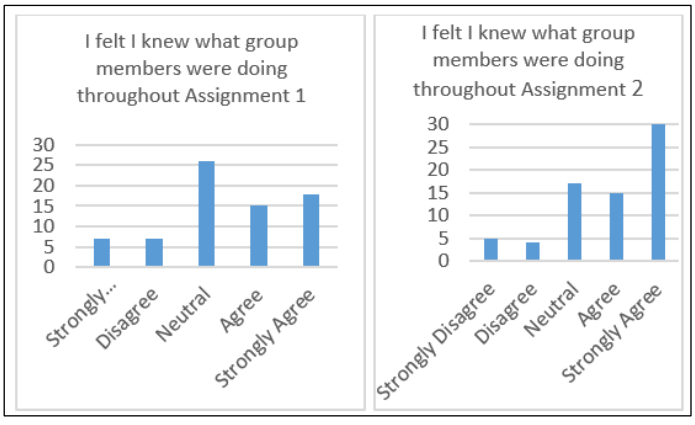


Figure 17: Comparing awareness of group member activity during A1 and A2

Taken together, these results confirm the importance attributed by students to transparency in group work and suggests that the use of Scrum by students led to increased transparency.

This was confirmed by comments elicited from the open-ended question, 'What comments or suggestions do you have for improving the group work experience for future assignments', which included a number of suggestions that also supported the use of the product backlog, for example, "implement the product backlog from the start" (x3) and "Product backlog adds transparency".

7.6.2 Would students think Scrum was a more effective method for conducting group work?

Students were asked to rank the statement 'I found the management of the first assignment an improvement on the second where a product backlog was used'. The results (median: 3; mode: 3) indicate only 12% of students agreeing/strongly agreeing with this statement, with 51% disagreeing/strongly disagreeing (See Figure 18). By way of confirmation, the next question 'I found that the second assignment was better managed than the first' produced results which were broadly the inverse of those for the previous question (median: 4; mode: 5), showing 60% of respondents agreeing or strongly agreeing with the statement while only 15% disagreed or strongly disagreed.

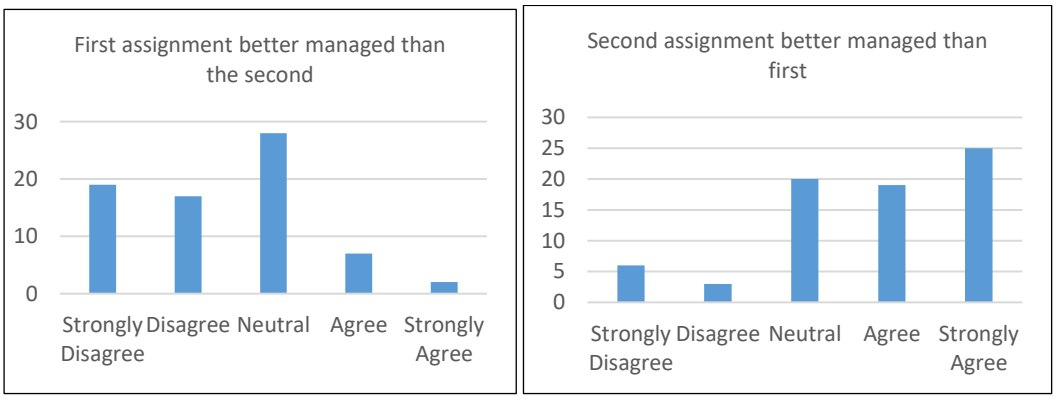


Figure 18: Perceptions on management of A1 and A2 assignments.

Students were also asked to comment on the statement 'I feel that using the product backlog for the first assignment could have improved the group work experience'. The results (median: 4; mode: 4) indicate that over half of respondents agreed or strongly agreed with this statement (See Figure 19).

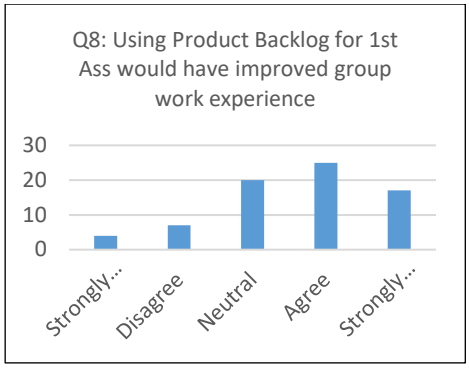


Figure 19: Using product backlog for A1 would have improved the groupwork experience

Taken overall, the responses to these three statements clearly indicate that students felt that there were advantages to using the Scrum approach, that it had contributed to a more positive second assessment and had the potential to improve the first assessment group experience.

7.6.3 Use of Scum

Q7 asked students to comment on the statement 'I felt my group followed the Scrum processes properly'. This question produced a median and mean score of 3 and indicated that over a third of students disagreed/strongly disagreed with this statement (see Figure 20).

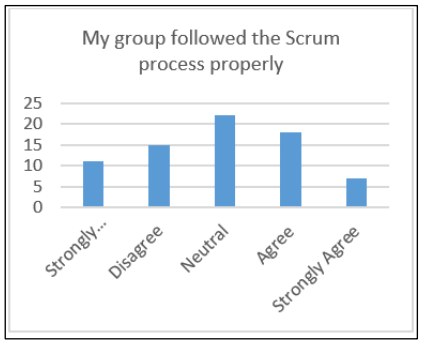


Figure 20: Results for 'My group followed the Scrum process properly'

The statement was inserted as tutors had observed that not all groups were following the rules when it came to implementing the Scrum approach and wanted to see how widespread this was. This was a significant finding and was highlighted as needing further investigation.

7.6.4 Would a Scrum approach improve student grades?

To answer the question of whether a Scrum approach would improve student grades, the grades for A1 (no Scrum) and A2 (with Scrum) for the cohort were compared (each assignment

was marked out of 50); A2 grades for the cohort were also compared with A2 grades of the previous year's student cohort who had not used the Scrum approach.

	No of students	Mean A1	Mean A2	Difference in mean A1-A2	Median A1	Median A2	Std Dev A1	Std Dev A2
Semi-Scrum cohort (cohort 1)	106	34.42	26.80 (with Scrum)	-7.62	33	27	6.57	8.59
Previous year cohort (cohort 2)	92	28.77	23.61	-5.16	32	25	15.20	11.28

Table 12: Summary of marks for Semi-Scrum and previous year cohorts

The module had run for three years with the same type of students, the same module leader and the same tutors teaching on the module. Marks are moderated by the module leader, so the experience of one year's cohort can be considered comparable to that of another. For all years, grades for A2 have consistently been lower than those for A1 and this proved to be the case for the cohort.

The results provide a mixed message (see Table 12). The A2 mean mark for the cohort (26.80) was higher than that of the previous year (23.61). An independent samples t-test produced a t-value of 2.190 with p-value (Sig. 2-tailed) of 0.03, confirming significance of difference in the means of the two populations tested. However, the cohort's mean A1 mark was also higher (31.42, versus 28.77 for the previous year's cohort) suggesting that the cohort could have comprised a stronger set of students overall. A paired t-test conducted on the cohort's A1 and A2 results produced a t-value of 9.558 with p-value (sig. 2-tailed) of .000 confirming significant statistical difference.

The Semi-Scrum cohort also produced the highest difference in the mean marks for the first and second assignments (-7.62, compared with -5.16 for the previous year) suggesting that, all things being equal, the introduction of Scrum may have had a negative impact on grades.

7.6.5 Would students be more satisfied with peers' performance after using Scrum?

The peer assessment marks provided by students for A1 and A2 were compared to see if students were more satisfied with their group members' efforts after the first assignment or the second. The assumption made was that the more contented students are with their group experience, the more likely they are to award equal marks to their group members. The

positive responses to Q5 and Q6 (see Figure 18) suggested that the majority of students were satisfied with the A2 group experience yet, as Table 13 shows, the proportion of students awarding equal marks to their group members fell with the introduction of the Scrum, suggesting that there were fewer instances of contented groups. A similar comparison could not be provided for the previous year's cohort as peer assessment was only conducted once, at the end of A2.

	Assessment A1	**Assessment A2**
Total no. of students	106	106
Total no. of students submitting peer assessments	102	102
Total No. of students submitting peer assessments with equal rating for all group members	42 (41% of student who submitted peer assessments)	27 (26.5% of students who submitted peer assessments)

Table 13: Peer assessment: No. of students giving equal marks to members for A1 & A2

Further analysis revealed that 29 students (approximately one third of the cohort) made a change to their peer marking (equal/non equal) between A1 and A2. The majority were changes from awarding an equal peer assessment score to all group members at the end of A1 to awarding differing scores at the end of A2, as shown in Table 14 below:

Analysis of peer assessment marks students with differing peer assessments for A1 and A2 (n=29)	
Change from equal mark for all group members for A1 to varying marks for group members for A2	22 (75.86%)
Change from varying marks for group members for A1 to equal marks for group members for A2	7 (24.14%)

Table 14: Analysis of peer mark changes by students

Initially this appears to contradict the findings from the questionnaire which showed that students found A2 better managed and an improvement on A1, which, if it were the case, should have provided more contented students and many more equal peer reviews within groups. It also goes against what might reasonably be expected when considering accepted theories of group working: for example, in Tuckman's (1965) theory of group development (comprising forming, storming, norming, performing and adjourning stages), groups often pass through a period of strife after their formation (the 'storming' stage), before members work through their individual differences and settle down and deliver productive work (in the 'norming' and 'performing' stages). From this, it seems reasonable to suppose that the 'forming' and 'storming' stages would have been completed by the end of A1, leaving

students to enjoy the productive and relatively conflict-free periods of 'norming' and 'performing' in the second assignment. If this were the case, then there should have been a much higher proportion of satisfied students at the end of A2, reflected in an equal peer assessment for their group members, or a higher proportion of students changing their peer marks from varying marks for A1 to equal marks for A2.

A possible explanation for this apparent contradiction could be the higher level of transparency provided by the Scrum approach, and specifically the product backlog, which provided compelling evidence of non-performing group members, thereby allowing their peers to mark them down more easily than if this had not been the case. Similarly, high performing students who had picked up on work assigned to non-performing members were easy to spot and their effort could be rewarded in the peer assessment mark. This explanation was upheld in discussions with the focus group who confirmed that in the case of non-attenders and poorly performing students, the product backlog clearly showed who had failed to complete a task and who subsequently had to take it over, making it easier to allocate peer marks accordingly. As one student put it, "I could be a bit braver about moving marks around for the second assignment as the evidence was all there for everyone (including the tutor) to see and nobody could argue with it." Another student commented that "although it was cumbersome to keep the backlog updated, in the end it did show up the non-performers". Both students had given an equal allocation of marks to their groups for A1, but when asked whether those assessments were fair, admitted that they were probably not, but as they had another assignment to finish with the same group, they thought that taking marks away from members who hadn't been productive might "ruffle some feathers" and cause conflict which could impact on A2. On completing A2 they had no such qualms.

Free comments from the questionnaire gave further, often contradictory, insights: "Backlog is a good system to be implemented, however comments on the peer assessment forms also help to express group activity in better detail than [the] backlog", highlighting that there were factors to take into consideration in the peer assessment other than the information on the Backlog. At the start of the module, students were required to come up with their own criteria for allocating peer marks, but very few of the peer assessment forms showed any reference to these criteria. Other suggestions related to improving the peer assessment exercise were "to use criteria to divide the marks on the final project backlog instead of many other criteria",

and similarly, “Combine peer assessment and the product backlog”, “Focus on backlog being uploaded with amount of time spent on tasks. Peer assessment is very subjective in some cases”, also “Make the product backlog a must do and associate it with marks.” These comments seemed to strengthen the view that students were receptive to the idea of primarily using the transparency of the product backlog as the basis for allocating peer assessment marks. One student also suggested that “it would be nice if marks were gradually reduced in case of failure to submit material regularly on Blackboard”.
The product backlog was backed up by interactions posted on the discussion board and group blogs. However, these were used with varying degrees of regularity by group members.

It has been suggested that making individuals' collective inputs identifiable may be enough to eliminate social loafing in many situations (Byun, 2020; Zhu & Wang, 2019). The requirement to maintain the Product Backlog was an attempt to do this, but the findings suggest that some students consider other factors such as attendance at stand-ups and other regular meetings to be equally important in this respect.

7.6.6 Team Communications

Question 9 on the questionnaire probed students to see if they thought that restricting teams to using only the group tools on the Blackboard VLE for team interactions would improve transparency, as this would require checking of only one place for all messages and interactions. The results (Figure 21) showed an equal majority being neutral or strongly agreeing that it would.

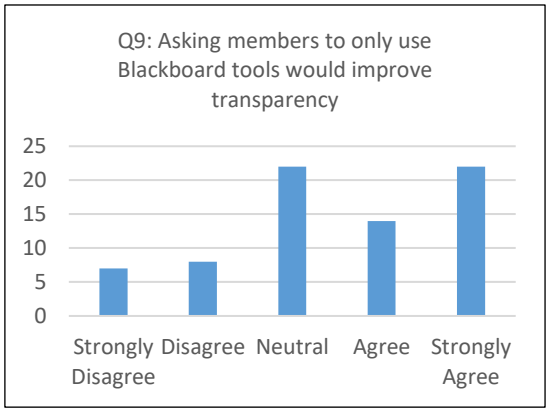


Figure 21: Using Blackboard for transparency

In free comments some students again indicated that Blackboard fell short of being an ideal platform for group work communication: “Just using the group tools available on Blackboard is not really good for communication as you don’t receive any notification when someone is posting something”. Others found the tools “not mobile friendly” and “clunky to use”. Nevertheless, results from the questionnaire seem to indicate that students considered that using it exclusively for group collaboration would increase transparency. This is difficult to operationalise as students typically use a range of social media, instant messaging, email, and other platforms in their daily life which they prefer to use for group work communication. For the study, students were asked to communicate and maintain the product backlog using only the group facilities available on the Blackboard VLE, but it became clear that other forms of communication were being used, making overall visibility difficult and perhaps forcing some students to rely solely on the product backlog for the peer assessment.

Question 10 aimed to establish the most popular means for intra-group communication used by students in the study. The question ‘What method of group communication would you prefer to use?’ elicited 63 answers, some of them giving more than one means of communication. The results (Table 15) showed that, in fact, Blackboard did not feature highly in the list of preferences, being mentioned only 9 times, compared, for example, with the 38 votes for the popular WhatsApp instant messenger.

Preferred Method	**No.**
WhatsApp	38
Email	12
Face to face	11
Blackboard	9
Skype	5
Google hangouts	2
Product backlog	1
Text messages	1
Microsoft Teams	1
Github	1
Social media group	1

Table 15: Preferred means of communication

The result suggests that to aid transparency, a prerequisite must be a user-friendly tool that is acceptable by students so that they are all able to record their group interactions solely using this tool. If students are having problems using the VLE and not accessing their group members’ correspondence, then this is likely to reduce the level of transparency provided. The focus group discussions confirmed that only one group stuck to using the VLE for

recording group interaction; the others supplemented that with discussions via WhatsApp, Facebook and phone calls.

7.7 Qualitative Analysis

Qualitative data was obtained from two open ended questions on the student questionnaires and from focus group discussions. To avoid repetition and where applicable, some results from the open-ended questions have been reported alongside topics to which they relate.

The focus group was conducted at the end of the module and was made up of six students representing five groups. The meeting lasted one hour and was recorded and transcribed for analysis. It aimed firstly to collect articulated data, expressed in response to specific prompts arising from questionnaire results, allowing for elucidation of findings. This elucidation is "one of the strengths of the focus group method and leads to a more thorough examination of a topic than can be had in an individually administered survey or interview" (Massey, 2011, p.25). In addition, it also aimed to stimulate wider discussion between attendees while trying to guide their conversations to the most fertile areas for investigation.

The findings have been grouped according to the major themes uncovered using thematic analysis.

7.7.1 Difficulties with the Scrum Process

The first area of interest concerned the response to Q7, 'I felt my group followed the Scrum process properly', which revealed that only approximately one third of respondents agreed or strongly agreed that their group had followed the Scrum process properly, with the majority neutral and approximately one third disagreeing with the statement. This constitutes a major concern for research investigating use of Scrum for group work.

These results were probed in the focus group where students were asked for their comments on the processes followed. There was general agreement that the product backlog spreadsheet was an effective mechanism for viewing the 'status quo' of the assignment at a glance, showing who had contributed on time, who needed an extension on their tasks etc. The process was not complex and in principle was easy to manage:

> "It was quite easy to list the tasks that needed to be done on the backlog and then decide what we needed to do in the Sprint, like 'come up with three queries each'."

However, for some groups the backlog did not always give a true reflection of what had been achieved as some group members changed the status of their tasks to 'completed' without posting the work they were supposed to have completed to the file exchange area, as required to do, as one student explained:

> "In our group one member simply went in and amended the Sprint backlog to show he'd completed everything, without posting his work to Blackboard…In fact he'd done hardly anything and the rest of the group had to pick up a lot of his tasks."

However, other participants did not think such incidents were widespread. They questioned why the errant member hadn't been pulled up when this behaviour was first noticed, as this would surely have prevented a repetition of this.

There was also a certain degree of confusion felt by some students over who should be updating the spreadsheet; it was suggested in the introductory lecture that it should be the group member who was acting as the Scrum master for that Sprint, but some group members had been updating the spreadsheet themselves as tasks were completed and uploading the updated spreadsheet to the file exchange area on Blackboard without updating the version number of the document.

The other issue to emerge in the discussions was that the daily stand-up and Sprint review/retrospective meetings needed reviewing. To start with, group members were often late to the weekly seminar for various reasons so ended up joining the stand-up for the last few minutes or not at all, and over time poor attendance meant that a lot of the groups discontinued the stand-ups and discussed progress and performance issues at their weekly meetings (where attendance was also an issue for some groups). However, the focus group agreed that the daily stand- up was useful and should be continued in future as this was where a lot of consolidation and progress was made. One student suggested that-stand ups could be done mid-way through the seminar, rather than at the beginning, but this would have disrupted the weekly practical which was only one hour long. Others suggested that it would be better to keep it at the start and penalise students for not turning up on time:

> ".. this would kill two birds with one stone, improve their overall timekeeping and make the meetings useful as it's pointless having a meeting to discuss things when only half the team are there."

One member proposed that the tutor should also be part of the stand-up as this would be a quick way of getting feedback on problems experienced by the group, but it was difficult to see how this could be done by one tutor with (on average) 5 to 6 groups in each seminar session.

7.7.2 Appropriate preparation

There was a clear view that there should be more time devoted to giving students a thorough overview of the Scrum process used, as well as making more extensive documentation available on the rules of the process, that students could refer to if they missed the introductory lecture. The general feeling was that there should be more time available for the process to be understood as A2 had been introduced in a rushed way, as one student noted:

> "We had to hit the ground running immediately after the lecture, without having time to assimilate all the details of the process"

7.7.3 Improvements to the process

The questionnaire results revealed that although the Scrum method had been generally well received, not everyone had found it a wholly positive experience and highlighted areas for improvement:

7.7.3.1 Product/Sprint Backlog support

The questionnaire results contained a number of free comments relating to the use of a spreadsheet for recording backlog items.

> "maybe working with a proper tool like Jira for the product backlog so that everyone engaged on the project is prepared to work with a tool that is used in industry"

Other options were suggested, eg:

> "or work with github as every member of the group could track changes on the project and work with a tool that is used in industry."

As with the questionnaire free comments, the focus group revealed a clear preference for using tools that are common in industry in order to be work-ready. They were also unanimous that using Scrum (albeit a trimmed down version of the real thing) was a "great positive" as one member stated:

> "looking at job adverts, Scrum and Agile is something that comes up a lot"

Other respondents addressed the practical issues of accessing the backlog spreadsheet through the Blackboard system:

> "possibly have the backlog spreadsheet shared online"

> "have easier access to backlog, ie in a program"

When prompted for their views on the efficacy of using a spreadsheet for the product backlog, the general consensus was that it worked in principle, but it didn't allow for a user friendly way of updating or accessing that information: progress made by team members on various tasks was clearly visible on the spreadsheet once the spreadsheet was opened, however the process of updating and even viewing the information was not that user friendly as it involved the file being downloaded, changes made, a new version saved and the new version uploaded to Blackboard. In addition, because there were no hard and fast rules about who made the updates and how often they were made, team members were often unaware that the backlog had been updated until they logged in to check activity in the file exchange area. This is an example of where visibility of updates had been provided in the backlog, but team members' awareness of them was lacking.

The focus group concluded that the spreadsheet was a clumsy tool for maintaining the backlog and the process of making new copies and updating them to Blackboard was tiresome, but stated that it was still, in any case, an effective way of summarising the effort made by each student, provided everyone followed the rules.

7.7.3.2 Suggestions for improving student effort

Another line of discussion was started with the prompt – "What suggestions do you have for dealing with students who don't follow the rules?"

One theme in response to this was to associate Backlog tasks with marks:

> "Backlog tasks for each week should be linked to marks. By evaluating each group's week progress weekly in terms of marks that they're projected to achieve if they follow the particular path will help to achieve better results"

Or to have more assignment submissions representing stages in the process, rather than a single assignment submission at the end of the assignment:

> "split the assignment into a number of submit dates, eg after each Sprint"

as this would 'focus the mind' on deliverables as

> "it's obvious that some students really only work hard when the assessment deadline is coming up."

Another view was that there was no need for such measures as anyone who didn't pull their weight should know that their effort, or lack of it, would be considered by their team members when allocating peer review marks, so

> "the peer review exercise takes care of that – they should know that if they mess around their marks will be affected"

This, it was suggested, should result in better behaviour.

One negative to emerge was the idea that it might be in a student's best interests not to help a teammate who was having problems and falling behind with tasks: by taking on these tasks, the student would appear in a more positive light and this could be reflected in higher peer assessment marks. As one student noted:

> "there's no need to make too much of an effort to help, because if they fail to do it you can step in and get the fame".

However, it was also pointed out that the backlog makes it easier to identify struggling group members and therefore helpful interventions by other group members can be provided earlier on in the process.

7.7.3.3 Tutor Input

Further comments from the questionnaire related to tutor input into the process. A student commented that:

> "it would be better for the teacher to divide the assignment up for each member"

which was echoed in:

> "I believe a pre-made backlog would be helpful to students as they would know what the lecturer would expect. If there is something missing it could easily be added to the backlog".

These comments go somewhat against the philosophy of Scrum, that teams are autonomous and self-directed and shows that not all students are comfortable with this and perhaps lack the confidence to do this. This suggests that a more scaffolded approach might be appropriate for first year students to help them build up confidence in the process.

Another student suggested that there should be more ongoing feedback from tutors:

> "There should be a mechanism for groups to have talks with the lecturer on the backlog completed tasks, to get verbal feedback".

This comment also indicates a certain lack of confidence in the ability of the team to collectively assess their progress, but again could be understandable, given the cohort of first year students. Tutors were available during the seminar sessions but time constraints and the numbers of groups in each seminar meant that there was limited time available for a detailed review of each group's progress.

7.8 Discussion

The experiment discussed in this paper used two different processes to conduct group work assessments on a core undergraduate module. A1 was carried out using a 'conventional' process employed by previous cohorts of students, whereby students elected a leader who did his/her best to manage the group and outputs from other members; no formal requirement was made for structuring or documenting the collaboration interactions or interim outputs, students were free to choose their preferred method. For the second assignment a Scrum approach was employed, focusing on the maintenance of a product backlog, a list of the tasks necessary for the successful completion of the assignment, indicating which tasks students had pledged to complete by the end of the bi-weekly Sprint, whether the tasks had been completed, and if not, who had taken over responsibility for their completion. The process did not fully comply with Scrum due to constraints posed by timetabling: because students had been mixed up from different courses, often with different timetables, it was difficult to find times to meet between practical sessions, so the daily stand-ups became weekly stand-ups taking place at the start of each seminar session, and the focus was on maintaining and actioning the product backlog. The essence of Scrum as self-organising teams deciding how to meet deadlines in a way that works for all members, was captured. The Sprint backlog was maintained as an Excel file accessible via the Blackboard VLE and updated every two weeks by the designated Scrum master. However, evidence from the survey responses, backed up by focus group discussions showed that in a significant number of cases the ceremonies which underpin the Scrum method were difficult to arrange and therefore neglected, making this at best a 'Semi-Scrum' experience for students.

Nevertheless, results from the questionnaire survey show conclusively that students thought the Scrum approach was an effective way of conducting the second group work assignment, preferring it to the method used in the first assignment and considering it to provide a high level of transparency.

It is suggested that transparency is a pre-requisite for effective group work, giving group members insight into each other's work. However, transparency does not in itself guarantee effective collaboration as individual members can still choose not to produce a piece of work on time, or to produce substandard tasks that need to be redone. Students still needs a certain kind of temperament to mark down their peers, even when it is obvious that they haven't pulled their weight and students often show a reluctance to confront or challenge free-riders (Maiden & Perry, 2010). However, the use of the product backlog in A2, although not implemented to the letter in some cases, did appear to highlight individual successes and failings, giving other group members the ammunition to apportion lower peer marks if a group member had not performed, particularly when this possibility had been expressly stated in the assignment brief. Conversely, for A1, records of group members' individual efforts were dispersed among emails, discussion boards and meeting notes, or not at all, making it more difficult to access the evidence of who did what. An examination of the peer assessment marks for both assignments suggested that students were much more willing to redistribute marks for the second assignment, based on what the product backlog showed. The first assignment had a larger proportion of students giving equal marks in their peer assessment to their group members, though anecdotal evidence suggested that some of the groups receiving equal marks were far from harmonious. Research has shown that, particularly when anonymity cannot be guaranteed, students can often give more positive assessments because of peer pressure, but that this act produces very dissatisfied learners (Li, 2017).

A significant finding was that overall grades for the second assignment did not increase though the use of Scrum, but followed the pattern of previous years, where the average mark for the second assignment was lower than that of the first. Part of the explanation for this could be attributed to the set-up of the module: as with many First Year modules, it does not contribute to the overall degree classification and students need only to pass the module to progress to the next year of their studies. With no thresholds and a pass mark of 40% overall,

some students reduce their efforts after a successful first assignment, in the knowledge that they need to only attain a mediocre mark for the second assessment to pass the module overall.

One of the clear advantages of the Scrum approach is that it goes some way to addresses the social loafers and free-riders who decide to engage in the very last stages of a group project to claim the group mark. This is no longer an option as they agree to implement tasks at the start of a sprint, which are then taken over by others if they have not been completed on time. The result is that a project is less likely to be compromised by students who contribute late or who do not contribute at all; tasks can be reassigned and reformulated so that there is progress even when there is a lack of individual commitment or unexpected difficulties experienced by a member that might normally impact negatively on the project. Instead, the method highlights any obvious differences in contribution from individuals so that team members can decide what rewards or penalties to exact on such students. It can also prevent domineering students from inflicting unrealistic expectations on their team members or from monopolising tasks for themselves.

The student focus group discussion touched on some concerns however, among them the suggestion that the method could reduce the amount of help that students gave to struggling group members, as they could do the work of the struggling members themselves and benefit from higher esteem from their group. However, an alternative scenario voiced was that struggling group members would be easily identifiable and might therefore benefit early on from helpful interventions by other students.

Students in the focus group seemed to consider the whole process having room for improvement, particularly with regards to maintaining the product backlogs, but overall, not over-demanding, suggesting that the transaction cost of using Scrum for managing group work is not excessive.

7.9 Conclusion

The study has shown that:

a. Students considered that the Scrum approach used to manage A2 provided more transparency than that provided in A1.

a. Students stated they preferred the Scrum approach to that used in A1.
b. However, Scrum seemed to make no notable difference to overall grades and if anything, grades were lower for A2.
c. Peer assessment results indicated that students appeared to use the transparency provided by the product backlog in apportioning marks more realistically.

7.10 Critique and areas for further study

The study was valuable as an exploratory study into the use of Scrum for delivering transparency, showing that it warranted further research. There were several flaws in the research that need to be addressed, as well as areas that were opened up for further investigation:

1. One potential advantage of the study was that the same student groups could be used to directly compare two different processes for carrying out collaborative learning. However, this also represents a significant limitation of the study as students starting assessment A2 would already have spent six weeks working together and getting to know each other in their groups. This would invariably have impacted on social relationships and group processes, as they would have passed through Tuckman's 'storming' phase of group development while engaged in A1, thereby starting A2 as a more harmonious and productive team in the 'performing' stage of Tuckman's model. This could have skewed results of the investigation in a positive direction, eliminating conflict and making the groups more receptive to Scrum overall. However, an unusual finding is that despite this, many students were prepared to mark down group members in A2, having given equal marks to all in A1.

2. Although the study appears to confirm that Scrum delivers some transparency to the collaborative learning process, it would be useful to investigate Scrum's support for the student-centric view of transparency, as uncovered in the laddering study. As students are at the centre of CL, transparency should be viewed from this perspective and targeted to supporting their requirements.

3. It was clear that students concentrated on maintaining the product/Scrum backlog and that the ceremonies (stand-ups, Sprint reviews and retrospectives) which are so central to Scrum were neglected in many cases. Schwaber and Beedle (2002) stress the positive

effect that Scrum ceremonies such as Sprint reviews and retrospectives have on process visibility and transparency, so students were losing out by by-passing these elements. These also offer the benefit of visibility for conflict resolution when disagreements or misunderstandings arise. Any further empirical study needs to ensure that Scrum ceremonies are not neglected by students.

4. Feedback from students suggests that in some cases the backlog is not entirely transparent in terms of showing who has done what and could be supplemented with a check system or other mechanism that could confirm whether members have indeed submitted work to the file exchange area when they say they have.

5. The results from the student questionnaire suggested that students might benefit from a more effective method for communicating with their group members which involves everyone agreeing on a single system and using that exclusively in order to increase communication transparency. This could also make student communications more easily available for interaction analysis.

6. Another area for investigation is to re-examine the link between transparency and improved grades. Ultimately, one of the main motivations for having transparency must be to improve the end product of the collaborative activity, which is usually expressed in the form of grades; if these are not improving, then it suggests either that there is poor transparency or alternatively that there is no point to transparency, even though it is claimed to be significant for successful CL. The Semi-Scrum study was a useful experiment in testing the waters, but further investigation is required to investigate the link between transparency, as provided by Scrum, and outcomes.

7. Another aspect for investigation is the transaction cost of this approach. The trade-off between expanding cognitive capacity caused by the possibility of dividing work up among a group of students and the associated cognitive costs of managing the process of group work is an important aspect determining under which conditions collaborative learning environments may or may not be effective for learning. While anecdotal evidence suggests that transaction costs of Scrum are low, this could also be formally investigated, including analysis of the kind of regulation activities performed by groups using this approach. Several free comments suggested that there should be more oversight and

direction of processes by tutors. However, from a tutor perspective, in an environment where student-tutor ratios are steadily increasing and efforts are being directed towards seeking out assessments that place a lighter burden on teaching staff, this type of approach may seem undesirable, and focus might be better placed on investigating how to improve self-regulation or socially shared regulation in teams.

8. Another limitation of the study is that the task carried out in A2 falls into Scrum's traditional domain, namely software development, using Oracle software to build a database. The nature of the task could therefore have contributed to its success, as it mirrors the type of projects that are run successful in industry using Scrum. However, as most collaborative projects in HE are not of this type, it can be said that the A2 task is not representative of the bulk of CL activity in Higher Education.

This preliminary study paves the way for further research looking to build on some of the findings and to address some of the limitations of the Semi-Scrum investigation. More specifically, it will attempt to employ a more comprehensive implementation of Scrum and to explore whether students' perceptions of transparency, as outlined in the laddering study, are supported in Scrum. Furthermore, it will examine CL undertaken on a project that is outside the realm of software development, to see whether Scrum can be used successfully on such projects.

CHAPTER 8: THE SCRUM STUDY

8.1 Introduction

Having attempted in Chapter 6 to tease out the attributes that students associate with transparency and the end values that they consider important, this chapter moves on to measure the transparency credentials of Scrum in these terms. The laddering study revealed five abstract attributes of transparency: open communications, visibility, honesty, accountability, and respect for others, along with two concrete attributes, face-to-face meetings and product backlog. This chapter describes an investigation aimed at establishing the degree to which the attributes of transparency identified in the laddering study are perceived by students to be present when carrying out a group project using Scrum. The overall aim is to provide an objective measure of Scrum's support for this student-defined transparency as well as to assess student satisfaction with the group processes and outcomes and to learn lessons for the future.

This chapter also provides a rare empirical study of using Scrum for managing a 'creative', non-software development project. The subject was selected in order to test whether Scrum, as a collaborative learning management approach, can be applied universally. This was done by selecting a project from a domain outside of Scrum's typical scope. If successful, it might allow Scrum to become a single, standard approach for CL projects in HE.

8.2 Research Questions

The previous laddering study uncovered attributes of transparency identified as significant by students. The current experiment involved students undertaking a group assignment using Scrum to investigate the extent to which these attributes are perceived to be present. The study also aimed to implement a full version of Scrum, taking on board some of the criticisms and findings from the previous Semi-Scrum experiment.

The research questions set were:

RQ1: Would using Scrum lead to high levels of open communication, identified by students as an attribute of transparency?

RQ2: Would using Scrum lead to high levels of visibility, identified by students as an attribute of transparency?

RQ3: Would using Scrum lead to high levels of honesty, identified by students as an attribute of transparency?

RQ4: Would using Scrum lead to high levels of accountability, identified by students as an attribute of transparency?

RQ5: Would using Scrum lead to high levels of mutual respect, identified by students as an attribute of transparency?

In addition, the study aimed to elicit the levels of process and solution satisfaction experienced by students when using Scrum for managing a collaborative assignment:

RQ6: What levels of process satisfaction result from using Scrum for a groupwork assignment? Given a choice, would students prefer to use Scrum or other methods of project management in future groupwork?

RQ7: What levels of solution satisfaction arise from using Scrum for a groupwork assignment?

8.3 Research design and methodology

A first year, first semester module, Skills for Information Systems Professionals, was chosen for the study. The module introduces topics such as study skills, academic writing, working in groups, presentation skills, information retrieval and business statistics. This had a six-week group assignment requiring students to develop an idea for a digital artifact to address a stated problem, using Scrum as the project management method. The assignment was chosen because it did not involve any systems or software development, in which context Scrum has been widely studied (Persson et al, 2011; Linden, 2018). Instead, groups worked on a creative, idea-generating project, representing a novel domain for using Scrum and investigating its transparency credentials and outcomes. The assignment formed 50% of the overall module assessment and was also the first assessment set for the module and therefore likely to generate maximum effort from students.

8.3.1 Task

The task set in an empirical study is an important component of the research. The groupwork in this study was the complex, unstructured type for which collaboration is important. There was no single solution and groups were expected to gather, evaluate, and synthesise information from a variety of sources. The project involved researching, proposing a

solution/idea to address a given problem, and producing a presentation which incorporated a five-minute pitch of the solution to potential investors, as well as an evaluation of the group processes that the team had used (see Appendix 4).

This typically involved the tasks shown in Table 16:

1.	Agreeing on which scenario (out of a choice of two) to choose for the development of an application.
2.	Putting forward ideas on which aspect of the chosen scenario to focus on.
3.	Investigating applications/systems that currently exist for that purpose, their relative advantages and limitations, and identifying a gap in the market that a new product might target
4.	Deciding on the aim, scope and functionality of the group's app.
5.	Researching the advantages of the proposal for PR purposes.
6.	Designing a paper-based prototype or mobile phone screen prototype
7.	Designing, running, and evaluating results of a market research activity to gain students' feedback on the application's purpose and design (typically a questionnaire involving a 20-50 student sample)
8.	Amending the design according to feedback (if necessary)
9.	Designing the 5-minute promotional pitch video
10.	Researching methods for producing the video, recording participants, and providing a background soundtrack, etc.
11.	Getting feedback on the video and amending if necessary.
12.	Putting together the presentation, incorporating background research, results of market research, and reflection on the collaborative learning experience
13.	Rehearsing and delivering the presentation

Table 16: List of Scrum project tasks

The project aimed to address three of the four learning outcomes (LO) set for the module, namely:

> LO1 – Use appropriate tools to locate academic materials and produce professional documentation and presentations;
>
> LO3 – Work effectively as a member of a group and appraise own performance, applying professional codes of conduct;
>
> LO4 – Choose, employ and comment on appropriate methods for obtaining, manipulating and summarising data to solve a given problem;

8.3.2 Procedure

To address some of the concerns raised by students in the Semi-Scrum experiment, more time was spent on preparing students for the Scrum project. Students involved in the study were first primed on the philosophy and use of Scrum and were shown examples of backlogs and how they could be completed, as well as videos of Scrum in action and statistics on the use of

Scrum in industry. Recent pedagogical research highlights the importance of students undertaking groupwork being provided with opportunities to emulate professional communities of practice (Fearon, McLaughlin & Eng, 2012). By highlighting the successful use of Scrum in the work environment and the benefit that students could get from experiencing the method at first hand, it was hoped this would lead to positive impacts on the affective domain, namely students' perceptions of satisfaction, attitudes, and appreciation for the learning experience (Russel, 2004).

A total of 73 students (55 male; 18 female) were enrolled on the module, comprising 14 groups of 4 to 6 students. Unlike in the Semi-Scrum study, all students were following the same timetable so that seminar attendance and arranging times for meetings outside of timetabled classes was made easier. Approximately one third of the cohort were 'second semester starters', namely students who had started their studies the second semester of the previous academic year and were therefore a semester ahead of the rest of their current cohort. The significance of this was that this group of students had been introduced to the concepts of Scrum and had used Scrum in an assignment running the previous semester, and therefore had some knowledge of the process.

Students were allowed to organise their own groups, however, in practice, most were new students and had not yet formed any firm social connections, so most teams were put together randomly by tutors. Student groups were given the project task two weeks into the course and after 6 weeks they presented their work and answered a post-assignment questionnaire.

Groups were provided with Blackboard LMS 'Group' facilities and were told to upload all individual and group outcomes, evidence of meetings, Product/Sprint backlogs and group interactions. This was an upgraded version of Blackboard to that provided in the Semi-Scrum study which included additional features such as an online meeting environment. They were also allocated an hour of timetabled time each week for group activities. The assignment was weighted at 50% of the overall module mark, so comprised a sizeable portion of the module assessment. Additionally, the two teams with the best proposals were to be entered for a nationwide competition.

Students were expected to set up their own milestones for the project, and to work together as a team throughout its duration. They were responsible for organising tasks themselves, following Scrum principles of self-organising teams. As well as using the one hour of timetabled time for Scrum meetings, they were required to work on the project outside of timetabled classes. The restrictions on time meant that a single meeting was often used for more than one event: the 'stand-up', the Sprint planning and review, and a retrospective. Wherever possible, all meetings were to be face to face. Instructors took a back seat role and did not monitor performance but were available for any conflict resolution and for general assistance. Students could work on individual elements, but to progress the assignment solution, team members were required to come together to share their work, evaluate, synthesise material and come to some agreement prior to embarking on the next project Sprint. They were also informed that every member of the team would be expected to answer questions on any aspect of the project process and outcomes in the final presentation, thereby re-enforcing the requirement for interdependence among members.

All work was required to be documented in the team's Blackboard facility. The project began by brainstorming and identifying tasks that needed to be completed to reach a successful conclusion to the project. Although groups had been shown examples of Product and Sprint backlogs, these were examples from software development and not easily translated to their creative projects, so this task proved to be quite time consuming.

Table 17 shows the implementation of Scrum roles, ceremonies and artifacts for the Scrum study. The duration of the Sprints was proposed at one week, more frequently than the Semi-Scrum project in order to provide more opportunities for monitoring by tutors. A dilemma arose in allocating the role of the product owner. Although the product owner is central to Scrum, an external product owner is often absent from student Scrum projects (Baham, 2020) and in such cases the role is assumed either by the whole team or by an instructor. In the current study students had to collectively research and propose a suitable idea for development, rather than have a specific idea suggested to them by an instructor, so teams adopted collective product ownership.

Sprint Element	Implementation in the Scrum study
Ceremonies	
Sprint Planning	Set at one week, at the timetabled group seminar
Daily Stand Up	Weekly 10-minute stand-ups at the start of group meetings arranged outside of timetabled group seminar
Sprint Review	Weekly, at the start of the timetabled group seminar, prior to the next Sprint Planning meeting.
Retrospective	Conducted every two weeks, either in the timetabled group seminar or in meetings arranged outside of the session.
Artifacts	
Product Backlog	Itemised tasks listed on a spreadsheet that needed to be undertaken for the assessment to be completed successfully: these included research and review of other group members' work.
Sprint Backlog	The tasks that were required to be undertaken in the next two-week Sprint, highlighted on the Product Backlog spreadsheet
Burndown chart	Students were not asked to implement this; instead, they were asked to concentrate on keeping the backlog updated to show progress made against plan, as represented by the Sprint Backlog task submissions.
Potentially Shippable product	A collection of all the tasks that were completed during the Sprint and uploaded to the group's file exchange area.
Roles	
Product Owner	The team adopted collective product ownership.
Scrum Master	This role was rotated among members in some groups, while in others one member assumed the role for the duration of the project
Development Team	The team members (five to six students)

Table 17: Implementation of roles, ceremonies and artifacts for the Scrum study

All backlogs and completed tasks were required to be uploaded to the team's Blackboard file exchange area. Students were asked to use the Blackboard blog or discussion board area for communication so that all interactions were visible. Groups also had access to Blackboard 'Collaborate' offering an online meeting environment.

At the end of the process, students completed a questionnaire survey and a confidential peer assessment form which was used by tutors in the moderation of team members' marks. Two focus groups (with representatives from 6 different teams) were also run to explore some of the findings from the questionnaire as well as to probe for additional insights from the student experience. The first focus group was run immediately following the submission of the assignment, the other, comprising a separate group of students, was run after the assignment results were available and the data from the questionnaires had been analysed. A number of students had volunteered for the focus group and the researcher was keen to make use of them, in particular to see whether views changed before and after the assignment marks had been made known.

8.4 Data Collection Instruments

Several data collection instruments were employed in a mixed methods investigation.

8.4.1 Student Questionnaire

A questionnaire was formulated to elicit students' attitudes towards each identified attribute of transparency. The first requirement of a questionnaire is that it is suitable to collect data that can be used to test the research questions. As previous studies of this kind could not be located, measures of the variables were self-developed based on existing literature, where available, and consisted of a bank of three questions for each of the abstract attributes elicited from the laddering study.

The questionnaire also collected some demographic data including gender and age, as well as data on students' previous exposure to collaborative projects and to Scrum. Further questions were targeted at measuring the relative importance of the concrete attributes in providing transparency, process satisfaction, defined as the degree to which the student feels a positive association with the learning process, and solution satisfaction, being the degree to which the student feels a positive association with the learning result (Ocker & Yaverbaum, 2001).

The questionnaire items were measured on a seven-point Likert scale from 1= strongly disagree to 7 = strongly agree (see Appendix 3), seen as a highly reliable scale for measuring attitudes in a wide range of contexts (Taherdoost, 2019). The questionnaire was scrutinised by a senior academic so that any ambiguous questions could be improved or discarded, thus ensuring it had sufficient face validity. It was also piloted by five students before being deployed, which resulted in some minor refinement of the content to ensure, as far as possible, that it was clear, unambiguous, and uniformly workable.

Efforts were made to avoid 'acquiescence bias', an inclination by respondents to agree with statements to some extent regardless of their content (Johns, 2010) by including some open-ended questions and reversing the direction of the wording of some of the questions (i.e. including negative statements among the positive ones), thereby creating a more balanced questionnaire. Instructors administering the questionnaires were also asked to advise students to read the questions carefully before answering, and to give students ample time to complete the questionnaire fully.

The questionnaire was paper based and restricted in length to a single, double sided A4 page to have the greatest chance of being completed in its entirety (Iglesias and Torgerson, 2000).

It was handed out to students at the end of a timetabled lecture, over a three-week period to maximise response rates.

8.4.2 Student focus groups

Two focus groups were run to probe significant findings from the questionnaire. The membership was made up of student volunteers and included two class representatives who were privy to comments they had received about the assignment from other students studying the module. This provided a group perspective on some of the results. The additional heuristic value of running focus groups lies in the kind of interaction that emerges during the discussions, which can provide a wealth of additional information on the topic under investigation (Acocella, 2012) and this proved to be the case. The first focus group was run immediately after the assignment submission and aimed primarily to probe the transparency themes that were uncovered though the laddering study. A second focus group was run at the end of the module with a separate group of students to promote a wider discussion of the benefits and constraints of using Scrum for transparency and collaboration and to see how these were manifested in the Scrum assignment, with the added benefit of time for reflection.

8.4.3 Peer Assessment feedback and grades

Each student was required to submit a peer assessment form which assessed group members (including self) using criteria which were established by the team at the start of the project. This provided insights into positive social environment (Kreijns et al, 2007) and students' perceptions of their team members' performance. As well as commenting on engagement and effort, students were also required to provide a numerical grade for each team member which tutors used to moderate the group mark (see Appendix 4).

8.4.4 Individual and group grades

The academic performance of each group's assignment and presentation was graded by three members of staff who were subject experts. As far as possible, the graders were blind to the experimental design.

8.4.5 Summary of data collection instruments and data analysis methods

A summary of the data collection and analysis methods are provided below (Table 18). The internal consistency of a scale refers to a statistical measure that indicates the extent to which

its items can be said to be measuring the same thing, the logic being that two items can be said to be measuring the same attitude if those who agree with one item also agree with another, i.e. responses are closely related. In a Likert scale the standard measure of internal consistency is Cronbach's alpha coefficient. The closer alpha is to the maximum value of 1, the more internally consistent the scale, with >= 0.7 being the most acknowledged benchmark (Taber, 2018).

Investigating transparency attributes		
Research Question:	Data Collection method	Data Analysis method
RQ1: Open communications RQ2: Visibility RQ3: Honesty RQ4: Accountability RQ5: Mutual Respect	*Student Questionnaire 7-point Likert style questionnaire (strongly disagree – strongly agree response to statements) *open-ended questions *Focus group meetings	*Descriptive statistics including measures of central tendency and variability (mean and standard deviation) * Internal consistency measures using Cronbach's alpha coefficient *Qualitative analysis on open-ended questions *Focus groups: thematic analysis
RQ6: Process Satisfaction (PS)	*Student Questionnaire *Peer Assessments *Focus group meetings	*Descriptive statistics, as above *Qualitative analysis of focus group transcripts, as above
RQ6: Solution Satisfaction (SS)	*Student Questionnaire *Peer Assessments *Group/individual marks *Focus group meetings	*Descriptive statistics *Qualitative analysis of focus group transcripts

Table 18: Summary of data collection instruments and data analysis methods

8.5 Data Analysis and Results – Quantitative Data

A total of 73 students were enrolled on the module, forming 14 groups of up to 6 students. However, not all students completed the questionnaire. After filtering out the invalid questionnaires (including two questionnaires which showed the same response for all questions and indicated clear acquiescence bias), there were 62 usable questionnaires, one of which was incomplete as the student had completed only the first page of the questionnaire but was considered for inclusion in some of the analyses as the respondent had provided scores for all the transparency questions. This represented a satisfactory response rate of approximately 85%.

The analysis of the data was consistent with the approach of other research studies examining student perceptions of the group and group processes (Hoyle & Crawford, 1994; Jarvenpaa, Shaw & Staples, 2004), where data was analysed at the individual level, but also at the group level. The study aimed to analyse individual students' views of transparency provided by

Scrum. It also sought to understand overall group satisfaction with Scrum process and outcomes.

8.5.1 Was Scrum followed correctly?

To ascertain whether Scrum provided transparency, it was first necessary to check the extent to which the major Scrum processes were correctly followed by students.

Table 19 below shows statistics for each group. All groups, apart from one, uploaded regular updates of their Sprint Backlog, corresponding to weekly Sprints, and evidenced completed work through upload of files to the group's file exchange area. Furthermore, nine groups (approximately two thirds) documented their meetings, either as meeting minutes or as recorded meetings. The Scrum Guide does not prescribe Scrum documentation and some commentators claim that documenting meetings such as Sprint Retrospectives destroys more than creates anything as "all team members will understand that the discussions happening there are not safe if they are recorded" (How to capture and document Sprint retrospective results, 2014). However, the requirement to include evidence of meetings taking place was part of the assignment brief, made in response to findings from the Semi-Scrum study where face-to-face meetings had been sporadic at best and non-existent at worst. In most cases evidence was provided as meeting minutes, in one case as recorded meetings and in one case even using both methods. The most diligent group posted comprehensive minutes of all meetings including what to "start doing", "stop doing" and "continue doing" in Sprint Retrospectives. Two groups did not post any minutes, but meeting dates were mentioned in interactions posted to Blackboard. Two groups made no reference to any meetings on Blackboard, although they must have occurred as students were present at most of the timetabled seminar sessions dedicated to groupwork. One group did not post any Sprint Backlogs, all others posted a between 4 and 7 Sprint Backlogs over the six weeks of the study. There was a broad range in the number of postings made by each group to the file exchange area, from 17 to 66, and an even more significant variation in the number of postings made by individual team members (from 1 to 23).

Group No.	Sprint Backlog entries	No. of Postings	No. of Meeting Minutes	No. of Recorded Meetings
1	6	33	4	5
2	6	56	5	0
3	5	66	4	0
4	5	30	0	0
5	5	39	3	0
6	0	36	0	0
7	5	38	5	0
8	5	41	0	0
9	5	41	4	0
10	5	23	2	0
11	4	33	4	0
12	4	17	0	0
13	4	18	0	0
14	7	38	0	5
		Average=36		

Table 19: No. of backlogs, postings and meetings for each group

While 17 postings do not seem to represent any significant interaction for a group of 6 students over 6 weeks, analysis of peer assessment forms and discussions in the focus groups revealed widescale use of other platforms (primarily WhatsApp) for interactions and recording work, going against tutors' instructions to use only Blackboard facilities to document work and group interactions.

Tutors were also present at the timetabled weekly group session, so were able to observe group meetings in action.

It can be concluded that, although there were significant variations between groups and individuals, the Scrum methodology was broadly followed by all groups, in terms of Sprint Planning, Sprint Reviews and Retrospectives.

8.5.2 – Study Research Questions

The next sections address the evidence to support each of the research questions. Item T1 in the student questionnaire, "I believe it is necessary to have full transparency in group work," elicited the second highest mean score of all the questions in the survey, 6.31 (SD=1.03; Med=7), providing confirmation of the importance that students placed on transparency, as a background to the study.

8.5.2 RQ1: Would using Scrum lead to high levels of open communication?

Group members were asked to indicate their agreement with three statements using a seven-point Likert scale. The concept of open communications has been treated as synonymous with listening, candour, trust, supportiveness, and a variety of similar concepts (Rogers, 1987). Topics covered by open communications include criticisms, complaints, bad as well as good ideas and personal opinions (Rogers, 1987) and may often involve messages that may be ego-threatening (Myers et al, 1999). The concept has therefore been measured in a variety of different ways. Klauss and Bass (1982) used two questions to measure openness while Likert (1967) used four questions. Rogers's (1987) Communication Openness Measure (COM), widely regarded as the most definitive measure of open communication, is based on 19 questions. With only limited space for each concept, the questionnaire synthesised the measures identified from the literature into three statements:

C1: Group members were able to express all ideas and feelings with one another throughout the project.

C2: Group members actively communicated with other members of the team.

C3: Group members were empowered to share their thoughts without any fear of repercussions.

The results showed strong agreement on all three statements, with means ranging from 5.21 to 5.53 (See table: 20).

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.812	.814	3

Item Statistics

	Mean	Std. Deviation	N
c1	5.53	1.339	62
c2	5.21	1.559	62
c3	5.34	1.390	62

Inter-Item Correlation Matrix

	c1	c2	c3
c1	1.000	.684	.562
c2	.684	1.000	.534
c3	.562	.534	1.000

Table 20: Results for 'Open Communication' Questions C1-C3

Cronbach's Alpha of .812 confirmed a high level of internal consistency, with a positive correlation between the three items.

The results show strong support for the research question, namely that using Scrum did lead to high levels of open communication. This characteristic is reinforced using face-to-face meetings in the weekly stand-ups, Sprint reviews and Retrospectives, all of which promote open communication. Face-to-face sessions give students the opportunity to ask questions, give feedback and offer opinions in a direct way, and sticking points and sensitive issues can be raised and resolved quickly, thereby preventing them from developing into major problems.

On the other hand, studies have also shown that face to face meetings have some negative connotations, with a possibility of 'group think' emerging to reinforce a consensus prior to in-depth discussion and evaluation (Sumner & Hostetler, 2000) and in this respect stifling open communication.

8.5.3 RQ2: Would using Scrum lead to high levels of visibility?

Visibility in group work is most often concerned with task visibility, enabling individual efforts to be observed by others. Task visibility was measured using three statements which included one to assess the group member's willingness to make tasks visible to others.

V1: I knew which member was doing which task, which tasks had already been completed and which were still being worked on throughout the project.

V2: It was easy to see the status of the assignment at any time by looking at the product backlog.

V3: I was happy to make all my inputs and work visible to the whole team.

The results show strong agreement for all three questions, with means ranging from 5.79 to 6.03 (see table 21).

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.779	.780	3

Item Statistics

	Mean	Std. Deviation	N
v1	6.03	1.145	62
v2	5.79	1.381	62
v3	6.02	1.138	62

Inter-Item Correlation Matrix

	v1	v2	v3
v1	1.000	.564	.465
v2	.564	1.000	.597
v3	.465	.597	1.000

Table 21: Results for 'Visibility' Questions V1-V3

Questions were positively correlated though the correlation between V1 and V3 fell below the 0.5 threshold. Cronbach's Alpha for the three questions was .779, confirming a high level of internal consistency and reliability.

8.5.4 RQ3: Would using Scrum lead to high levels of honesty?

Group work requires a climate of honesty to be successful (Jaques, 2000) but honesty is difficult to measure objectively. A number of 'honesty' tests exist, more often called 'integrity' tests, but these are concerned with establishing whether an individual is intrinsically honest and trustworthy (Sackett & Wanek, 1997) rather than whether they did act in an honest way in a given situation. The questionnaire therefore gathered self-reported data on students' perceptions of their own, and their peers' honesty during the Scrum process through three questions (the wording of one question was reversed on the questionnaire order to detect any acquiescence bias):

H1: I feel group members acted with honesty at all times.

H2: The Scrum processes (eg Scrum face to face meetings and product backlog) encourage honesty in team members.

H3: I acted honestly throughout the process.

The results show that H3 obtained the highest mean (mean=6.37; SD=1.08) of any statement in the questionnaire (see Table 22).

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.740	.738	3

Item Statistics

	Mean	Std. Deviation	N
h1	5.71	1.497	62
h2	5.61	1.407	62
h3	6.37	1.075	62

Inter-Item Correlation Matrix

	h1	h2	h3
h1	1.000	.670	.251
h2	.670	1.000	.530
h3	.251	.530	1.000

Table 22: Results for 'Honesty' Questions H1-H3

This compared with a mean of 5.71 (SD=1.50) for H1, suggesting that team members considered their honesty to be above that of their fellow members. This is supported by the inter-item correlation matrix which shows a low positive correlation (.251) between questions H1 and H3. Again, Cronbach's Alpha coefficient was high (.74) showing a high level of internal consistency and reliability.

8.5.5 RQ4: Would using Scrum lead to high levels of accountability?

Accountability implies that each group member must develop a sense of responsibility to own and complete their individual tasks, and that this can be scrutinised. Group projects can be problematic due to students perceiving low accountability and withdrawing their efforts when working within a group (Voyles, 2015).

Three statements were designed to assess perceived accountability:

A1: The use of the product backlog showed clear accountability

A2: The Scrum process ensured that team members were accountable for their tasks

A3: Team members carried out the tasks they were assigned

The results (Table 23) show a high level of agreement with all statements, with A1 producing the highest mean (mean=6.21; SD=1.22). This confirmed near-unanimous, strong agreement that the product backlog showed clear accountability by students for given tasks. Notably however, A3 produced the lowest mean (mean=5.34; SD=1.62), suggesting that accountability

did not always equate with team members carrying out the tasks for which they were accountable. Cronbach's Alpha coefficient was .765, confirming internal consistency.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.765	.784	3

Item Statistics

	Mean	Std. Deviation	N
a1	6.21	1.217	62
a2	5.84	1.204	62
a3	5.34	1.619	62

Inter-Item Correlation Matrix

	a1	a2	a3
a1	1.000	.673	.463
a2	.673	1.000	.508
a3	.463	.508	1.000

Table 23: Results for 'Accountability' Questions A1-A3

8.5.6 RQ5: Would using Scrum lead to high levels of mutual respect?

Mutual respect is a precursor for any effective collaborative venture and implies knowledge and recognition of the complementarity of the contributions of others (San Martin-Rodriguez et al, 2005). It requires respectful behaviour as well as sensitivity and awareness to the causes of frustration that can lead to inappropriate behaviour, as rude or intimidating conduct can hamper the progress of any collaborative project. The laddering study identified mutual respect as an attribute of transparency, with interviewees acknowledging it as an integral part of transparency.

The survey included the following statements:

R1: There was mutual respect shown by team members throughout the Scrum project

R2: Members were never dismissive of another's suggestions

R3: Members valued the opinions of other members

As can be seen from Table 24, results for all three statements show high means (from 5.61 to 6.06) demonstrating strong agreement with the statements. Cronbach's Alpha coefficient was .854, confirming high internal consistency.

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.854	.854	3

Item Statistics

	Mean	Std. Deviation	N
r1	6.06	1.291	62
r2	5.61	1.453	62
r3	5.87	1.349	62

Inter-Item Correlation Matrix

	r1	r2	r3
r1	1.000	.582	.598
r2	.582	1.000	.802
r3	.598	.802	1.000

Table 24: Results for 'Mutual Respect' Questions R1-R3

8.5.7 Student scores for combined transparency attributes

The mean of all transparency statements was computed for each student and the frequencies shown in Figure 22. This shows that the band with the highest number of students was for means of between 6.3 and 7.0, representing responses in the 'strongly agree' category. The chart shows only a small proportion (8%) of respondents with a mean of less than 4.0, representing disagreement with the statements.

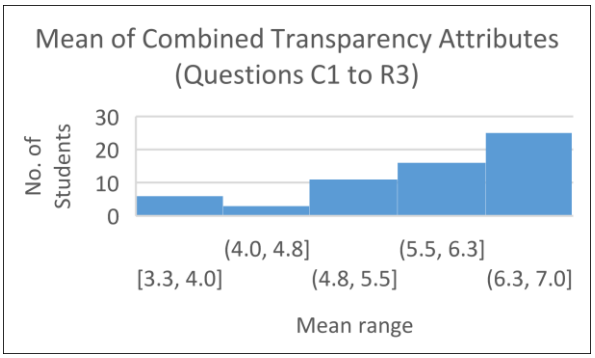


Figure 22: Distribution of means for combined transparency attributes

8.5.8 RQ6: What levels of process satisfaction result from using Scrum? Given a choice, would students prefer to use Scrum or other methods of project management in future group work?

a. **Questionnaire Responses**

Responses to the statement (SP) 'Overall, I felt that using Scrum worked better for me than using other group management methods' elicited a strong level of agreement. Respondents with no previous experience of group work assignments (n=23) were excluded from the

analysis. The statement produced a mean score of 5.56 (SD=1.24) and showed no significant difference between those with experience of 1-3 collaborative assignments, and those with longer exposure to groupwork (means of 5.55 and 5.67 respectively).

Students were also asked "Would you be happy to use Scrum for future groupwork assignments? This drew a highly positive response, with 82% of respondents (n=51) stating they would, against 18% (n=11) stating they would not.

Comparisons were undertaken of responses for the 'yes' and 'no' groups (see Table 25) with other survey results, to identify any significant correlations or patterns. The results show a similar level of agreement on questions relating to transparency attributes (mean of 5.22 versus 5.88 for 'no' and 'yes' groups respectively). However, the means of responses for the remaining questions show significant differences. The 'no' group produced a 'neutral' mean (4.25) for process satisfaction (SP) compared with strong agreement (mean=5.94) from the 'yes' group. Even more marked was the difference between the outcome satisfaction (SO)

Happy to use Scrum in future		Mean of Transparency statements C1-R3	SP Process Satisfaction	SO Outcome Satisfaction (better grade)	GO Overall Satisfied with group outcomes
No	Mean	5.22	4.25	3.82	5.09
	SD	1.23	1.16	1.08	1.58
Yes	Mean	5.88	5.94	6.12	5.44
	SD	0.88	1.24	1.12	1.64

Table 25: Would you be happy to use Scrum for future group work?
'yes' and 'no' groups cross tabulated against mean transparency and process, outcome and overall group satisfaction

mean of 3.82 for those who were not happy to use Scrum in future, representing marginal disagreement with the statement 'overall I felt that using Scrum helped to produce better outcomes for the team', versus a very strong agreement (mean of 6.12) from students who answered 'yes' to using Scrum in future.

These results show that students who stated they would prefer not to use Scrum in future did not feel that the use of Scrum contributed to providing better outcomes for them, or that it was more effective than other project management methods. However, despite this, both groups were equally happy with their group outcomes, scoring high levels of agreement with the statement 'Overall, I was happy with my group's outcomes' (means of 5.09 for the 'no' group and 5.44 for the 'yes' group).

Further analysis was undertaken by cross checking these results against demographics and background factors. 41% of respondents (nr 25) stated they had used Scrum in a previous assignment, and this group displayed a higher willingness to use Scrum in future than students who were using Scrum for the first time, as shown in Table 26 below.

Sample Category	No (%)	Yes (%)
Used Scrum previously (nr 25)	16.0	84.0
No previous use of Scrum (nr 36)	19.4	80.6
Gender: Female (nr 14)	21.4	78.6
Gender: Male (nr 47)	17.0	83.0
Age: < 20 yrs (nr 26)	15.4	84.6
Age: 20 to 29 yrs (nr 30)	23.3	76.7
Age: > 30 yrs (nr 4)	0	100.0
Previous group assignments: none (nr 22)	13.6	86.4
Previous group assignments: 1-3 (nr 33)	24.2	75.8
Previous group assignments: 4+ (nr 6)	0	100

Table 26: Willingness to use Scrum for future group work responses cross tabulated against previous experience with Scrum, age and gender

Responses are also shown cross-tabulated against age, gender, and number of group assignments.

Every category shown in Table 26 is strongly skewed towards using Scrum for future group work, confirming high levels of satisfaction with Scrum. Most notable are results (100%) for older respondents (>30 yrs) and those with more exposure to group assignments. The small samples for each of these categories preclude any major generalisations to be made, but in the context of this study, it does appear that those with more experience have opted wholeheartedly to adopt Scrum.

b. **Process satisfaction and interaction with peers**

When considering process satisfaction in any collaborative project, an important element is the degree to which the process produces satisfactory levels of interaction, cooperation and agreement between peers to deliver the benefits of collaborative learning. One indicator of this can be found in the peer assessment grades given by each student to their team members. Peer assessment forms were analysed to establish what levels of cooperation and satisfaction existed between team members and how this was reflected in peer assessment marks.

As with the Semi-Scrum experiment, the assumption made was that students with a wholly positive group experience would award their peers equal marks in the peer assessment exercise. An analysis of equal versus non-equal peer assessments (Table 27) reveals that only 4 teams scored all members equally, as opposed to 10 teams who did not. However, 44% of individuals distributed marks evenly among their peers, suggesting a higher level of peer harmony and positive group experience.

	Equal Marks given	Unequal Marks given
No. of teams	4 (29%)	10 (71%)
No. of individuals	32 (44%)	41 (56%)

Table 27: Equal versus Unequal marking in peer assessments

8.5.9 RQ7: What levels of solution satisfaction result from using Scrum

Solution satisfaction refers to the satisfaction or otherwise with the outcomes from the group work. Student groups were provided with some feedback on their performance from tutors at the end of their presentations but were unaware of their individual marks which may have been adjusted through peer review, prior to answering the questionnaire.

Two aspects were examined:

RQ7a The objective quality of task performance in meeting learning objectives, evidenced in tutor's grades

RQ7b Students' subjective satisfaction with the overall group outcomes. This was probed using two statements:

SO: Overall I felt that using Scrum helped to produce better grades than if it were not used (which respondents were then asked to provide further comments on)

and

GO: Overall, I was happy with my group's outcomes

8.5.9.1 RQ7a Analysis of grades

The solution performance is indicated by the grade the team received for their work and presentation. This provides an objective, independent measure of the group's effectiveness, beyond the perceptual measures collected though the survey.

The academic performance of each group's solution was graded by two staff who were subject experts. Instructors independently graded each team and their scores were averaged.

The group mark was then subjected to moderation based on marks submitted in the peer reviews provided by each member. This allowed reallocation of up to half the group mark, with some threshold limitations. Moderation was again carried out by two staff.

Overall, the group marks were high (see Figure 23) with an average group grade of 64%.

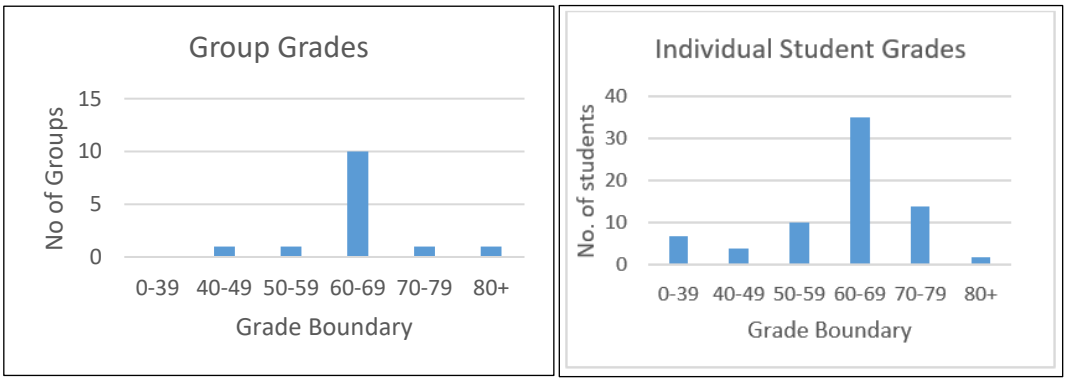


Figure 23: Group and Individual Student Marks for 'Scrum' assignment

Only two groups scored below 50%. The highest concentration was in the 60-69 band (representing 71% of the groups) and two groups scored marks in the 70's and 80's. In summary, 12 out of 14 groups (85.7%) achieved a mark in the 2.1 or First Class degree category.

Individual marks showed a broader distribution, reflecting the moderating effect of the peer assessment exercise. The average was 59.3% and again the scores exhibited a high concentration of marks in the 60-69 grade band (representing 49% of students). However, 21 students (29.2%) received grades of lower than 60% and 6 (8.3%) students received a mark of zero. This shows that peer assessment was able to exert considerable influence on students' overall grades.

Nevertheless, even though evidence of poor performance was available in the product backlogs and postings, poorly performing students were reluctant to penalise themselves: a greater number of poorly performing students did not reduce their mark in their self-assessments, compared with those who did. Of the students who had marks reduced by their peers, only 4 also allocated themselves lower marks, compared with 14 who did not. However, their marks did not have sufficient weight to prevent their overall grades from being reduced.

Comparison of Marks with Previous Year cohort

Marks were compared with a previous year's cohort who did not undertake the assignment using Scrum (see Figure 24). This cohort consisted of 37 students divided into 10 groups of 3 to 4 students. The average group grade was significantly lower (45%), largely due to three dysfunctional groups who failed to submit a presentation (without these groups, the group average would have been 66%), while the average individual student grade was 50%, again significantly lower due to the dysfunctional groups (without these groups, the average would have been 64%). These results could reflect a particularly poor cohort, but they also highlight that none of the 14 Scrum groups completely failed, in the sense of not delivering an assignment output which, in the researcher's experience, is frequently the case with first year group assignments.

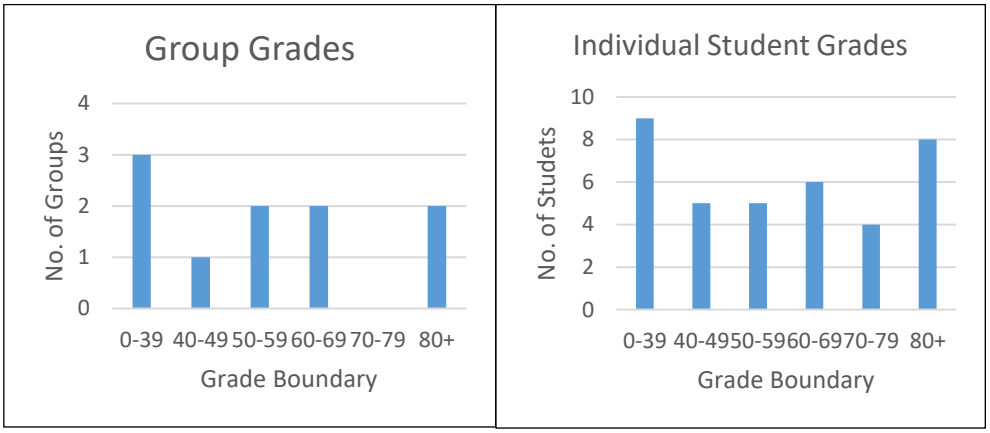


Figure 24: Group and Individual Marks for previous year 'non-Scrum' assignment

8.5.9.2 RQ7b: Self-reported satisfaction with the group's outcomes

Students were asked to rate their satisfaction with outcomes through two statements: 'Overall, I was happy with my group's outcomes' elicited a mean of 5.38 (SD=1.62) and 'Overall, I felt that using Scrum helped to produce better grades for the team' produced a mean score of 5.71 (SD=1.41) showing strong agreement with both statements.

8.5.10 Tools to support Scrum

The questionnaire aimed to elicit views on the tools provided to students to support the Scrum process (Blackboard, File Exchange, Blog, Discussion board). The statement 'Overall, I was happy with the tools provided on Blackboard to support the Scrum process' provided a mean score of 6.92 (SD=1.20; med=6). This represented a very high degree of agreement with

the statement but was a surprising result, given some of the comments relating to the 'clunky' and unsatisfactory nature of Blackboard raised in the Semi-Scrum study. It is also possible that respondents were suffering from questionnaire fatigue by this stage in the survey. As the facilities provided had not changed much since the Semi-Scrum study, this was flagged as needing further investigation.

Students were also asked to rank the support for transparency provided by four measures: face to face meetings, including the tutor in the group, maintaining a product backlog, and using a single platform or app to communicate with the team members. The choice of measures was informed by discussions with a group of students halfway through the project during informal feedback on how their teams were progressing. The aim of the question was to establish students' preferred measures and ultimately to investigate whether systems could be put in place to further enhance them.

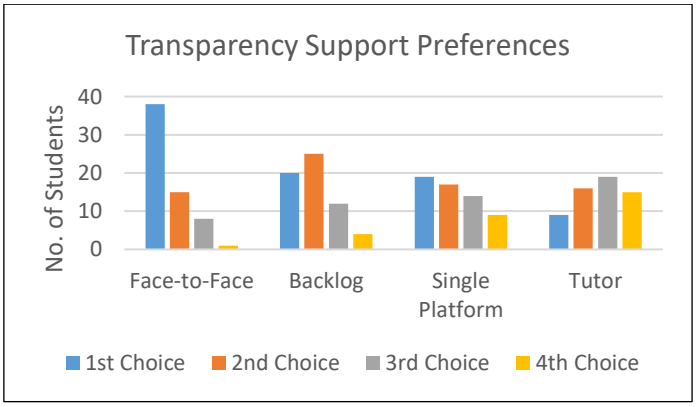


Figure 25: Popularity of Transparency Support options

Figure 25 shows the strongest support for face-to-face contact, with 61.3% of respondents indicating this as their first choice. The next popular is maintenance of a product backlog (32.3%) and single platform for correspondence (30.6%). The least popular option was including the tutor in the group which was chosen by 24.2% of students.

8.6 Data analysis and results – Qualitative Data

Rich qualitative data was obtained from two focus groups made up of students who had volunteered to be part of the group, following a request from the researcher. The first focus group meeting aimed to probe the transparency themes that were identified from the laddering study. The second, consisting of a separate group of students, was more exploratory open ended. All students gave permission for the discussions to be recorded and they were

then transcribed. A number of questionnaire findings were probed to elicit further clarification, during which additional facets of the research questions were uncovered. Several themes were identified from analysis of both group discussions and open-ended questions.

8.6.1 Transparency attributes

The researcher was interested in probing focus groups for their views on how the student-elicited attributes of transparency were supported in Scrum. The questionnaire revealed high levels of agreement with statements that Scrum supported accountability, honesty, open communication and mutual respect in addition to visibility. However, it was unclear to what extent these were the result of using Scrum, or whether they would naturally surface in any group project, irrespective of the project management process used.

8.6.1.1 Accountability

Accountability was unanimously linked by participants with the Sprint/Product backlogs which provided a simple overview of who was responsible for what in the project. Efforts were made wherever possible to accommodate students' strengths so that each team member was accountable for tasks that they could manage:

> "Actually at the initial stage we came up with "do you think you are comfortable with …"(like a brainstorming stage). "Yes – you tell us what you are comfortable doing", rather than just throwing tasks at them… what are your strengths, what can you do for us."

Everyone had their assigned tasks and if they did not do them without good reason then they were assigned to someone else. One participant indicated that the process was not always as inflexible and rigid as was suggested, explaining:

> "Well sometimes you do their outstanding task as a team because sometimes some people … aren't available, so things like that happen. So it's just how you manage your team. You take responsibility to help others as it's a whole team effort really. So if someone really can't manage a task then you go back to the rest of the team and say 'how can we all sort out this'?"

This elicited this response from another participant:

> "In my group it was completely different because there was just one person that would give out the tasks and people would just be assigned them and if they done it they done it, and if they didn't then they were just assigned to someone else, and that was it".

This emphasised the different approaches taken by the scrum master and team in redistributing work and making the rest of the team accountable for certain tasks which could not be managed by one individual. In the case of the first participant, notwithstanding this willingness to help, the product backlog was still updated to show that the team member's task had been re-allocated to other members, thus ensuring that accountability was clearly visible, and nobody could claim they did not know which tasks they were responsible for or who ultimately carried out those tasks.

The overall conclusion reached was that accountability was clearly supported by Scrum and that this degree of accountability would be more difficult to achieve using other approaches to manage the project.

8.6.1.2 Honesty

With respect to the degree to which the attribute of 'honesty' was supported or encouraged through Scrum, one participant summed up the view of the whole group:

> "It's more difficult to be dishonest if you're in a face-to-face meeting with your team"

There was a view that honesty was necessary for transparency in the sense of conveying a true picture of something, and that the face-to-face nature of the Scrum ceremonies not only made it difficult to act dishonestly, but that meetings, and in particular Scrum retrospectives built up social bonds and increased rapport between students which discouraged dishonesty.

But this did not mean that team members could not be dishonest. One participant pointed out that members could still "cheat a bit when you're not staring into someone's eyeballs", referring to a task which everyone in the team had to complete and submit, followed by a task which required group members to evaluate and rank the individual submissions:

> "some team members just wait for someone to upload something and then basically copy this, maybe changing the odd detail, and upload it as their own efforts."

Another member confirmed this could happen but:

> "other students got wise and held back their work until literally the very last minute of the deadline before posting it online".

Another pointed out that this may not have been dishonesty but a sign of desperation if someone did not know what to write. Referring to her group:

> "Sometimes we give tasks and not everyone is able to do them on their own. So I had one individual and I was the Scrum master and I would kind of guide them when we were in a meeting and so they would do work, and then I'd say how about doing this research or that research and we would do it together because sometimes students are just lacking skills and they just don't know how to do certain things."

Group members need to be sensitive to students who may not be dishonest but who are having problems understanding work. However, honesty is also required from the student experiencing problems for this to happen, and students are often not prepared to admit that they are struggling.

The focus groups also discussed the topic of honesty and transparency in relation to peer reviews. The fact that a lot of poorly performing students gave themselves the same mark as their peers did not surprise them. As one participant wryly commented, "At the end of the day, students want to pass modules". However, analysis of the peer review marks revealed that none of the poorly performing students allocated themselves marks that were *greater* than their group members' average, indicating a certain self-imposed limit to their dishonesty. The suggestion was made that it was possible that these students believed that they had deserved equal marks, but the focus group members doubted this as product backlog transparency would have provided evidence to the contrary.

One participant suggested that the peer review marks could be made available to all members of the team, as is common in industry, to provide full transparency: the knowledge that others would be able to view their marks would prevent students from over-rating themselves and lead to more honest feedback. However, this was refuted by most participants who thought that this would result in marks being inflated by assessors who would not want to appear mean, thereby producing an inaccurate picture, and that peer review visibility should be maintained at the level of feedback comments rather than marks, to produce the highest levels of honesty from the greatest number of students:

> "You can still give them negative feedback in a friendly sort of way that will make them realise why they won't get the full mark and they will be sort of ok with that but letting them see that you're giving them a proper lower mark can change things in a big way, especially if they know who gave them that mark."

This assertion is backed up by research papers that show that peer review has a better chance of being accurate and trustworthy if it is given anonymously (e.g. Davies, 2002, Li, 2017).

This is an example of one of the dilemmas associated with transparency. As the literature shows, it is commonly assumed that providing full information will result in the highest level of transparency which equates to the greatest good. However, in some cases restricting transparency (in the sense of reducing visibility or withholding certain information) may produce better overall outcomes for most stakeholders.

8.6.1.3 Mutual respect

The focus group was slightly bemused by the suggestion that mutual respect was an attribute of transparency but recognised that it encouraged harmonious relationships and was a pre-condition for promoting honest interactions between group members:

> "Without mutual respect students aren't likely to be honest and transparent. If there is mutual respect you can kind of say something that's negative, if it's true … and it needs to be said, and not worry that someone's going to take it the wrong way"

Students were asked whether they felt that Scrum promoted mutual respect in any way. Again, the answers alluded to the significant role of face-to-face events in developing friendships with other learners which they felt nurtured mutual respect.

8.*6.1.4 Open Communication*

All participants agreed that open communication was necessary for transparency:

> "You can't be hiding things, you have to speak your mind, even if it's going to annoy some people. If you just sit on things then that's going to cause resentment at the end of the day and be worse for everyone."

However, it was also noted that open communication is more difficult for some students than others:

> "We had an Indian student whose English wasn't that good and he stayed quiet for most of the project and just sort of agreed with everything. You've probably got to be kind of confident to disagree with stuff and make your point and it's made worse if you can't speak the language very well."

This issue was not confined to overseas students but might also be relevant for other less self-assured or socially anxious students. One participant suggested that a focus on face-to-face communications might not be the best strategy for eliciting open communication for these students and that they might be more comfortable with online communication, for example using the blog facility, which was not so immediate and allowed them time to get their thoughts together and make their points in writing. This view is also widely supported in the

literature (e.g. Mather & Sarkans, 2018). The assignment was set up such that there was no way to avoid face-to-face meetings, so these students could be considered at a disadvantage. However, it was also pointed out that they had opportunities to use the blog facility on Blackboard to make their points and that they would lose more than they would gain by not attending meetings in the sense of missing out on opportunities for personal interaction and personal growth. It was agreed that team members should look out for such students and be sensitive to their requirements.

8.6.1.5 Visibility

In discussions regarding visibility, students suggested that the term was synonymous with transparency and that "the Scrum assignment was transparent because things were visible". To unpick this, the researcher asked participants to give examples of what had been visible and therefore transparent, and whether there had been anything that had not been visible, thereby restricting transparency. The 'visible' list was centred around the backlog (tasks that needed to be done; tasks that had already been done; dates when tasks were due and completed and by whom), meeting minutes (who was there; what was done) and meetings (visible teammates).

The 'less visible': what people are doing 'behind the scenes'; absent students; "people's faces on Collaborate".

One participant recounted an incident in his group of a task that had been completed not being visible, which had caused some tension within the team:

> "xxx already completed his bit of the work he'd been assigned and he posted it as a blog post …which nobody noticed as we didn't really bother with the blog, so xxx (*the Scrum master*) gave him grief … cos he kept saying he'd uploaded it but xxx couldn't see anything on Blackboard and was almost accusing him of lying."

Although this issue was quickly resolved after the missing work had been located, it does highlight the importance of awareness and although no direct questions were asked about awareness in the focus group meetings, a number of findings emerged from the focus group data related to awareness or problems that occurred either as causes or consequences of lacking awareness.

8.6.2 Transparency features in Scrum

The questionnaire results revealed that there was very strong support for the view that Scrum provided transparency. But the researcher was keen to elicit views on the elements of Scrum that students thought were responsible for this transparency, and whether some of these transparencies are simply a natural by-product of students working closely together to carry out a group project and would happen anyway, irrespective of what method was being used to manage the groupwork. Students were probed on what specifically could be attributed to using Scrum.

Backlogs

The product backlog was considered by the focus group to be "very significant" for transparency, confirming the results from the questionnaire.

Focus group participants confirmed that they were generally able to ascertain the status of the project by looking at the latest backlog and could easily identify who had completed which tasks and which were left to do, as summarised by one:

> "The backlog – it's so organised so everyone knows exactly what they are doing so no one can say they don't know what they are doing… everyone needs to take accountability for what they've been designated, they can't say 'oh I can't remember' or, you know, 'I forgot to do that bit there'. It's there, it's all written down."

The backlog also gave a transparent view of effort expended by individual students, as voiced by a participant:

> "Also having the product backlog, if you do it every single week you can see who's done the most work by just looking at it – everyone is assigned which task, you can see everything."

The principle of 'self-organising teams' meant that group members were able to opt to do tasks that they were most suited for and could therefore share their skills effectively.

However, two participants did voice some concerns, firstly, with students not uploading work on time in line with what was stated in the backlog. They referred to incidents where a team member had updated the product backlog to show that his task had been completed and the output uploaded to the file exchange area by the deadline date, when in fact it had not and was posted later. This issue was also raised in the Semi-Scrum study as a result of which

students had been warned about it in their introductory lecture on Scrum procedures, but it seems that some groups had not taken this on board. There was general agreement that this should not be allowed to happen, and in fact could not happen if product backlog updates were only made by the Scrum master (unless the Scrum master was the errant team member).

Another participant stated that in his group there had been some confusion over who was updating the backlog and how often. This highlighted that clearer advice and instructions should be given on the 'who, how and when' of backlog updates. The student explained that in his team individual group members agreed to update the latest version of the backlog with their task completion dates as and when they completed their tasks. In practice this meant downloading the current version of the backlog, making the required changes, and then replacing the old version with the updated version to the file exchange area. This could result in a proliferation of backlog versions, with the added danger of concurrent updates made by different members being missed, thereby making the latest version inaccurate and "not that transparent". The aim was to show the backlog in 'real time', but it ended up being time consuming and confusing. Others suggested that this was not necessary, and the confusion could be avoided by just having the Scrum master make the update at the end of every week or end of every Scrum meeting, and to post one updated version incorporating everyone's uploads.

There were also different opinions on whether rotating the scrum master role was a good or bad idea. In industry this Scrum role is not rotated, but the idea to rotate it was suggested by tutors as a way of giving all members some experience of acting as Scrum master. A participant noted that:

> "chopping and changing does not allow for continuity and adds confusion to the process."

However, another student whose group had rotated the role disagreed saying that it hadn't caused any confusion, worked perfectly well and was transparent to all. In addition, it had "given everyone a chance at being boss". Other participants had simply stuck with the same Scrum master throughout and considered this to be the most successful method. Research into the effectiveness of the Scrum master role in industry suggests that there is not much

difference in perceptions regarding the advantages and disadvantages of rotating versus non-rotating Scrum masters (Bolloju, Chawla & Ranjan, 2018).

The conclusion reached from data elicited from participants was that the backlog worked well in providing high levels of task visibility and was an effective vehicle for delivering many of the categories of awareness that had been noted in the literature review.

Meetings

The focus group also confirmed that Scrum meetings were responsible for providing transparency in Scrum, firstly by virtue of being face to face and secondly because they were compulsory (in the sense that there was a timetabled session for the group work where student attendance was monitored) and therefore provided the highest level of visibility - "because everyone turns up". Students also confirmed that because they all had a specific aim or were focused on specific tasks,

> "they were not just time wasting exercises, as most group meetings tend to be"

but where the real work of problem solving and coordination of the project took place. One participant commented:

> "Well that's about the only time people did any work to be honest. They were forced to be there, some people, which is good. It's the same if you work in a job – you don't have the option of not turning up."

And another,

> "The problem with group meeting sometimes is that unless you've got some kind of clear agenda (which most of the time you don't) you sort of sit there staring at each other and end up spending a lot of time chatting about everything except the assignment and not really getting anything done. I think with the Scrum meetings you knew exactly what needed to be done because you've got the tasks in the backlog to go over or you've got to do a retrospective … and the whole thing about Scrum is not to spend hours on meetings but to keep them short and focused. I think my group achieved that."

There was unanimous agreement that providing a timetabled session every week for the meetings helped with attendance:

> "We met every week, every Thursday. Sometimes twice a week, but always in the seminar session as everyone was there. Really useful."

and

> "The good thing was that because the meeting could be conducted in the uni and everyone was in at that time so they literally just all went together to the library. If it was a different day I'm not sure that they would attend to be honest ..yeah, they definitely wouldn't."

These comments clearly indicate that to encourage Scrum processes to be followed correctly, timetabled sessions need to be allocated to group work meetings, rather than expecting groups to meet whenever they can. This is particularly relevant where groups are made up of students from different courses having different timetables.

However, as well as getting work done, regular meetings were a good opportunity to develop social cohesion between group members, which ultimately strengthens group members' desires to help one another and to contribute equally to group tasks (O'Donnell & O'Kelly, 1994). One participant stated:

> "I didn't know anyone in my group when I stared but we became great friends by the end of the assignment and we all had a common purpose to do a good job. I'd definitely like to work with this group in future."

This also featured in many of the peer assessment forms, with repeated comments along the lines of "I didn't know xxx before, but I would like to work with him/her again".

Students were probed on the usefulness of online meetings. This met with derision from participants who stated frankly that they do not work, as their previous year's Covid experience had shown. Of online Scrum meetings, one student stated:

> "Nobody's going to turn up. We did Teams meetings and there was literally two of us who turned up every time, nobody else attended."

Others commented on their lack of transparency, in that a lot of students hid behind icons when joining on-line meetings rather than revealing their faces by enabling the camera. Sometimes they were not even sure who was talking. Online meetings were considered a useful last resort if people could not make it into university, but as only two groups used them in the Scrum study, there seemed to be no great need for this last resort measure.

It was also significant that no mention had been made of using online meetings in any of the open questions in the survey, even though many students had extensive experience of conducting meetings online during Covid, and online education is a growing trend in HE (Allen & Seeman, 2014).

8.6.3 Process Issues

The survey confirmed high levels of process satisfaction, with 82% of respondents stating they would be happy to use Scrum for future assignments. The questionnaire contained an open question asking students for any further comments on or improvements that could be made to the Scrum process. This question was also posed to the focus groups and raised a number of issues as well as comments which touched on some of the themes noted previously.

Defining a completed Backlog task

Some issues were raised by participants regarding confirmation of tasks on the product backlogs. The first related to an incident of work being uploaded to blackboard on time, consistent with backlog entries, but being of dubious worth. The perpetrator was within his/her rights to insist that the task had been submitted on time and that the backlog should be updated accordingly.

A discussion ensued on whether this was due to deliberate laziness on the part of a student or the result of someone with academic problems or a misunderstanding of the issues. Students concluded that the decision on how to deal with this depended on which situation applied but either way this could be addressed in the next Scrum meeting: if laziness, some 'open communication' should be undertaken with the perpetrator and if it persisted then the peer assessment mark would reflect this; if the poor submission was due to problems in understanding the task, then this would need help from the team, or redirection to a tutor for help.

Another student noted that:

> "I think some of the tasks could have been defined a bit better and not left so vague and in some cases it made tasks open to abuse. Like, 'coming up with an idea' resulted in a page of explanation and lots of good references from xxx and literally about two lines from another student."

More generally, there was a discussion as to whether there should be a means of assessing that a task posting met some minimal requirement for it to be marked as 'completed' on the backlog. This is the equivalent of the concept of 'Definition of Done' (DoD) in software development using Scrum, where a task in the product backlog is generally in the form of a 'user story' specifying a functionality or increment of software that needs to be developed and including acceptance criteria to establish that the functionality has been delivered. The

DoD represents a shared understanding within the Scrum team on what it takes to make an increment releasable (Silva et al, 2017). A number of issues were raised about the practical implications of doing this:

> "it's a bit difficult to come up with what done or completed properly should be with tasks at the beginning when you're just doing research and not sure yourself what you'll be coming up with, if you see what I mean"

and

> "where would you put what needs to be done for the task to be completed correctly? We just put the name of the tasks in the task column on the backlog or just a brief description after we agree it in the Sprint meeting and everyone kind of knows what they need to do… you couldn't put all definition of done stuff in that column so you'd need to have a separate document for every task instead which is sort of making more work for everyone"

Students acknowledged the wisdom of having some definition of minimum requirements for a task but also the difficulties of coming up with a DoD for more 'fuzzy', creative tasks, with suggestions of setting a minimum word count or other concrete measures.

However, the consensus reached was that consistently poor work was not a common problem as most students were conscious that, once posted, their efforts would be judged by others and therefore produced solid work to the best of their ability.

> "We're all human and from time to time you get in a situation where you end up rushing and producing something you're not particularly proud of .. nobody's perfect. But I don't think anyone goes out deliberately to produce something that's rubbish. So best thing is to have a quick word – Oi mate, wasn't your best but no problem.. I'm sure the next one will be great .. let us know if you need help .. and so on, and encouragement ..That's going to be a better approach than humiliating them for rubbish output."

Group tasks and task accountability

A possible problem was raised regarding the same task being assigned to all members, for example brainstorming ideas, which sometimes resulted in members copying completed tasks that had already been uploaded by other group members and claiming them as their own, as previously noted:

> "One of our first tasks was coming up with two ideas for a viable product. This was given out to all team members for completion and uploading by a certain time, but this is open to abuse as one person, he just waited until just before the deadline and posted ideas that have already been submitted by other members… It's better if tasks are not duplicated."

One of the group members suggested getting around this issue by giving group members the task of identifying two viable ideas, but with each member required to pick examples from a different business domain, producing a unique task for each member, as illustrated in Figure 26(b). It was suggested that, where feasible, this should be the standard approach.

Backlog	Sprint 1			
Task No.	Description	Allocated to team member	Due Date	Date posted to Exchange/Blog
1a	Read through scenario 1 and 2. Think of 1 suggestion for either scenario. Write a short pitch for your suggestion and post on the file exchange.	cl	25/10/2021	
1b	Same as above	ha	25/10/2021	
1c	Same as above	ca	25/10/2021	
1d	Same as above	am	25/10/2021	
1e	Same as above	ra	25/10/2021	
1f	Same as above	ka	25/10/2021	

Sprint 1				
Task No.	Description	Allocated to team member	Due Date	Date posted to Exchange/Blog
1a	Establish ground rules for assignment	all	21/10/2021	
2a	Research hybrid approach in leisure	ap	as above	
2b	research hybrid approach in healthcare	mp	as above	
2c	research hybrid approach in education	oo	as above	
2d	research hybrid approach in finance	al	as above	
2e	research hybrid approach in gov't	ra	as above	

Figure 26: Backlogs a) and b) showing two ways of allotting the same task to team members

Administration of the product backlog

The questionnaire provided a few comments from students relating to the administration of the product backlog, suggesting it could be confusing:

> "It's a better way of managing all of the team members. Sometimes the backlog did get a little confusing at times."

Another suggested that, useful though it was, it was subject to a temporary gap in transparency:

> "no progress on individual tasks is shown - which means we didn't know how much of the task is completed by individuals until the backlog was updated."

This was an issue that was raised previously and responding to this, the focus group agreed that meetings allowed for the progress of individuals to be checked and as meetings were held weekly, the amount of time that team members might be 'in the dark' about what their team members were up to was short, providing that team members turned up to meetings.

Among all the positive comments on the efficacy of the backlog in the survey free comments, there was one which demonstrated a clear misunderstanding of the whole process, from a student whose suggestion was to "add a to-do list" which crudely is what a Backlog is supposed to represent! This highlights the need to ensure all students receive a thorough introduction to Scrum prior to starting a project.

There was also a discussion on the suggestion that some confusion might be caused by student groups having too much choice in for example, organising Scrum roles, with one participant stating that:

> "the tutor is the one who knows best and should state what the most effective method is,"

rather than leave students to experiment with rotating/not rotating roles, who was updating/not updating the backlog, and so on.

However, this view was countered by another member who pointed out that her team had rotated the role of Scrum master, and this had worked well and "given everyone a chance at being boss".

Better preparation for Scrum

A few comments from the questionnaire focused on students needing better preparation for Scrum. This was quite surprising as the researcher felt that students had been adequately prepared at the start of the project due to measures that had been put in place following similar concerns made in the Semi-Scrum study.

One comment was "more examples of Scrum" and this was echoed by the focus group who suggested there could be more examples of Sprint Backlogs from previous assignments that students could look at to familiarise themselves with the whole process and particularly the way that generic, ill focused tasks could be broken down into more structured, manageable tasks for the backlog. Unfortunately, there were no examples of backlogs from previous assignments of the type being undertaken in the study as it was the first time the assignment was being run using Scrum.

Meetings and making meetings compulsory

A number of comments and suggestions were made in the survey about meetings, most confirming their central role in the Scrum process, as indicated by the following sample:

> "more meetings please"

> "we could have met up a little more to ensure that everyone was more up to date with what was going on with each task"

> "longer meetings"

> "attend the meetings on time"
>
> "timed meetings (not too long, not too short)"
>
> "more time allocated to the group work meetings in class as this would help with groups whose members did not prepare any work outside of class"
>
> "no recorded meetings as nobody likes being recorded"

A discussion of some of these points among the focus group participants confirmed what has already been noted, namely that meetings were central to getting work done, knowing what was going on in the group, both from the point of view of reviewing the progress of the current Sprint and setting tasks for the next Sprint, and for reflecting on processes. In short, meetings were essential for maintaining high levels of visibility, awareness and ultimately transparency.

Because of this there was support for mandatory attendance to be enforced through the assignment marking scheme. One suggestion was that:

> "..tutors should deduct a couple of marks automatically for anyone who doesn't turn up to a meeting. That could be done through SAM (*the student attendance monitoring system*)"

though not everyone agreed that it should be done automatically:

> "That would be unfair where someone couldn't genuinely make it, like our group had someone who was away abroad for three weeks because he was a late enroller. In the end everyone agreed that he should get the same marks as everyone else because he worked hard to make up for his late start."

The discussions concluded that there was no fool-proof method of using SAM or tutors to automatically apply sanctions on group members who missed meetings and the best approach available was to allow group members full autonomy in assigning marks through the peer assessment exercise, based on all the available evidence, including a member's attendance at meetings, and true to the Scrum philosophy of self-directed groups.

Keeping records of meetings

The focus group discussions acknowledged that minutes of meetings showing, as a minimum, attendance and brief points on what business was conducted, was needed as a means of encouraging students to turn up and to avoid being listed as absent, with the repercussions that this might have on final grades. There was also agreement that Sprint retrospectives

were beneficial in identifying good practice and behaviours that needed to be changed. Some groups had taken this very seriously and "had fun sticking post-it notes all over the windows", following the method recommended by the tutor. If conducted properly, this has positive benefits for social presence and group cohesion. However, only two groups had documented the outcomes from their Sprint retrospectives, others just confirming in the minutes that they had carried out a Retrospective meeting.

The focus group was unanimous that meetings should be physical, face-to-face meetings, rather than conducted online. They also agreed that nobody liked to be recorded, although one participant suggested that if some record needed to be kept of an online meeting, then automatically recording the whole meeting might be the easiest option. Group 1 who recorded all their online meetings (confirming that no more than three members attended for most of the sessions), also posted minutes of their physical meetings to their Blackboard exchange area. Group 14, the only other group to record all their online meetings did not.

It was difficult to ascertain the average length of meetings as meeting duration was not noted in meeting minutes and could only be obtained from the recorded meetings. The Scrum Guide's guidance on Scrum meetings is that the total length of the Scrum meeting should approximate to the number of weeks the Sprint is about to last multiplied by two hours, in which case the duration of each group's meetings should have been approximately 2 hrs per week. However, this is not a strict rule as the more experienced the team becomes, the faster they are able to complete the work required and this appeared to be the case with Group 1 who recorded their online meetings and demonstrated that the length of their meetings decreased as the assignment progressed: meeting 1 lasted 1hr 20 minutes, followed by meetings of 1hr 30 minutes, 1hr 07 minutes, 38 minutes, and 42 minutes). This pattern was not exhibited in the only other group to have recorded online meetings (Group 14), where the duration of meetings was fairly uniform, ranging from 43 to 51 minutes.

The focus group confirmed that, with a few exceptions, meetings were undertaken in the one-hour session that was timetabled for the group assignment, but additional meetings were also held outside of these times and a record kept of each.

Effort made by team members

There were a few comments from the survey suggesting that the assignment could be improved with more (equal) effort being exerted by individuals. This is a theme which is regularly voiced by students carrying out collaborative projects, irrespective of the project management process used:

> "more team engagement rather than I do all the work in the team. Team could perform better if the other team members could participate more."
>
> "in future I want every group member to be active. For every task to be done on time."
>
> "in future we have to have better time management and have to complete on time"
>
> "coordination and punctuality please!"
>
> "more team members engaging"

However, the focus group did not feel that the overall picture was at all negative and with a few exceptions, most had experienced high levels of cooperation and effort from team members. Although there were instances of students not performing, they did not consider social loafers to be a common problem because tasks were transparent and Scrum events contributed to keeping members engaged and responsible for the overall project results.

On differences in effort, one participant noted that,

> "there weren't really students who contributed less in our group, there were only students who contributed more"

A number of students also commented that they were surprised at what their teams had produced through good team cooperation and could not have imagined coming up with such professional presentations on their own.

Reassuringly (and surprisingly), nobody from the focus groups and only one questionnaire respondent raised the common grievance from students doing collaborative projects of wanting to pick their own group.

Other comments relating to improvements were suggestions for improving specific assignment outputs, for example:

> "We didn't practice for the pitch presentation and this let us down. Next time I strongly believe that I have to focus more on the pitch presentation. This should have been a task in the backlog."

> "The presentation needed animation to engage with the audience, video pitch needs background music. Nobody knew how to do that."
>
> "..should practice presentation skills such as speaking and body language during presentations."

Identifying and estimating tasks for an 'unstructured' project

The focus group was probed on their views on Scrum as a suitable project management system for a creative project, rather than what it was designed for (IS/software development). For example, how easy did they find identifying tasks for the product and Sprint backlogs for what was essentially a presentation of a design of a prototype to address a given problem. Students confirmed that at the start they needed some help from the tutor, not only in identifying tasks, but also in defining them at an appropriate level for completion by within the Sprint period:

> "Initially when we were brainstorming we came up with three tasks for the backlog – 'everyone puts forward their ideas', 'everyone votes on the best one', and 'everyone implements the winning idea'. Not all that useful. As we weren't sure what the winning idea would be we weren't sure what further tasks would be needed. But we started off by setting a first task for everyone in the group to do - just research and come up with two possible ideas and give a brief description of them in the first Sprint then gradually you know learned to decompose broad tasks into smaller ones and to allocate them to individual members with a bit of help from xxx (*tutor)*."

Deciding how long each task should take was also difficult as students had not had any experience of this. A common view in Scrum is that correctly estimating effort for tasks plays an important role in the success of projects, and many tools and strategies have been developed along the years to improve the forecasts (eg Munialo & Muketha, 2016; Mahnic & Hovelja, 2012), broadly divided into those using an empirical approach based on the personal judgement of the team members, and more systematic approaches based on statistical and mathematical methods, even including machine learning techniques (Abadeer & Sabetzadeh, 2021). In some respects, the situation that teams found themselves in was no different to that of 'fresh' Scrum practitioners with no previous projects to base their estimates on, so estimates were guided by empiricism, i.e., a best guess at what could be done in a week (the usual length of a Sprint) and adapting estimates as teams learned more and gained more experience. One participant described the process her team used as "just trial and error.. just assuming the tasks would be done" and there were no reports of using well tried techniques such as planning poker for estimating tasks. Students again emphasised that in future it

would be useful if good examples of previous groups' backlogs were available to give an idea of how to structure and estimate tasks.

8.6.4 Transaction cost of using Scrum

This theme examined students' views on the overheads incurred in running the project using Scrum, how complicated they thought following the Scrum process was and whether they felt extra effort was required over what they would normally use in running a collaborative project.

There was acknowledgement by participants who had been involved in other collaborative projects that Sprint planning and maintaining the product backlog was an additional overhead but that it was not significant and was outweighed by more efficient team working. Students confirmed that Scrum provides many useful features that are effective for groups undertaking collaborative projects, such as visual representation of the different tasks that need to be undertaken by the team, regular monitoring of the work through the daily stand up and other meetings, and fair distribution of prioritised tasks that ensure that the work is carried out efficiently. There was also a view expressed that the meetings, particular retrospectives which focused on what could be improved in the next Sprint, helped to avoid many conflicting situations which might slow the project down.

8.6.5 Support for Scrum transparency

The next theme examined the kind of support and applications that group members preferred to use for collaboration, eliciting their views on the most effective measures for increasing transparency.

Groups were provided with Blackboard 'group' facilities, with each group having access to their own file exchange area, blog, email, discussion board and Collaborate online conferencing system which included two-way audio, video, interactive whiteboard, application and desktop sharing and session recording. As with the Semi-Scrum assignment, the assignment specification instructed students to use only Blackboard facilities for group interactions and posting work to increase transparency but again it was clear from participants that few groups followed this advice, with most setting up a WhatsApp chat for communication, discussion, exchange and even storage of documents. Other applications used by participants included Microsoft Teams and Zoom.

Nevertheless, questionnaire responses indicted a very high agreement (mean = 6.92) with the statement that "Overall, I was happy with the tools provided on Blackboard to support the Scrum process". Findings show that Blackboard was used by all students as a minimum to upload completed tasks and updated Sprint backlogs (as evidenced in Table 8.4) but other group facilities such as discussion boards, blogs and collaborate were not used at all or at best used intermittently by one or two group members, which caused some lack of awareness issues, as described in section 8.6.1.5.

The focus group participants suggested two main reasons for this: firstly that although Blackboard was not the best system to use for group collaboration, all students knew how to use it as they accessed it regularly in the course of their studies, and it was adequate for the basics of uploading weekly updates to the file exchange area to support the Scrum process although they did not rate it highly for its user-friendliness. However:

> "the discussion board was a non-starter for us with all its threads and things and the blog was not interactive enough, like WhatsApp."

The second reason was that most students did not want all their messages and interactions to be available for viewing by tutors:

> "you're kind of .. always guarded like, if you know the tutors have access to what you're writing, so you're gonna leave things out or change things a bit for their benefit"

Another student noted that:

> "it would be more stressful knowing that they (*tutors*) were watching your every move."

This suggests a desire for limits to transparency, although this view was not held by everyone. One participant was adamant that all interactions should be made available for tutors to inspect, otherwise there was no transparency, insisting that even WhatsApp messages should be uploaded to Blackboard. In his case he was keen for all the conversations to be made available to show that one member had been rude and domineering throughout the later stages of the project and for this to then be reflected in the peer assessment.

The questionnaire confirmed that the suggestion to include the tutor as a member of the group was the least desirable of all the options provided for supporting transparency, and the focus group participants agreed with this. Though acknowledging that it might be useful to

have an academic 'on tap' to provide feedback and to encourage student engagement and good manners, there was concern that this would create a 'big brother' issue, raise stress levels among students and stifle creativity rather than improve transparency.

30% of questionnaire respondents ranked 'using a single platform for correspondence' as their first choice for increasing transparency. The focus group concurred that transparency would be improved by having all conversations and group outputs in one place. Certainly, this would remove the problems of lack of awareness resulting from work being posted elsewhere without the knowledge of other team members.

The questionnaire results indicated that the strongest support for transparency was through face-to-face contact, and this was again confirmed by focus group participants. Studies have shown that face to face interaction promotes honesty (Van Zant & Kray, 2014) because it provides opportunities for conversations which increase the rate of social information transmissions and allow members to build rapport and develop mutual respect and these were themes that were picked up by the participants. One participant also noted that it also accommodates those students who do not want to divulge emails or phone numbers to their group.

The next popular measure, also confirmed by participants, was the product backlog, the advantages and disadvantages of which had been widely discussed.

The conclusion reached from these findings is that support for transparency in Scrum should be directed towards ensuring that students have ample opportunities for face-to-face communication for the duration of a Scrum assignment and that systems are in place facilitate the easy maintenance and update of product and Sprint backlogs.

However, participants also made the point that although there was an emphasis on face-to-face communications, there should be better online support to facilitate collaboration outside of on-campus hours as Blackboard was not ideal, nor was WhatsApp, which some students didn't want to use for privacy reasons:

> "In my team the Scrum master set up a WhatsApp group and was forcing students to use it but I personally didn't want to as I want to keep my mobile number private. Not that I've got anything against my group members, it's just a personal thing. But I think he saw it as a snub."

8.6.6 Negatives of transparency

The final theme to be identified concerned limitations and negatives of transparency, such as whether there could be too much transparency in a collaborative project, or if there were any negative consequences of transparency.

Participants agreed that transparency was necessary but there were situations where it could impact negatively on certain types of individuals, or even the whole group. One participant explained that:

> "Personally I don't think there are any downsides to transparency as long as everyone takes criticism well. But some might not respond well to negative criticism and might lose motivation to work further on the project. Not having their input can impact on good results for the whole group."

Another commented that the team dynamics can change very radically from positive to negative because of an off the cuff comment:

> "if it's in real time you can easily say something negative without thinking, with no sugar-coating, which causes sudden bad feeling and alienation"

There should also be certain boundaries to transparency when it concerns people's privacy:

> "People might have issues that affect their work for one or two weeks and they might not want to share those details with the group, so there should be a cut off and common courtesy applied."

It was suggested that transparency can provide pressure on group members to show that they are contributing regularly, which might even encourage dishonesty or dubious behaviour, such as students trying to show that they are doing more than they are doing or taking short cuts such as stealing ideas or copying work to have something to show to their team members. A participant suggested that too much transparency benefited lazy students as it allowed them to look at work that others had done to help them with their own and therefore to produce something with less effort. However, others stated that in the long run it was more likely to disadvantage lazy and non-performing students as their lack of effort would be more visible to all.

It was suggested that transparency could be seen as a negative if measures to achieve transparency were outweighed by the costs of obtaining it:

> "If you've got complicated systems for getting everyone to make their work visible .. there are rules for doing this and that at certain times or for posting x or y every day

you might have transparency but end up spending more time doing all this admin and less time for proper work."

8.7 Conclusion

This chapter described the aims and outcomes of a study investigating the extent to which attributes of transparency uncovered in the Laddering study were perceived to be present in a student group project managed using Scrum. In addition, the study examined the levels of student satisfaction with the processes used and outcomes gained from using Scrum and identified best practices and areas for future enhancement.

The research questions set were:

RQ1: Would using Scrum lead to high levels of open communication, identified by students as an attribute of transparency?

RQ2: Would using Scrum lead to high levels of visibility, identified by students as an attribute of transparency?

RQ3: Would using Scrum lead to high levels of honesty, identified by students as an attribute of transparency?

RQ4: Would using Scrum lead to high levels of accountability, identified by students as an attribute of transparency?

RQ5: Would using Scrum lead to high levels of mutual respect, identified by students as an attribute of transparency?

RQ6: What levels of process satisfaction result from using Scrum for a groupwork assignment? Given a choice, would students prefer to use Scrum or other methods of project management in future groupwork?

RQ7: What levels of solution satisfaction arise from using Scrum for a groupwork assignment?

The research questions were answered using data from a student questionnaire and focus groups. Overall findings are that using Scrum did lead to high levels of open communications, visibility, honesty, accountability, and mutual respect. Students indicated high levels of satisfaction with the outcomes and with the processes used, but also identified problems and areas for improvement. These findings will be further discussed in the next chapter, in the context of the overall research questions set for the thesis.

CHAPTER 9: OVERALL RESEARCH FINDINGS AND DISCUSSION

9.1 Introduction

The term 'transparency' provided the initial spark for this thesis, after a review of the literature showed transparency in the context of CL to be an under-researched topic. Since the term was not clearly defined in the context of collaborative learning, a broader review of the literature covering the concept of transparency in other domains was undertaken to gain insights into its nature. From there an attempt was made to establish how these insights might relate to collaborative learning. The various conceptualisations of transparency and their relevance to collaborative learning obtained from this study represent an understanding of transparency from an academic point of view.

A second viewpoint, that of the student perception of transparency, was obtained through a novel investigation using end-means analysis which attempted to establish what attributes students associated with transparency, what they saw as its benefits, and what higher order values they linked to transparency. At the same time, an enabler of transparency was identified in the form of Scrum, a process with strong transparency credentials used widely in software development projects and credited with improving success rates of information systems development in recent years.

This discussion begins by re-visiting the three empirical studies forming the backbone of the thesis and using their combined findings together with insights from the literature review to address the research questions posed at the start of the thesis.

9.2 An integral understanding of findings

The primary research question explored in this thesis is whether the outcomes of collaborative learning in Higher Education could be improved through transparency, and whether Scrum could be utilized to promote transparency and improve outcomes in this context. This was addressed through a review of existing literature and three empirical studies.

The Laddering study aimed to obtain a student-centric view of transparency, by unpicking what students meant by transparency in group work and why it was important to them. The literature review on transparency alludes to the fact that transparency needs to be

considered in a situational context. The Laddering study was designed to address this by conceptualising transparency as a commodity which students make use of in groupwork and attempting to extract salient attributes of this commodity in this context by using means-end analysis, a method that has its roots in market research. Means-end analysis has been widely applied to topics in the realm of education, though not CL, and this suggested that it might be a novel and fruitful line of enquiry for uncovering the meaning of transparency from a student perspective.

The Semi-Scrum investigation was designed to explore the ability to deliver transparency in CL through Scrum. The study was introduced halfway through a collaborative project which falls within the traditional realm of Scrum, namely software/systems development, to assess how and to what extent transparency was supported and what difference using Scrum made to learning processes and outcomes. The study also revealed that, while the main artifacts of the Scrum approach had been faithfully employed, the process could only be considered Semi-Scrum as some of the ceremonies had not been adhered to, meaning there were significant gaps in the implementation of Scrum. Notwithstanding this constraint, the findings revealed that Scrum did deliver transparency for students and had some positive effects on outcomes. However, some limitations of the study were noted, the first being that students had already been working in their groups for six weeks prior to starting the Scrum assignment, so should have entered the conflict-free and productive stage of teamworking, which could have impacted positively on group working processes and outcomes. Secondly, the task undertaken in the A2 study was a software development project, which may have had a positive impact on the results, as Scrum is designed to support such projects, however, they are not representative of most CL projects undertaken in HE.

The results of the Semi-Scrum and Laddering studies fed into the final empirical study. An objective of this study was to improve upon the Scrum credentials of first study by ensuring that the Scrum methodology was followed in its entirety. In addition, a decision was made to base the study on a type of project that was non-existent or at best vastly under-represented in the Scrum literature, namely a creative, ill-structured project, rather than one related to the more structured domain of software development for which Scrum was originally designed. This decision was made to test the universality of Scrum, as a process for managing HE collaborative projects of any type.

The overall aim of the third study was to obtain students' views on the degree to which the transparency attributes uncovered in the Laddering study were manifested using Scrum, as well as assessing what effect this transparency had on overall outcomes and evaluating the strengths and weaknesses of Scrum in this context.

The results of these three studies will be discussed in the context of the research question set out in Chapter 1:

> Can the outcomes of collaborative learning in Higher Education be improved through transparency, and can transparency be delivered using Scrum in order to improve outcomes in this context?

9.3 Research Context

The three studies were designed to focus on different elements of the overall research questions yet be similar in research context and settings. These consistencies in research setting can be summarised in terms of the learning environment, the facilities used to support groupwork processes and the type of students who participated in the studies.

Firstly, it was intended that all learners be participants of authentic learning environments. All studies were conducted with undergraduates in HE courses. Students enrolled on these courses had as their main aim to graduate with a good degree and the assignments they undertook as part of the studies contributed to that overall outcome. Such authentic learning settings are ideal research environments for collecting empirical data as they increase external validity (Steckler and McLeroy, 2008) and reduce the pressure of participants to respond to the researcher's expectations.

The task undertaken by students in an empirical study is a crucial component in research. It can be divided into two basic categories, simple tasks which are well-structured and have a single solution, versus complex tasks that have ill-structured problems and may have multiple solutions. Collaboration is important for the latter as it promotes positive interdependence among learners, generates cognitive conflict and resolution and motivates learners to participate (Scager et al, 2016). Kirschner et al (2009) suggest that the suitability of a task for collaborative learning should consider other dimensions in addition to well-structured/ill-structured, among them constructed versus authentic, and divergent versus convergent. Authentic tasks should be "complex, ill-structured, and based on real-life scenarios and

instances, resulting in a published product" (Herrington et al, 2006). A alternative view is provided in Kopp et al (2012): rather than attempting to characterise the type of projects suited to a collaborative learning approach, the authors identify the main activities that that a collaborative project needs to support, namely 1) cognitive activities that allow for knowledge exchange, argumentation and problem solving, 2) social activities, including interpersonal interaction, and 3) metacognitive activities such as organising and regulating collaborative learning.

The tasks for the Semi-Scrum and Scrum studies comply with the above requirements: both can be considered authentic tasks, being ill-structured, challenging, based on real-life case studies and providing scope for divergent thinking and for building shared ownership with students. The 'published products' were the designs and codes for a small database in the case of the Semi-Scrum study, and a promotional video and presentation for the Scrum study. Both supported cognitive, social and metacognitive activities, requiring close interaction between team members to develop a satisfactory solution, and were thus suitable for research into collaborative learning.

9.4 Overall Findings – Research Questions

Each study had its own set of research questions which contributed to answering the primary research question: Can the outcomes of collaborative learning in Higher Education be improved through transparency, and can Scrum be utilized to promote transparency and improve outcomes in this context?

This section provides an assessment of each of the focused questions relating to the primary research question, and the evidence used to answer them.

9.4.1 RQ1: What is meant by transparency in the context of collaborative learning, and what are its benefits? What do students mean by transparency in this context?

An initial literature review, while uncovering some publications linking collaborative learning with transparency, provided very little by way of definitions of the term. In the context of transparency in education, one suggestion was that "It means being open, frank or candid" (Baltzersen, 2010, p792) while in the context of cooperative education, Dalsgaard and Paulsen (2009) defined it as students and teachers having insight into each other's activities and resources. In view of the dearth of definitions it was felt necessary to first examine

conceptualisations and definitions of transparency in other domains to get a clearer understanding of the concept, and then to attempt to apply those findings to the area of collaborative learning. This showed that transparency is more complex and nuanced than suggested by the two definitions provided. Transparency is generally concerned with information disclosure (Berglund, 2014) and the assumption is that full information disclosure will provide insight which in turn creates accountability and better conduct (Christensen & Cheney, 2015). However, Schnackenberg & Tomlinson (2016) point out that disclosure is just one dimension of transparency. To this must be added clarity and accuracy, with each being a critical factor explaining the character of transparency.

A number of different viewpoints of transparency can be identified, held by optimists, pessimists, and sceptics. Optimists consider transparency as something positive, stimulating a culture of openness and holding individuals and organisations to account; pessimists on the other hand claim that transparency is overrated and causes as many problems as positive outcomes through information overload (Bamberger & Belogolovski, 2017), while sceptics claim that transparency has no effect and its importance is overstated (Grimmelikhuijsen, 2012). In collaborative learning research, optimists prevail: notwithstanding the lack of concrete definitions of transparency, the literature appears to show an almost unanimous view of transparency as a force for good, serving as a key coordination mechanism and an enabler of collaboration, and producing an improvement in teamwork competence (Sein-Echaluce et al, 2021).

The pessimist's viewpoint is nonetheless recognised in the phenomenon of the 'transparency paradox' (Stohl, Stohl & Leonardi, 2016) which shows that providing excessive information (with the aim of improving transparency) can be counterproductive for transparency, overwhelming and preventing stakeholders from discerning the relevant from the less relevant, and in effect leading to an overall reduction in transparency. This has led to some conceptualising transparency as a form of 'visibility management' (Flyverbom, 2016), requiring efforts to make only appropriate information visible for interested parties. This customised approach can lead to information being filtered or presented to different stakeholders at different levels of analysis or emphasis, leading to transparency being viewed by some as 'a perception of received information' (Schnackenberg & Tomlinson, 2016). The

danger of this approach is in the potential for intentional or unintentional distortion or bias by the party doing the information filtering or processing (Garsten & De Montoya, 2008).

Transparency is acknowledged to be an abstract and complex concept (Srivastava, 2018; Ruffini, 2013; Fisher, 2014) and the term cannot be treated as a unitary construct (DeBoskey & Gillett, 2013). Instead, it is made up of a number of dimensions distinguished by the subjects that one can be transparent about. Therefore, a starting point for investigating transparency in CL was to identify aspects of CL to which transparency could be applied. These were defined as identity transparency, interaction transparency, content transparency and process transparency. Each of these dimensions of transparency were found to have clear benefits, as well as some drawbacks for collaborative learning. Identity transparency can lead to increased accuracy in the information being provided by team members because they are aware that others are watching; similarly, content transparency can result in productivity and quality improvements as individuals are motivated to perform better when they know that their work can be compared to others in the team (Gerber, 2020; Dalsgaard & Paulsen, 2009); increased interaction transparency can make searches for new information more efficient (Guy et al, 2010), while high levels of process transparency can reduce transaction costs of CL by allowing team members to clearly understand and foresee the work processes. However, some of the acknowledged drawbacks of social transparency are stress and evaluation apprehension, change in behaviour, and privacy concerns that can result from the perception by students of being monitored (Thompson et al, 2009), as well as a danger of creativity being stifled as students attempt to conform with what other team members are doing.

The Scrum Study provided anecdotal evidence of both the advantages and disadvantages of transparency. Students were prompted to submit work on time and of a reasonable quality as they could see their names against tasks on the product backlog, but in the early stages of the project, where fresh ideas and creative thinking was required, there were examples of students waiting until the last minute to submit their initial ideas, after they had had an opportunity to view what other team members had produced, and in such cases the suggestions submitted were along the lines of what others had proposed.

Other second order effects of transparency were demonstrated by students in both Scrum studies: comments made in focus groups confirmed that students felt that interactions between team members should be ‘off the record’, hence most groups set up WhatsApp chats

for this purpose. When it was suggested that a tutor might be part of the chat group to provide support, or that the content of chats might be available for tutor scrutiny, this was flatly rejected by most students who said that this would shut off natural interaction and replace it with interaction that students thought the tutor would like to see. This sentiment is supported by other research; for example, a study by Baishya & Maheshware (2020) reported that when tutors were enrolled into student WhatsApp groups, students became inhibited, language became much more formal, and the number of texts fell to less than 10% of that of groups without a tutor.

Investigations into transparency explored the link between the concept of transparency and that of 'visibility': unless appropriate, disclosed information is easily visible, transparency cannot exist; visibility of relevant information is therefore a condition for transparency. However, it is not enough for information to be made visible somewhere; relevant stakeholders need to be aware that it exists and to be directed to that information. Awareness can therefore be seen as a way of operationalizing transparency. One way to think about these terms is to consider the viewpoints of the person of system making the information available versus the person receiving it. In this context, 'visibility' refers to the act of the sender providing information, while 'awareness' refers to the degree to which the recipient is aware of the information that has been made available.

An example of how these factors can play out was provided in the first study: the Sprint backlogs provided students with task visibility by indicating who was doing what, which tasks were complete, and which were outstanding. However, in some groups, team members were unaware that the status of some tasks had changed as other team members updated the backlog randomly between Sprints without notifying the team. In another example, a student had posted the outcome of a task as a blog entry without making others aware of its location, which caused some tension. The implication of these incidents is that for full transparency, processes might be needed to be put in place to improve awareness levels, for example, to provide awareness of task updates as soon as they occur.

The significance of awareness in the context of group work transparency has spawned a myriad of support systems for various types of awareness covering diverse facets of collaboration, all aiming to improve CL by making groups and individuals aware of different aspects of their collaboration.

There is much information that individual stakeholders can be made aware of, but the phenomenon of the transparency paradox shows that too much information can be counterproductive for transparency, overwhelming and preventing stakeholders from seeing the wood from the trees. Although transparency is most associated with complete disclosure of information, in certain situations it may be prudent to be selective with what is released in order for the positive effects of transparency to be achieved and the negative effects of full transparency to be avoided. To maximise transparency therefore, support systems may be needed to provide visibility and awareness of the right quantity of relevant information needed by stakeholders for a specific purpose.

This may partly explain why students considered the Sprint backlog to be a popular support for transparency. It is a stripped-down statement of tasks, completion dates and team member activity and is not bogged down by excess information. Visually it was compact and immediately comprehensible to students and was cited by many as an enabler of transparency in the empirical research undertaken in this thesis. This is not universally the case however: In a study by Kautz, Johansen & Uldahl (2016) poor visualisation and implementation of the product backlog resulted in participants' confusion, reluctance to use it, and lack of overview of the collaborative project, highlighting the significance of HCI issues in this context.

This also raises the question of who or what decides on the right quantity and relevance of information, leading to issues of potential for bias and control which work against transparency (Garsten & Montoya, 2008). Individuals may have conflicting ideas about what does and does not contribute to transparency depending on their personal views and purposes which may ultimately hinder transparency for other parties. An example provided in the thesis relates to a student wanting to publish his group's complete WhatsApp dialogues to reveal a colleague's negative behaviour, which would have provided complete transparency as far as that student was concerned. However, it would have resulted in other group members desisting from using the app or using it very cautiously to avoid making their conversations available for possible examination by tutors or other third parties, thereby reducing visibility and ultimately transparency of student interactions. This highlights the recurring paradox in the literature on transparency, namely that information disclosure,

which is at the heart of transparency, often needs to be restricted for transparency to be effective.

Examination of the literature on transparency in CL revealed a lack of studies examining it from a learner's viewpoint. The Laddering study described in chapter 6 therefore provides a student-centred look at this topic in order to answer the research question. If educators wish to improve or introduce innovations into pedagogical practice then the student voice needs to be represented (Bourke & MacDonald, 2018) and it was felt that the means-end chain analysis could provide a genuine contribution to this area, not just a tokenistic process as Maunder (2012) points out is often the case with 'student voice' issues. The laddering study posed the question "*what do you think of* when you think of transparency" to obtain the concrete and abstract attributes that students associate with transparency in CL, then the consequences arising from these attributes, and ultimately the underlying end-values to which they are linked.

The study revealed seven attributes, the most mentioned being 'open communication' followed by 'visibility', which, looking at the coding structure and comments subsumed under this code, can be seen to incorporate 'awareness'. Significant also were other attributes which represent 'expected behaviours' associated with transparency: honesty, accountability and respect for others, the implication being that these are an integral part of transparency and without them transparency cannot exist, or at best will be severely limited. Two concrete attributes were also proffered by students, face-to-face meetings, which reinforce the transparency-enabling power of face-to-face communications, and backlogs which confirm the ability of backlogs to provide task and interaction visibility.

The potential benefits of transparency as defined by these attributes can be seen in the consequences identified in the study, among them not only the expected outcome of 'good grades', but also social and soft skills outcomes of building trust, inclusivity/collaboration, maximising team skills, and doing a fair share of work – all properties and skills that employers wish to see in HE graduates.

Finally, the ultimate, higher order values that students associated with transparency in CL and that could be interpreted as personal benefits for students, were listed as

cooperation/friendship, accomplishment, self-esteem, fairness/justice, intellectual growth and hedonism.

However, though a small minority, there were also some voices who identified negative aspects of transparency in the study, citing visibility as an attribute of transparency which led to consequences of 'taking advantage' and 'bad feelings'. The low instances of these negative consequences meant that they were excluded from the analysis, but their presence raises an issue which has been reported in a number of means-end studies (e.g., Juttner et al, 2013; Grunert & Bech-Larsen, 2005) namely, that only positive consequences seem to be represented in the MECs, though negative aspects may also be of significance for the area under investigation. The cause of this could be attributed to an underlying assumption of means-end analysis: that people use a means to achieve a (positive) goal. As a result, it has been suggested that future research may need to revise the traditional means-end chain approach to also allow exploration of negative consequences and values (Jung, 2014). A more in-depth analysis of the negative aspects of transparency from a student perspective could be a useful starting point for highlighting areas that could be addressed to make it less so.

9.4.2 RQ2: Does a Scrum approach to group work increase transparency in CL, compared with non-Scrum approaches?

This research question was addressed through the literature review and the two Scrum studies. The importance of transparency in Scrum is reflected in its status as one of the three underlying 'pillars' of Scrum (Schwaber & Sutherland, 2017). It dictates the need for clarity in all processes used throughout Scrum (Betta & Boronina, 2018). However, although publications stress the importance of transparency in this context and propose ways that such transparency can be achieved, very little empirical evidence is available for how this advice is put into practice (Kautz, Johansen & Uldahl, 2017. This situation appears to be mirrored in CL, where transparency is afforded an equally important status, but empirical evidence showing how it is implemented in practice has been scarce. Studies have attempted to identify technologies that can support or enable transparency in CL, for example the use of social networking (Dalsgaard & Paulsen, 2009) or the use of wikis (Abdekhodaee, Chase & Ross, 2017; Christensen, Gilliland & Crowther, 2022) and publications reflect continuing interest in and development of awareness systems to support specific dimensions of CL transparency,

such as tracking the activities of a group on a shared artifact to support social transparency (Alsaedi, Phap & Ali, 2019).

To address the question of whether a Scrum approach could increase transparency in collaborative learning, a mapping was shown of the support for transparency delivered by Scrum's artifacts and ceremonies, against the transparencies associated with collaborative learning. This revealed that they provided strong supporting mechanisms for process, identity, content, and interaction transparency. Social transparency was also seen as being a natural by-product of the face-to-face nature of the Scrum ceremonies. In theory, therefore Scrum appears to support CL transparencies, even though empirical studies of this support are sparse.

Further theoretical underpinning was provided in Scrum's support for effective teamwork which forms the bedrock of collaborative learning, through Moe & Dingsoyr's (2008) mapping of Scrum's roles, artifacts and ceremonies to Salas et al's (2005) 'Big Five' components for effectiveness in small teams. This showed that Scrum supported all five components (team leadership, mutual performance monitoring, backup behaviour, adaptability, and team orientation) as well as the model's three coordinating mechanisms (shared mental models, closed-loop communication, and mutual trust).

To empirically test whether CL transparency was greater for Scrum than for non-Scrum processes, the Semi-Scrum study introduced Scrum into the second half of a two-part assignment (A2) and qualitative and quantitative data was obtained through surveys and focus groups to gauge students' experience of this. Although the study suffered from some limitations, as previously noted, the results show overwhelming agreement that the second part of the assignment was more transparent. The use of the product backlog was highlighted as a significant vehicle for transparency, with approximately two thirds of the student sample agreeing or strongly agreeing that 'The use of the product backlog improves transparency in group work'. 70% of the sample agreed that awareness of peer activity was increased during the second part of the assignment and feedback elicited from the open-ended questions included comments such as "product backlog adds transparency" and "implement the product backlog from the start". At this stage, transparency was considered as a 'black box', a concept that was not elucidated further, in line with much of the literature on transparency in CL, where the term is viewed as self-explanatory. The limitations of the Semi-Scrum study

were addressed in the full Scrum study where efforts were made to provide an environment that would be more conducive for students to follow the Scrum process in full. This was facilitated in part by timetabling an hour each week for group meetings, by requiring students to document their meetings to evidence that they had taken place, and by providing more training and awareness of the Scrum methodology.

Prior to this, the means-end chain investigation provided a student-centric view of transparency which identified attributes that students associated with the concept. This provided a complementary view of transparency to that obtained from the academic literature. One of the aims of the full Scrum study was to investigate the degree to which attributes obtained from the means-end study were present when using Scrum for a creative collaborative project. The findings from a post-assignment questionnaire revealed strong agreement that it led to high levels of open communication, visibility, honesty, accountability and mutual respect, with the combined scores for all attributes attaining a median of 6 in a 1 to 7 point Likert scale. Qualitative data also strongly confirmed that the Scrum experience had been positive and provided higher levels of transparency compared to previous collaborative learning experience, much of this attributed to the process and social transparency afforded by backlogs and face to face communication.

9.4.3. RQ3: How and to what extent can the transparency support provided through Scrum improve the outcomes of collaborative learning?

Dillenbourg (1999) argues satisfactory outcomes from CL should be measured not only through formal assessment of cognitive outcomes produced by both individuals and the group, but also by considering the efficiency of the learning process and satisfaction of the learners. This considers social aspects of CL, such as communication, coordination and social cohesion.

The research question considered outcomes to incorporate satisfaction with both processes and cognitive outcomes from using Scrum, which covered 1) group and student academic performance (measured by grades given by tutors), 2) student motivation to use Scrum in the future, and 3) student satisfaction with the learning experience overall, including satisfaction with their own and their peers' performance. Peer assessment was used to encourage member engagement in the CL processes; CL research emphasises that it is crucial that all

members of a group carry out their fair share of work, as problems such as social loafing and freeriding can arise when this is not the case (Stahl, Koschmann, & Suthers, 2004).

9.4.3.1 RQ3a: Does using Scrum improve student grades?

This research question was addressed through the two Scrum studies. In the Semi-Scrum investigation, the grades for the second assignment (A2) were compared with the grades obtained for the same assignment from students in the previous year's cohort who had not used Scrum. In the full Scrum study, marks were compared with those from a previous year's cohort.

The Semi-Scrum study showed student marks for A2 (which used Scrum) to be lower than those for the first assignment, A1 (which did not use Scrum), with means of 34.42 for A1 and 26.80 for A2. A comparison with grades from the previous year's cohort also showed that A2 marks were lower than A1, due to what the researcher postulates is an overall reduction in effort by students in assignments taking place towards the end of a module. However, comparing the A2 marks from the Semi-Scrum study with the previous year's cohort revealed a small increase in the overall mean (26.80 for Scrum cohort and 23.61 for previous year without Scrum).

In the full Scrum study, there was a marked improvement in student attainment, and an increase in the average grade obtained by the Scrum cohort (mean of 64%) compared to the non-scrum cohort (mean of 45%). However, this disparity was largely due to the presence of three dysfunctional groups in the non-scrum cohort who failed to submit a presentation. Discounting these groups would have increased the mean to 66%. A limitation of such comparisons also needs to be acknowledged, namely that there is no way of gauging whether the academic level and abilities of each of the cohorts were equal for direct comparisons to be made and that a myriad of other factors can affect grades.

Overall, these results do not provide conclusive evidence that using Scrum improved student grades and further research would need to be conducted to probe this. Although the literature on using Scrum suggests that this approach improves grades, very little empirical evidence exists on whether this is the case, possibly because of the difficulties in setting up an even playing field for robust investigations of this kind and the need for a control group for any effective comparison to be made. Where this has been attempted the results are

varied: In a study using Scrum to teach software architecture, Wedemann (2018) found students who had used Scrum obtained consistently better grades than students who had not, though the Scrum cohort consisted of only six students which could have skewed the results. Similarly, Dinis-Carvahlo et al (2018), reported that one of the groups in a Product Based Learning class opted to conduct a capstone project using Scrum and attained the highest score in the class. A larger scale study which introduced Scrum into a mathematics course observed that students working within 'traditional' or Scrum frameworks achieved similar grades (Pude, 2021).

While grade data may be inconclusive, there was nevertheless a clear perception by students in the Scrum study that the full Scrum implementation provided increased levels of transparency in the collaborative learning process which ultimately impacted favourably on grades. An endorsement of this was provided in the responses by students to the survey statement, 'Overall I felt that using Scrum helped to produce better grades for the team' which elicited a mean of 5.71 in a 7-point Likert scale, representing strong agreement.

However, outcomes other than grades also need to be considered: a strong rationale for the increase in collaborative learning in HE is to satisfy the requirement from employers for HE to equip students with relevant soft and transferable skills for the world of work, chief among them teamworking skills (Michaelsen et al, 2004). Evidence from surveys, focus groups and peer assessment feedback points to students' recognition of the benefits Scrum brings for improving learning experiences and developing life skills. This view is also backed up in other empirical studies, where grades are treated as a marginal issue or not considered at all, and focus put instead on the impact made on acquisition of soft skills. In a study using Scrum for teaching Agile project management, 82% of students reported that the method had significantly or very significantly their improved teamwork skills, their time management and negotiation skills (76%), and their face-to-face communication (68%) (Cubric, 2013). These findings are consistently supported in Scrum studies (eg Pinto, Mendonca & Nicola, 2022; Jurado-Navas & Munoz-Luna, 2017); Another widely acknowledged outcome is acquiring familiarity and practical experience of using Scrum, to prepare students for the growing use of Scrum, not only in software development but also as a project management tool in other domains (Gustavsson, 2016).

9.4.3.2. RG3b: Are students more satisfied with their peers' performance when using scrum?

Evidence from questionnaire, focus group and peer assessment data showed a high degree of satisfaction with peer behaviour and performance, with the full Scrum study confirming high levels of open communication, honesty, accountability, and mutual respect among students. However, this was not universal: some groups still complained of lazy students, cheating practices, or students not turning up to meetings, problems commonly associated with teamwork, underlining that the use of Scrum does not guarantee effective CL, and human factors such as motivation and commitment still play a significant part in its success or failure (Franca, da Silva & Sousa Maritz, 2010).

The research question was also addressed by examining the peer (and self) assessment marks awarded to students by their group members in both the Semi-Scrum and Scrum studies. An assumption made was that students with a positive group experience would award their peers equal marks in the peer assessment, which was the message conveyed by tutors to student groups at the start of the project.

The Semi-Scrum study allowed a direct comparison to be made between A1 of the groupwork which did not use Scrum, and A2 which did (albeit a 'cut down' version of the process). A clear limitation of this study was that groups taking part had already been working together on their A1 assignment prior to starting A2, and the length of contact between group members would have affected social bonding and impacted positively on groupwork processes. Contrary to expectations however, the number of students awarding equal marks to their peers decreased after using Scrum: 41% of students who submitted peer assessments for A1 awarded equal marks to their peers, compared with only 26.5% for A2. Evidence suggests that the reason for this reduction was that the task visibility provided by the backlogs meant that students were braver about lowering marks for students who did not contribute, as "the evidence was there, for everyone to see" and that, somewhat perversely, the ability to do this provided higher levels of satisfaction.

In the second Scrum study, 44% of students allocated equal marks to their peers, a significant increase on the first study. One explanation for this increase is that the full Scrum experience (facilitating face-to-face meetings) made for a better, more harmonious experience with fewer of the problems experienced in the Semi-Scrum study. However, there is also an

underlying question about the assumption being used, as some focus group data and comments on peer assessment forms suggested that unequal marking, rather than being seen as a negative, could be an indication of group members wanting to reward particularly diligent group members, often at the cost of a point or two being deducted from their own mark. Despite some negative comments regarding 'rogue' team members, the overwhelming sentiment from focus group discussions and peer review forms was one of satisfaction with the behaviour and performance of peers, with many students highlighting positive aspects of team members' behaviour and stating their desire to work with the team again.

The findings of positive satisfaction among team members confirmed the anecdotal evidence of Scrum's benefits reported in the literature (Mahnic, 2010).

9.4.3.4 RQ3c: Does using Scrum motivate students to use Scrum for projects in the future?

The findings from the full Scrum study show that 82% of the student sample stated they were happy to use Scrum for future groupwork assignments, with those who had used Scrum in a previous assignment displaying an even greater willingness to use it. The results also indicated that the highest preference for using Scrum was in older students and those with more exposure to group assignments, where the levels of agreement reached 100%. This suggests that the preference for using the process is likely to increase with every exposure to Scrum. These conclusions are backed up by similar findings in the literature. In a study spanning three years, Melnik & Maurer (2005) found that students who had used Scrum indicated a preference to continue to use Agile practices into their workplace if allowed.

9.3.3.5. RQ3d: Does using Scrum improve students' satisfaction *with the overall collaborative learning experience?*

This research question was partly answered by the evidence submitted for RQ3c: 82% of the student sample were happy to use Scrum for further projects, indicating that they were satisfied with the overall learning experience. However, more focused evidence can be found for the factors that are responsible for this. In both Scrum studies students expressed high levels of satisfaction with processes and artefacts underpinning Scrum, in particular the role of the product and Sprint backlogs in providing a transparent and easy means of managing tasks, highlighting individuals' accountability and performance. Evidence also shows that face-to-face meetings, with their tightly controlled agendas, were an efficient means of

progressing the project and for building up strong social bonds and working relationships which impacted positively on satisfaction levels.

Questionnaire data also directly confirms satisfaction; in the Semi-Scrum exploratory study over 60% of students agreed or strongly agreed with the statement 'The second assignment was better managed than the first' and a similar proportion also agreed or strongly agreed that 'using the product backlog for the first assignment could have improved the group work experience'. In the second Scrum study there was strong agreement by students with the statement 'Overall I felt that using Scrum worked better for me than using other group management methods.'

Nevertheless, although there was strong support for the research question, there were also criticisms and suggestions raised by students for improvements that could be made to the improve the overall experience.

9.5 Conclusion

This chapter presented the overall findings of the thesis and demonstrated how the three empirical studies reported in chapters 6, 7 and 8 contributed to answering the research questions set at the start of this report. The next chapter will put these findings into context by outlining contributions to research and suggesting areas for further investigation.

CHAPTER 10: CONCLUSIONS

Collaborative learning is increasingly being employed in Higher Education. As revealed in the literature review, all evidence points to the fact that it is likely to continue to grow as a teaching and learning strategy. Over time, HE practitioners have faced ever-increasing class sizes, new administration duties and higher teaching workloads, resulting in greater stress (Johnson et al, 2019). A recent survey of academics in a UK university confirmed that heavy workloads continue to be identified as a significant stressor at work, with academics feeling that, as a result, they cannot deliver classes as well as they would like (Darabi, Macaskill & Reidy (2017).

Group work assignments are seen as one way of servicing these larger numbers without increasing staff numbers, as group work can result in less marking (Joyce & Elliot, 2007). However, this should not be, nor is it, the main motivation for conducting collaborative learning.

Collaborative learning is central to constructivist education, a paradigm with historical roots in Dewey (1929), Vygotsky (1962) and Piaget (1978) that focuses on student-centred learning, with the learner as an active agent in the process of knowledge acquisition. The benefits of this type of learning have been widely reported, and include the promotion of communication, social and negotiation skills - all essential to success in the real world (Bada & Olusegun, 2015). In a systematic review of teamwork in HE, Riebe, Girardi, & Whitsed (2016) argue that, in the workplace teamwork has moved from a desirable skill to an essential requirement. With the advent of the fourth industrial revolution (industry 4.0) collaborative innovation is being seen as an engine for economic and social growth (Choudhury & Murzi, 2020). Working in cross-functional teams is fast becoming a trend in industry and is likely to take on more importance as this revolution progresses (Ocampo et al, 2021). Employers therefore expect graduates to leave HE with the ability to work in teams in order to contribute seamlessly when they join the workforce. However, despite decades of research into the topic, groupwork continues to attract mixed reviews from students, with some rating it as the best learning experience of their university education and others regarding it as their worst (Caple and Bogle, 2013). Recurring problems are the presence of 'social loafers', unfair grading and difficulties with interpersonal dynamics (Wilson, Ho & Brookes, 2018).

It is incumbent on educators therefore to find more effective ways of implementing collaborative learning to address these issues and foster the development of skills demanded by employers.

Transparency has been recognised as being important for successful collaboration, a fact that was reinforced in discussions with students, but the topic was under-researched in the academic literature. The thesis therefore set out to examine this concept, first through the lens of the researcher to uncover its varied meanings and interpretations, and then through the lens of students engaged in CL using a novel approach that aimed to expose the link between attributes of transparency that students felt were important, and the higher order values that these ultimately produced.

The study then moved on to investigate how transparency could be implemented in CL to deliver successful projects. Outside the academic environment, there was ample evidence of the high transparency credentials of Scrum, a popular project management process used in industry, particularly in the context of software/system development, but increasingly being extended to use cases in other realms. This led to the question: could Scrum be used to deliver transparency in CL to produce more satisfying and effective outcomes? The Semi-Scrum study was an attempt to directly compare the use of groupwork without and with Scrum by introducing Scrum into the second half of a two-part assignment. The results showed that Scrum was preferred by students, but this could not be attributed fully to Scrum as students had not followed Scrum's processes in full.

The final study was significant in investigating the use of Scrum for a project that is outside its normal remit and is more typical of most collaborative projects run in HE. Students worked on a creative project where many of its dimensions were unpredictable and required a flexible approach. The Scrum process reduces the high-risk perception by focusing on tasks that are smaller, more predictable, and achievable. In many cases, students do not know how a project will evolve – it evolves as it happens, based on feedback from team members or teaching staff, and this demands adaptive approaches with frequent feedback, which is the essence of Scrum. Scrum provides many features that are effective for teams performing project work, such as Sprint backlogs that provide a visual representation of the tasks to be performed by the team, constant monitoring of tasks, and Retrospectives that focus on a team's continuous improvement.

The following sections summarise the contributions of the thesis in the areas of research and practice.

10.1 Contributions to research

1) Research on transparency in collaborative learning is lacking, with transparency mostly taken as a 'given' in the academic literature. The thesis attempted to explore the concept in more detail, to examine it in the context of other related concepts such as visibility and awareness and to provide a rare student perspective of the meaning and benefits of transparency in CL.
2) Scrum is associated strongly with transparency, yet there are few empirical studies showing how that transparency is manifested or measured in a Scrum project. This thesis provides one such study, demonstrating how students perceive Scrum artifacts and ceremonies to contribute to overall transparency in a group project.
3) Although means-end-chain analysis continues to be used productively in a range of educational contexts, its application to transparency in CL is novel and has a theoretical implication in suggesting a new angle of value-oriented research in this area. The principal theoretical contribution of the study is an examination of the value-oriented approach to students' use of transparency in the context of CL. Identifying the values that students ultimately aim for through CL transparency and understanding students' hierarchical value structures, reveals how students benefit from transparency. Furthermore, awareness of the attributes that students see as important for attaining their higher order values may provide educators with opportunities to implement practical measures to strengthen support for these attributes to increase the likelihood of the positive consequences and higher order values associated with them being achieved.
4) Research on the application of Scrum in HE is still scarce and mainly exploratory, although it has benefited from a growing interest in the last few years. This thesis has provided two empirical studies of the use of Scrum for collaborative learning, providing educators with findings and advice that will help them to implement Scrum in their collaborative projects.

   As far as the researcher is aware, and notwithstanding the lack of a 'full Scrum' implementation, the Semi-Scrum study is unique in providing a comparison of Scrum

versus non-Scrum project experience and outcomes using the same group of HE students, which showed that the student cohort preferred Scrum to the 'traditional' approach to project management. However, as was noted, it is also possible that other factors could have affected these results. In particular, students had completed A1 and had been collaborating in their groups for six weeks prior to the start of the A2 assignment, which means they were likely to be past the 'storming' phase of team development and accustomed to one another's working styles. This could have had a positive effect on how the groups operated and the outcomes they achieved in A2.

A notable contribution to research is also in providing case studies of Scrum being used by first year students. There are examples of Scrum being used for collaborative projects, particularly in the field of software engineering, however empirical research is, with very few exceptions (eg Pejcinovic, Wong &Bass, 2019) targeted at post graduate or final year of undergraduate level. Projects undertaken are often capstone projects that are semester-long, multifaceted and serve as culminating academic and intellectual experience at the end of an academic program. At this stage students are experienced and may have developed strategies for dealing with the more negative aspects of collaborative learning. Such CL projects and students are vastly different to those in the first year, where projects tend to be of shorter duration and undertaken by inexperienced students, and where a negative groupwork assignment can have a greater impact than just poor grades. Increasingly, there is a view that successful CL has great potential for improving first year retention rates which most universities battle with. According to figures published by the HE Statistics Agency (2022) 5.31% of first year students entering university in 2019-20 were no longer in HE a year later, but this figure masks substantially higher rates for individual institutions: for example, one university suffered a dropout rate of one third of first year students. Students look forward to, but find the 'fresher' experience daunting; most now work part time and many commute long distances to university, and for them the classroom may be the only opportunity to meet peers and to build a sense of belonging. Much of the literature on retention policy refers to the importance of actively involving students in CL (Hernandez-Stevenson, 2021; Mitra, 2022; Grace-Odeleye, B., 2020; Loes et al, 2017), through which they can form social ties, develop increased academic and

professional skills and acquire an enhanced sense of community. Yet all too often first year students experience learning as isolated learners whose learning is disconnected from that of others (Knowesen & Naude, 2018). Universities should therefore "ensure that shared learning is the norm, not the exception, of student first year experience" (Tinto, 2007, p4). Furthermore, "As the responsibility for the financing of HE has shifted from the state to the student, so the understanding of student retention and engagement has shifted from being the student's responsibility to that of the HE institution" (Tight, 2019, p689). This makes it incumbent on universities to implement successful CL from day one to help address the retention issue as well as improve CL outcomes. In this context, collaboration using Scrum holds great potential, but there are few empirical studies of its use or outcomes at first year level. Where this has been attempted, Scrum has often been reduced to a partial implementation in order not to overburden students with new learning goals (Pejcinovic, Wong & Bass, 2018).

One contribution of this thesis is therefore to provide an empirical study to fill this gap, which demonstrates that a full Scrum application can be used successfully at first year level. Furthermore, if educators want students to reap the benefits of Scrum in CL, then the Scrum experience needs to start in the very first semester of a student's academic journey and used and reinforced in later years to produce graduates for whom group working is second nature and is equated with success and satisfaction, rather than frustration. The contribution of the thesis is therefore a positive endorsement of the ability to use Scrum successfully with first year cohorts, with the implication that if it can be used successfully at this level, then it can be used successfully at any level.

In HE most empirical studies of Scrum are around software development and engineering and although studies in other areas are appearing, for example Rush & Conolly (2020) where a Scrum approach was used to teach project management, these are still rare. This thesis also contributes to research by providing a case study of Scrum being applied to an ill-structured, creative project. The results show that this can be done successfully, with positive outcomes for both students and tutors. Such projects are vastly under-represented in the literature, although it is logical to assume that

non-software development projects must form the bulk of collaborative assignments in HE.

Another point worthy of note is that in conducting the Scrum projects, no additional software or bespoke support systems such as physical task boards etc, were used. Studies have championed the use of such tools for Scrum projects (Lu & DeClue, 2011; Werner et al, 2012). Although the use of Blackboard, a standard LMS, was criticised by some students, particularly in the semi-Scrum study, the response to the statement "Overall, I was happy with the tools provided on Blackboard to support the Scrum process" elicited a high degree of agreement from students, suggesting that it 'did the job', even if it was not perfect. If educators wish to encourage greater take-up of Scrum in the classroom for non-software engineering projects, then this is relevant as it shows that running a Scrum collaborative project need not involve additional expense and effort in acquiring and learning new task management systems but can be done satisfactorily with the current LMS tools at the tutor's disposal.

The thesis also explored important differences between Scrum being used in the professional context, and Scrum being used in education (see also contributions to practice).

10.2 Contributions to practice

The thesis provides some of practical implications for two groups of stakeholders: academics and learners.

10.2.1 Academic staff

The thesis offers several practical suggestions for tutors. Scrum has long been associated with transparency and the thesis has shown that it delivers, to a large degree, the attributes that learners associate with transparency in collaborative learning. This research further endorses an approach which has the potential to replicate the project successes enjoyed in industry using Scrum. The findings from both the semi-Scrum and Scrum studies demonstrate a high degree of satisfaction by students and shows that pursuing collaborative projects using Scrum is beneficial. Scrum clearly sets out events, artifacts and roles that need to be adhered to, as well as outlining a philosophy covered by its three 'pillars'. However, the thesis shows that for Scrum to work in an educational context, certain adjustments need to be considered. The

literature contains examples of adaptations of Scrum to suit the HE context (Mahnic, 2010) but most of them relate to Scrum as used for software development projects. The following advice is based on experience gained from the empirical research carried out in the thesis, as well as general advice provided in the literature, and is designed as an aid for any educator wanting to implement a Scrum project.

10.2.1.1. Initial preparation for students:

Prior to starting any Scrum project students need to be well prepared and to receive adequate training on Scrum. The importance of this is highlighted in many studies, with less successful case studies citing the lack of training as a major contributor to problems (Milasinovic, 2018). The basic Scrum concepts can be taught over one or two class sessions. A minimum suggestion is outlined below.

1) Videos, readings, and background literature on the widespread use of Scrum in industry should be made available to help students understand why this process was developed. Tutors should stress Scrum's potential, even for areas outside its traditional domain, to make a positive impact on group processes. This can be backed up by references to Scrum, Scrum Masters, etc. in job specs and job vacancies. Anecdotal evidence from the thesis showed that students were positive and even excited at the prospect of gaining experience of a process that was being used widely in industry.

2) An introductory lecture on the philosophy of Scrum and its roles, ceremonies and artifacts needs to be provided, with some indication of how these might be implemented in the group project. Others have stressed the need to explain the philosophy so that students have a more rounded understanding of Scrum (Rush & Connolly, 2020). The importance of this preparation warrants the use of a short assessment (e.g., a multiple choice test) to check that students have fully understood the philosophy and processes involved and how they relate to the collaborative assignment being set. Students should be instructed that Scrum ceremonies must be carried out rigorously and that they should not just go through the motions of doing them.

3) There is consensus that as a concept Scrum is relatively easy to understand, but that its adoption and correct usage can be difficult (Milasinovic, 2018). Examples of product and Sprint backlogs from other assignments, or even fictitious assignments, can be made available to give students an idea of how to break a project up into tasks and the different categories of tasks that can be considered, in order to provide an overview of Scrum in practice.

The above will also be useful for any tutors who are not familiar with Scrum.

10.2.1.2 Consideration of type and duration of project:

As already stated, careful consideration must be taken of the type of project used for CL to ensure it is sufficiently complex, offers interdependence of tasks and can be completed within the specified timeframe. Scrum is a flexible, yet structured approach to project management and ultimately requires all projects to be decomposed into tasks that fit into a product backlog. For software development projects this is a relatively straightforward process, as individual programs, design models and database tables all emerge as natural units of work and therefore product backlog tasks. More creative and unstructured projects also need to be organised to fit into a product backlog, and students may initially find this difficult, needing guidance from tutors.

10.2.1.3 Recommendations for using Scrum in student projects:

Findings and lessons learned from the thesis have been used to produce a table of guidelines and recommendations for using Scrum in CL projects in Higher Education (see Appendix 7). This shows the roles, artifacts and ceremonies of Scrum, as used in industry, and sets out various options for their implementation in an educational context. It is hoped that this will give guidance to academics wishing to embark on Scrum projects.

10.2.1.4 Peer assessment:

Though perhaps incongruous with the use of Scrum in industry where a successful project outcome represents a single result achieved by all members of the development team and not subject to any type of 'peer moderation', evidence from the study confirms that peer assessment and feedback is an important tool in fostering effective student collaboration, working as both a carrot and a stick in keeping students engaged in the Scrum process and committed to delivering good work, as well as yielding the threat of a mark reduction for poor

performance (or mark increase for exceptional work). Given that tutors are not able to see what is taking place within a team, peer assessment is recognised as a valid and effective mechanism for evaluating the contribution of team members to a group project (Bong & Park, 2020; Kollar & Fischer, 2010). It can be regarded as an extension of the collaborative learning experience: some have likened it to collaborative learning, being based on mechanisms which rely on interaction, individual accountability, and positive interdependence among students (Strijbos, Martens & Jochems 2004). A distinction can be made between formative peer assessment where students are involved in discussing criteria, providing, receiving and reacting to feedback, and summative peer assessment which involves peers rating each other according to a set of criteria. In this respect, Sprint Retrospectives play the part of 'formative peer assessment', valued in providing a team perspective on what is being done well or could be improved. The peer assessment undertaken by students at the end of the project is of the summative type and, if done diligently, helps students to understand where and how they can improve in future, as well as providing praise and confirmation of tasks done well which impacts on students' self-esteem. For this to have any effect, that feedback must be made visible to students (preferably anonymously and without revealing the actual marks that students have apportioned), which unfortunately places additional administrative and processing burdens on the tutor. However, in the researcher's experience, this is worth the extra effort for the benefits that students gain from the feedback. In the thesis studies where this was implemented, a number of students informed tutors that the best thing about receiving their assignment grades was reading the feedback they had received from their peers.

Students should be made aware of the peer assessment mechanism to be used and the expectation that a good team experience is likely to be manifested in all group members getting equal marks. Additionally, a 'collaborative charter' must be agreed by all members prior to starting the group work, outlining the criteria that a team has agreed to use to apportion marks in the peer assessment exercise, which should be backed up by evidence uploaded to the LMS (i.e. product backlog, individual tasks, team meeting minutes etc). It has been demonstrated that making the students define the assessment criteria gives them more responsibility for their own assessment process, as well as making them reflect as a team on what they value when working together, and how this could be measured (Ashenafi, 2017).

10.2.1.5 Tutors and process monitoring

As already stated, one reason for using collaborative learning for educators is to keep workloads to an acceptable level in the face of ever-increasing numbers of students in HE. This means that running collaborative assignments should not add extra workload through excessive controls and interference from tutors, or time spend dealing with dysfunctional groups. The experience of tutors in the full Scrum study was that using Scrum can minimise this overhead. In keeping with Scrum philosophy, teams are self-organising: individual members discuss and agree what they are to deliver to the project in their meetings, and the Product and Sprint Backlogs act as a transparent record of the project's development and the contribution of each member towards it. The tutor has no real need to access these backlogs (unless there is conflict within the team) until the end of the project, when the backlogs might feature in the marking criteria. Team members can decide for themselves what mark their teammates deserve in the peer assessment exercise, based on the product backlog, the evidence of tasks posted to the file exchange area, and their attendance and performance in the Scrum events, all of which are documented and visible. In essence, Scrum provides for socially shared regulation by the team, in which group members regulate their joint activities by regularly coordinating and monitoring their joint tasks and performance (Jarvela & Hadwin, 2013), aided by the transparency provided by the method. The tutor's role is largely limited to providing the academic input relevant to the project topic.

10.2.1.6 Importance of Scrum meetings

Evidence from the studies has highlighted the central role of the Scrum meetings. As well as being identified as a concrete attribute associated with transparency, they are a major means by which transparency is delivered and in which the attributes of transparency identified in the laddering exercise (honesty, respect for others, open communications) can be employed, nurtured, and developed. Daily stand-ups are a means of ironing out any misunderstandings and ensuring the project progresses smoothly. For this reason, face-to-face meetings should be facilitated by academics, for example by having a timetabled class for Scrum events, and a record kept of attendance at meetings. To ensure maximum attendance, applying penalties for absences could be considered, as suggested by students in the focus groups.

10.2.1.7 Levels of transparency and tutor access

The thesis has shown that there are certain limits to transparency, above which the benefits associated with transparency start to reduce. In asking what the best way for delivering transparency was, students opted for 'backlogs' which had "just about the right amount" of transparency. However, the backlog shows a limited amount of information: it does not show any of the exchanges that went on behind the scenes while producing the tasks shown. Were there any disagreements? Did other members have to help with a task? This could be better gauged by having access to the interactions between students, for example by making students use a discussion board or wiki. However, as has already been discussed in relation to students' WhatsApp use, revealing interactions would be considered intrusive and would lessen transparency overall as students would not feel free to voice their opinions in the knowledge that someone 'in authority' could have access to them. Similarly, the Scrum study showed that although two groups recorded their meetings, this was not generally favoured by students who felt that recording would limit conversations and particularly any dissenting voices who are often needed to produce a better assignment.

10.2.1.8 Introducing Scrum into the curriculum

It is recommended that Scrum is introduced into a First Year student project wherever possible so that students can practice using the methodology and make any mistakes early on, allowing it to be used with confidence in later years when the results from collaborative projects will have a greater impact on a student's degree classification.

10.2.2. Students/learners

Results from the research indicate that there are advantages to be gained by students from using Scrum for collaborative learning.

10.2.2.1 Knowledge and practical experience of Scrum

The first advantage is having knowledge and practical experience of using a project management process that is widely used and recognised for delivering successful projects in industry. Use of Scrum is clearly focused on the IT/software development sector, but as stated, has spread to other areas, notably the engineering and construction industries, and its reach is likely to broaden in future. Having practical experience of using Scrum can potentially boost a student's employability.

10.2.2.2 Support for transparency

One aim of the thesis has been to examine the transparency credentials of Scrum, transparency being identified as a significant factor in promoting successful collaborative learning. The findings demonstrate Scrum's strong support for transparency, thereby identifying it as a process that students should consider using if they want to increase their chances of delivering a successful team project.

Although the Semi-Scrum study revealed that using Scrum did not have any effect on student grades, the full Scrum implementation did show an increase in average grades against a comparable project that did not use Scrum. However, as has been emphasised, grades are just one element of successful outcomes from collaborative learning and a broader perspective needs to be taken. The attainment of outcomes, such as positive team member relationships and positive social environment along with interpersonal skills such as leadership and teamwork should also be considered, as these skills and outcomes are also crucial to academic achievement. Findings from the study suggest that Scrum provides an environment conducive to developing these qualities. There is ample evidence that the way a project is structured and progressed through regular face-to-face Scrum meetings nurtures many of the attributes associated with transparency which students find necessary for successful collaboration: respect for others, honesty, accountability, open communication, and visibility.

10.2.2.3 Practical implementation of Scrum

The study provided some practical takeaways for students considering using Scrum. The first is that to reap the full benefits of Scrum, elements of the methodology cannot be skipped. In particular, the Scrum meetings should be taken seriously and, even if timetabling and other constraints dictate that a seminar session must incorporate more than one Scrum ceremony, these ceremonies must be clearly identifiable and executed in sequence, to get maximum benefit from them, rather than being merged into a single, disorganised discussion.

Tutors expect groups in HE to exert a high degree of independence. One of Scrum's underlying philosophies is self-managing teams where there is minimal external supervision. Students should be made aware of the benefits (as well as potential pitfalls) of using Scrum to foster important soft skills that arise from this degree of freedom and be encouraged to use the

process for conducting collaborative learning, even when this is not mandated, to become proficient in using it. The adage 'practice makes perfect' applies. Considerable personal satisfaction has been gained by the researcher, on learning that following on from their first year Scrum experience, students taking a second-year project-based module had independently opted to conduct this using Scrum.

10.3 Limitations

As with all studies, this thesis suffers from a number of limitations. This section summarises these limitations and their implications for findings drawn from the thesis.

A mixed methods approach was employed for the thesis, to collect quantitative information through questionnaires, and qualitative information largely through focus group meetings, interviews and questionnaires. This allowed for triangulation and for interesting insights from the questionnaire results to be further probed through the focus groups. In terms of cohort sizes, the Scrum investigations used cohorts of an acceptable size, as judged against other studies examining teamwork and collaborative learning, but increased cohort sizes would have been desirable, particularly when carrying out quantitative analysis on subsets of the data which produced results which could not be generally transferrable due to the small sample sizes.

The Scrum studies were limited to students in their first year of HE studies and, while the advantages of using a first year cohort have been explained, such students may not be sufficiently representative of collaborating students in general. First year cohorts will typically include some students who are likely to drop out of the course for various reasons and therefore may not be fully committed to their studies, posing a danger of 'free-riding' and lack of motivation. By the second year such students have either dropped out or been removed, leaving a more dedicated cohort. This distinction is also magnified by academic regulations where first year module grades are not counted towards the degree classification, which can result in a 'minimum effort to pass the module' approach being adopted by some students. It is possible therefore that using 2nd or 3rd year students might have produced different findings.

Focus groups were an important source of data for the thesis providing valuable insights into aspects of collaboration that were not covered by the questionnaire surveys. The three focus

groups used in the study comprised of students who volunteered to take part. A common issue raised with volunteers is that they tend to be positive in their outlook otherwise they would not take the trouble to participate, and that this can introduce positive bias into discussions (Krueger, 2014). Any possible bias could have been reduced by offering a payment for students to take part and actively encouraging students with a more negative outlook to participate, which might have resulted in a more balanced population for the focus groups.

In examining the questionnaire responses, the researcher was slightly perturbed by the high levels of agreement expressed by students. Figure 22 which displays the distribution of means for the combined transparency statements, shows that only 8% of respondents had a mean of less than 4 (in a 7-point Likert scale), representing slight disagreement, with the greatest number of respondents falling into the 6.3-7.0 mean frequency. Careful attention had been paid to structuring the questionnaire to avoid acquiescence bias and to briefing students and giving them ample time for completing the questionnaire. In addition, the questionnaire was administered by a third party who had no knowledge of the research to avoid any inadvertent bias. Yet the levels of agreement seemed very high. This was raised with the focus group, but participants confirmed that as far as they were concerned, their responses reflected the situation as they saw it. There would also have been no reason for students to exaggerate their ratings, for example to 'score points' or keep the researcher happy, as the questionnaires were anonymous. These high levels of satisfaction and agreement must therefore be taken as accurate reflections of the cohorts.

The thesis research was focused on the transparency credentials of Scrum and its role in delivering successful collaborative learning. Transparency being a broad and vague concept, the laddering study attempted to tease out more specific attributes that students associated with transparency. The full Scrum study then attempted to establish whether these attributes were present when using Scrum for managing a collaborative project. This could be considered a rather simplistic investigation, dependent heavily on the results of the means-end analysis which, as was noted, is heavily reliant on the skill of the interviewer in teasing out attributes, consequences, and values, and open to the vagaries of accurate interpretation and coding of the interview data. While all the recommended processes for inter-rater consistency were carried out, it is possible that the small number of participants in the coding process could limit the validity of the results. However, an iterative process of independent

coding and discussion by coders was carried out to mitigate this limitation. Similarly, although the researcher underwent training and carried out several pilot interviews to gain confidence in conducting laddering interviews, it is nevertheless possible that limited experience of the technique could have affected the outcomes and that different results could have been produced by a researcher with more experience. Another potential weakness of the study was that because of the sample size, it was difficult to make meaningful group comparisons, for example between 'novice' and 'experienced' collaborative learners.

The research aimed to establish if Scrum could positively affect collaborative learning outcomes. The results appear to show that this is the case. However, the contribution to the thesis would be made more significant if a control group was used in the second study, i.e. for groups not using Scrum to run alongside those using Scrum, to allow direct comparison between the two. Though this was considered, it was difficult to see how ethical approval could be obtained for such a scheme.

Finally, a significant limitation of the thesis is that it has not looked at online Scrum collaborative projects. Many organisations were forced to go online due to the Covid pandemic, and evidence shows that many employees are resisting calls to return to the office. Recent figures show that approximately 60% of UK employees currently work fully or partially from home and estimates suggest that by 2028, 73% of all work teams will have at least some remote team members (Steward, 2022). The implication of this is that HE institutions will need to equip graduates with skills for online working, and that online Scrum cannot be ignored.

10.4 Future work

As with all research, the findings of any study are often catalysts for further investigations. This section summarises suggestions for further work.

10.4.1 Means end analysis

The means-end analysis study described in chapter 6 is a novel application of the method to transparency in CL and as such adds to the body of research into applying means-end analysis to domains outside the sphere of market research. The limitations of this type of research have been noted and further empirical studies are needed to validate the MEC findings described in this thesis. While the literature suggests that the nature of the technique means

it is difficult to replicate a particular MEC study, it would nevertheless be useful for other researchers with experience of the technique to carry out a similar study to validate the general findings.

10.4.2 Further empirical studies of using Scrum in creative project contexts

The Scrum study outlined in the thesis is rare in using Scrum for a creative project outside the normal domain of Scrum. The study supports the eduScrum movement which is an adaptation of Scrum to education and which, it has been claimed can be used in any class context where teamwork is dominant. The case has already been successfully made for using Scrum for software engineering projects in HE, with a steady flow of publications appearing over the years documenting examples of its use. Yet there are still very few studies outside of this domain, even though it has been claimed that Scrum can be used in any class context where teamwork is dominant. The shift must now be towards investigating its use in other domains. Further studies are needed using similar scenarios as used for the full scrum study and using cohorts of students from all levels of HE, to establish whether the benefits outlined in the thesis are applicable to collaborative projects in general. Further case studies from areas as diverse as music, creative arts and marketing could be used. However, in all cases, tutors need to consider whether a project is sufficiently complex and open enough to support meaningful collaboration requiring interdependence of tasks, and how the given project could be realistically broken down into tasks. Projects of varying duration should also be examined, to see if the length of a collaborative project has any impact on the use or the benefits that accrue from using Scrum.

10.4.3 Transparency and its effect on grades

The link between Scrum transparency and student grades could be further investigated using empirical studies employing control groups for more rigorous examination, as the evidence from the thesis was tenuous, being based on a small cohort of students. As has been stated, this is a difficult area to investigate because of the many factors that need to be considered in setting up a 'level playing field' for such studies, however the relationship between any new educational initiative and student attainment always warrants thorough investigation as it is ultimately seen as evidence of its success, and therefore has an impact on its take-up.

10.4.4 Virtual Scrum

As noted, with workplace activities now increasingly moving online due to the impact of Covid, empirical studies are needed of running Scrum projects online. If the evidence is that 'virtual' Scrum will dominate in the future, what is the best way of translating the benefits of face-to-face collaboration that is so central to the success of Scrum to online environments and how would this affect Scrum transparency? In a recent study which ran a Scrum project online due to the Covid pandemic, having previously run the project successfully face-to-face in the classroom, it was concluded that "The quality and intensity of face-to-face conversations in a classroom could not be reproduced in virtual distance teaching. Retrospectives also never reached the depth they had in the previous year when they were conducted on-site and in person" (Neumann & Baumann, 2021, p6). On the other hand, in a study of students participating in projects as members of online distributed Scrum teams, Söderback, Hrastinski, & Oberg (2015) found high levels of satisfaction, communication and interaction among students. If online education is likely to increase in the future, these conflicting views call for further research.

10.4.5 Costs of running a Scrum project

A number of interesting sub-topics emerge for research from the thesis findings. Anecdotal evidence from the thesis suggests that the costs of running a collaborative project using Scrum, in terms of time spent in overseeing the process, are lower for tutors than those for a non-scrum project. This assertion can be investigated more thoroughly and tested using empirical studies which compare different methods of monitoring and assessing Scrum projects, to provide concrete evidence to back up or refute these claims. If proved positive, these findings could encourage a greater take up of Scrum by educators.

10.4.6 Collaborative learning and Peer assessment

A strong case has been made in this thesis for including peer assessment as an integral part of the Scrum collaborative learning process. Peer assessment is an important element in a shift towards more participatory forms of learning and despite being studied for decades, it has yet to make significant advances (Ashenafi, 2017). Part of the reason for this is that it has failed to establish affiliations to closely related practices such as collaborative learning (Strijbos & Sluijsmans, 2010). "Stronger ties to collaborative learning research may greatly inform theory building and empirical research on peer assessment" (Kollar & Fischer, 2010,

p347). There is great potential for developing these stronger ties in the context of CL using Scrum, which may lead to the development of useful quality and measurement standards that could encourage robust evaluation and comparison of practices, promoting novel research in this area.

A challenge of peer assessment is the manual nature of assessment methods, which prove intractable as the number of students increases. The smaller of the two empirical studies covered in the thesis involved 73 students split into 14 groups (with 5 students per group, on average). Each student was tasked with providing feedback for every member of his/her group (plus self) which resulted in over 350 separate elements of feedback, requiring collating per student, calibrating grades, checking for anonymity/approval to publish, and uploading the collated feedback to individual student accounts on Blackboard, a task which was extremely time consuming and provides a strong argument *against* using peer assessment. To relieve tutors of this burden, research and development of tools that can automate some of this drudgery is required. Relatively little has been done in this area, mainly because peer assessment research has been so idiosyncratic, being based largely on solitary case studies and short-term experiments (Ashenafi, 2017). In a systematic review of tools that support peer assessment, tools used for the peer review of an individual contribution to a team were considered outside the scope of the review (Luxton-Reilly, 2009).

10.4.7 'Best practice' in using Scrum

Appendix 7 provides a list of recommendations for academics wishing to run a collaborative project using Scrum. Further studies can test, refine, and add to these recommendations, to provide a 'best practice' manual for academics wishing to undertake Scrum projects.

10.5 Conclusion

This chapter provides a conclusion to the thesis, summarising the main studies and their overall contribution to research and practice, as well as suggesting areas for further research, spanning means end analysis, transparency, Scrum and its implementation, and peer assessment.

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APPENDICES

APPENDIX 1 – Assignment Description – Semi-Scrum study

Assessment Part 1:

You will be put into a group of 4/5 students and allocated a case study (below) for which your group needs to produce a database design. Note that this is a group assignment. Individual submissions will not be accepted. Your group needs to submit a report containing the following:

1. User requirements: Identify four stakeholders and, identify at least 12 functional requirements that your database system should be able to meet (3 requirements per group member) . As the case study contains only an outline of a business scenario, you will also need to state any business rules, assumptions, etc, that your group has made in the course of putting together the database design. These need to be submitted with your design.
2. An ER diagram covering the data requirements of the scenario, together with a completed entity specification form for each entity shown on your ER diagram. An electronic version of the specification form can be found on Blackboard.
3. Evidence of group activity – ie all group meeting minutes, including project planning, task allocations, attendance at meetings etc. Note that from week 4 onwards time will be set aside in the practical sessions for formal group meetings. In addition, your group will need to schedule regular meetings outside of the class, which should also be minuted. Poor attendance and lack of evidence of collaboration by any individual will lead to adjustment of marks by the tutor, and in the most extreme cases, a fail grade for this assignment.

At your first group meeting you should establish the criteria that your group is going to use for the peer assessment exercise. These should be recorded in your first meeting minutes. Group work is succcessful when group members are communicating effectively. Blackboard 'group' facilities have been set up to support group communication – please use them.

Assessment Part 2: Database implementation

Your group is required to implement the design produced in Part 1 (amended appropriately following feedback provided by your tutor). This must be implemented using Oracle SQL Developer and a script file produced to allow your tutor to set up (and remove) your complete implementation.

What your group needs to submit:

1. Your final ER diagram clearly showing all attributes, Primary and Foreign Keys.
2. A notepad file containing the following scripts, suitably annotated and in this order:

   a. SQL Table creation and constraint scripts (in the order in which they need to be created).
   b. SQL Insert statements for the sample data you have inserted into your database. The data should fully test the functionality of the system, as illustrated by your SQL queries/outputs (below).
   c. SQL view creation script for two views that would benefit this application (the script should be annotated to explain the rationale for this view).
   d. SQL scripts for between 9 and15 SQL queries/reports (ie 3 per group member) that meet some significant user requirements (as outlined in Assignment Part A) and demonstrate the functionality of the system. Each query script should be annotated to explain the rationale for the query (what it shows, who would use it and why). Your choice of queries should illustrate the breadth and potential of the implemented database, as well as a good understanding of SQL.
   e. SQL scripts for two PL/SQL procedures/triggers that extend the functionality of SQL and best demonstrate your understanding of PL/SQL. The triggers should be used to implement business rules that your team has identified. Each trigger script should be annotated to explain its purpose and rationale, and scripts for testing the trigger should be provided.

   f. DROP TABLE statements to completely remove all tables (in the order in which they need to be deleted).

3. Evidence of group activity – ie meeting minutes, task allocation, attendance etc.

What each group member needs to submit:

4. A copy of the group's report.
5. A completed Peer Assessment Form (available on Blackboard). Peer assessment should be based on the criteria that group members agreed and recorded in the the first group meeting minutes.

Assignment Part 1 and 2 marks for each group member may be moderated by your tutor based on evidence provided in the group meeting minutes, seminar attendance, peer assessment forms and demonstration. Lack of evidence of attendance or lack of collaboration by a individual will lead to adjustment of marks by the tutor, and in the most extreme cases, a fail grade for this assignment.

Database Demonstration:

Your group will be required to provide a demonstration of your database to tutors in class. All group members must be present and are expected to be able to answer questions on any aspect of the work presented. Any group member who is absent will receive a mark of zero for Part 2 of this assignment, unless mitigating circumstances apply.

Assignment Scenario - Pinkton Psychiatric Hospital (PPH)

The Pinkton Psychiatric Hospital currently maintains an internationally renowned database of twins known as the 'Pinkton Twin Register' (PTR). The register was set up in 1930 in order to collect data on twins for the purpose of research, and now contains data on more than 10,000 pairs of twins. Records on all twins have been maintained and updated throughout the years and sample populations drawn from the PTW for specific research studies, of which there may be between 20 and 30 on-going at any one time, ranging from schizophrenia and anxiety neurosis to obesity and melanoma research.

When the Register was started it was set up in a hardback book which recorded, chronologically, the name, address, hospital number and diagnoses of all patients of the Pinkton Hospital who were born one of a twin and whose co-twin (other twin) was of the same sex as the patient. Later this was expanded to include twins whose co-twin was of the opposite sex and these lists were kept separately, so that the PTR was actually two separate registers. In 2000 increased interest in genetic studies led to a renewed interest in the PTR and the setting up of a spreadsheet containing basic details of twins (identification number, name and original illness), together with centralised paper files for each registered twin. These files contain information on present and past illness, the twins' hospital visits etc, and also the tests and research studies in which the twins have been involved. The records vary from a single set of case notes to five volumes of records totalling over 1000 pages.

PPH has a research department which runs a number of research projects. Each is assigned to a team of researchers, headed by a Lead Researcher. Each project uses a sample of twins who are picked on the basis of their diagnosed illness and twin type. There are three possible categories of twin type – same sex identical twins, same sex non-identical twins and differing sex twins. There are also some triplets on the register. As soon as a sample is established for a project, researchers need to track down the relevant twins, who may have moved since they were in hospital. This often involves a great deal of time and duplication of effort, as researchers on other projects may have previously found the students, but failed to record the new address in the file. There are also suspicions that some researchers deliberately withhold information that they have spent weeks, or sometimes months, tracking down.

The hospital now wishes to set up computerised database which it hopes will allow for the following, as a minimum:

1) A record of basic contact information relating to each sick twin and his/her co-twin. This will enable speedy and flexible retrieval of twins based on given criteria. (eg age, sex, contact details, place of birth, nationality, blood type, illness, age of mother at date of birth);

2) Records of each new illness and date of diagnosis for each twin (and co-twin, if applicable), so that there is an easily accessible health history for each twin to help researchers to locate suitable twins for their research projects.
3) A record of which twins were involved which research projects, and the result of any standard tests carried out on twins as part of that research project.
4) The twin record should show the number of research studies that he/she has participated in so that researchers can avoid aggravating twins by approaching them repeatedly for inclusion in projects;
5) Each project has a budget agreed at the start. This consists of a 'manpower budget' which represents the amount of time (in hours) allotted to carry out the tests deemed to be necessary for the project and a 'miscellaneous budget' (in £s) which covers just about any other expense incurred on the project (eg travelling expenses). Each standard test is allotted a set amount of time to complete (ranging from 0.5 to 4 hrs). The time is fixed and is the same for all projects. The hospital would like the system to update the 'manpower budget' automatically every time a test result relating to that project is recorded in the system, so that project leaders and their managers would be able to see at a glance the budget remaining on any given project (ie how many man hours are left). The same goes for miscellaneous expenses – ie any miscellaneous expenses should also be recorded and the cost deducted from the 'miscellaneous expense' budget.
6) Easily accessible information on the publications relating to projects: With Health Department finances being squeezed and increasingly being directed to the most successful institutions, Pinkton needs to ensure its research outputs are of a high quality (and quantity) to continue to attract government grants. Each successful research project should lead to a number of publications in scholarly journals. The hospital wishes to monitor the publication activity of individual researchers – and to this end wants the new system to record, for each researcher, the title of all published articles, together with the title of the journals in which they were published and the date of publication. Note that a single project may generate a number of articles, and an article may have several authors.

The above is a basic outline of the scenario for the new system. The new system must be able to produce a number of useful reports to satisfy the requirements of its stakeholders. You may make any reasonable assumptions in the course of constructing your database for the proposed system.

APPENDIX 2 – Groupwork Questionnaire

(semi-Scrum study)

APPENDIX 2 – Groupwork Questionnaire

(semi-Scrum study)

Questions: Likeart scale of 1-5

Please indicate your agreement or otherwise with the following statements:

1. It is important to have total transparency within a group
2. The use of Scrum improves transparency in group work
3. I felt I knew what each group member was doing throughout the first assignment
4. I felt I knew what each group member was doing throughout the second assignment
5. I found the management of the first assignment an improvement on the second where a product backlog was used
6. I found that the second assignment was better managed than the first
7. I felt my group followed the Scrum processes properly
8. I feel that using the product backlog for the first assignment could have improved the group work experience
9. Asking all group members to use only the group tools available on Blackboard would improve transparency.

Open questions:

10. What method of group communication would you prefer to use?
11. What comments or suggestions do you have for improving the group work experience for future assignments?

APPENDIX 3 – Coded ladders for each participant

APPENDIX 3 - Coded ladders for each participant									
Sample ID	Ladder ID	Year	A	B	C	D	E	F	Ladder length
1	1	3	1	13	11	16	12	21	6
1	2	3	2	13	25				3
2	3	3	3	11	13	23			4
2	4	3	1	14	16	13	23		5
3	5	3	1	10	12	23			4
3	6	3	2	11	12	25			4
3	7	3	2	11	15	22			4
4	8	1	1	10	16	13	12	25	6
5	9	3	1	13	16	12	23		5
6	10	3	3	10	16	12	26		5
7	11	3	3	14	13	14	23		5
6	12	3	1	13	10	16	12	25	6
7	13	3	4	13	10	22			4
8	14	3	3	10	12	23			4
4	15	1	2	10	15	22			4
8	16	3	2	13	14	23			4
9	17	1	4	15	16	22			4
10	18	3	1	16	11	13	26		5
9	19	1	3	11	14	12	21		5
10	20	3	2	14	22				3
9	21	1	5	14	12	23			4
11	22	1	1	10	15	13	22		5
11	23	1	7	1	10	23			4
11	24	1	3	11	14	12	21		5
11	25	1	2	15	22				3
12	26	3	1	13	13	12	21		5
12	27	3	3	14	13	23			4
12	28	3	4	10	15	13	22		5
13	29	3	1	11	13	16	23		5
14	30	1	7	13	13	23			4
15	31	1	2	14	16	22			4
15	32	1	3	16	12	25			4
15	33	1	5	15	13	21			4
16	34	1	1	11	13	16	23		5
16	35	1	2	10	12	23			4
17	36	1	2	11	13	14	23		5
17	37	1	4	11	14	26			4
18	38	1	4	14	12	23			4
18	39	1	1	13	12	23			4

19	40	3	4	14	16	15	23		5
19	41	3	3	10	16	12	23		5
20	42	3	1	13	12	25			4
20	43	3	4	16	13	25			4
20	44	3	6	14	16	12	25		5
21	45	3	4	13	22				3
21	46	3	1	13	24				3
22	47	3	2	16	22				3
22	48	3	1	10	12	25			4
23	49	1	4	13	12	21			4
24	50	1	4	13	12	23			4
24	51	1	3	10	12	23			4
24	52	1	1	10	13	12	25		5
23	53	1	1	11	13	23			4
23	54	1	3	11	12	21			4
23	55	1	3	13	24				3
26	56	1	4	11	13	23			4
25	57	3	2	11	10	26			4
26	58	1	4	14	16	25			4
25	59	3	7	11	16	26			4
26	60	1	4	13	12	23			4
27	61	1	3	11	13	12	21		5
27	62	1	2	14	16	22			4
28	63	1	2	14	12	25			4
28	64	1	3	14	16	22			4
29	65	1	5	14	13	16	23		5
29	66	1	3	14	16	12	26		5
30	67	1	1	10	13	12	25		5
30	68	1	2	11	13	12	25		5
31	69	1	2	11	13	12	21		5
32	70	1	2	13	11	12			4
32	71	1	3	10	16	22			4
33	72	1	1	13	25				3
33	73	1	6	10	12	25			4
33	74	1	2	15	22				3
34	75	1	1	13	12	23			4
34	76	1	2	14	26				3
35	77	3	7	1	10	13	23		5
35	78	3	3	15	14	16	25		5
35	79	3	1	11	12	21			4
36	80	3	7	1	10	15	25		5
36	81	3	6	4	14	25			4
36	82	3	4	13	24				3
37	83	3	7	1	10	15	25		5
37	84	3	3	10	12	21			4
38	85	2	5	14	16	22			4

38	86	2	6	13	24				3
38	87	2	77						0
39	88	3	5	14	16	22			4
39	89	3	6	14	24				3
39	90	3	7	14	16	22			4
40	91	3	5	14	16	23			4
40	92	3	6	14	24				3
40	93	3	7	11	13	12	25		5
41	94	3	1	13	23				3
41	95	3	4	14	16	23			4
41	96	3	6	11	14	25			4
42	97	3	2	11	10	12	25		5
42	98	3	3	14	16	12	23		5
42	99	3	7	16	23				3
22	100	3	7	16	26				3
43	101	1	1	10	15	22			4
43	102	1	4	14	16	23			4
43	103	1	3	11	13	12	25		5
Total elements:									428
Average ladder length:									4.20
Average no. of ladders per respondent:									2.37

APPENDIX 4 - Student Group Project

You are required to work in groups of 5-6 students to propose a solution to a problem outlined in one of the two scenarios below:

SCENARIO A:

The pandemic has altered the way we live, learn and work. Many people and organisations are now favouring a hybrid physical / virtual approach to learning and working.

> *Please propose a creative technology-enabled solution to enhance people's experiences in this hybrid world.*

OR

SCENARIO B:

Young people are bombarded by information about career choices from multiple sources. There is an almost infinite range of job options, industry sectors, and routes into them (e.g., training courses, apprenticeships, and degrees).

> *Please propose a creative technology-enabled solution to help students and young people assess the options available and make choices that will suit them.*

Your group is required to provide:

- A 15 minute presentation, followed by 5 minutes of questions, incorporating:
    - A five minute 'promotional' video, selling your solution/idea to potential investors. This can include music and animation. All group members should be involved or feature in this video.
    - Evidence of the research and processes that members undertook in the development of their solution.
    - An overview of your group's collaborative learning experience, which should refer to evidence of group members' interactions and product backlogs posted in the group's Blackboard account
- Entries in the group's Blackboard Group facility showing individual contributions and interactions, as well as regular Product/Sprint Backlog updates.

Each member of the group is required to submit:

- A completed peer assessment form.

APPENDIX 5 – Full Scrum study questionnaire

No	Question	1 Strongly Disagre	2	3	4 Neither agree nor disagree	5	6	7 Strongly Agree
C1	Group members were able to express all ideas and feelings with one another throughout the project.							
C2	Group members were actively communicated with other members of the team							
C3	Group members were not empowered to share their thoughts without any fear of repercussion							
V1	I knew which member was doing which task, which tasks had already been completed and which were still being worked on throughout the project.							
V2	It was easy to see the current status of the assignment at any time by looking at the product backlog							
V2	I was not happy to make all my inputs and work visible to the whole team							
H1	I did not feel group members acted honestly at all times							
H2	The Scrum processes (eg Scrum face to face meetings and product backlog) encourage honesty in team members							
H2	I acted honestly throughout the process							
A1	The use of the product backlog showed clear accountability							
A2	The Scrum process ensured that team members were accountable for their tasks							
A3	Team members carried out the tasks they were assigned							
R1	There was mutual respect shown by team members throughout the Scrum project							
R2	Members were never dismissive of another's suggestions							
R3	Members valued the opinions of other members							
SP	Overall, I felt that using Scrum worked better for me than using other group management methods							
T1	I believe that it is necessary to have full transparency in group work							
SO	Overall, I felt that using Scrum helped to produce better grades than if it were not used							
	Please explain/provide any further comments:							
GO	Overall, I was happy with the group's outcomes							
ST	Overall, I was happy with the tools provided to support the Scrum process (Blackboard File exchange, Blog etc)							

	Which of the following options do you feel best supports transparency for groups (ie enabling everyone to know what is going on at all times). Please rank these from 1 (best) to 4 (worst)	RANKING:		
	Face to face meetings:			
	Including the tutor in the group:			
	Maintaining a product backlog:			
	Using a single platform or app to communicate with the team members:			
	Any further comments on tools/support for the Scrum process?			
SP 2	Would you be happy to use Scrum for future groupwork assignments	Yes		No
	What improvements would you like to see to the way the group work is conducted?			
	Had you undertaken a groupwork assignment using Scrum/Backlog prior to this assignment?	Yes		No
	What is your age?	<20	20-29	30+
	What is your gender?	M	F	Prefer not to say
	What is your group number? (optional, but useful!)			
	What is your student number (optional, but useful!)			
	Do you have any final comments regarding using Scrum for the assignment?			

Thank you for completing this questionnaire.

APPENDIX 6 – Peer Assessment Form

Instructions:

1. Work out the total marks available for redistribution, using the formula:

   NUMBER OF GROUP MEMBERS multiplied by 5 marks

   Ie if 4 group members: 4 x 5 marks = 20 marks to distribute

   If 5 group members: 5 x 5 marks = 25 marks to distribute

   If 6 group members: 6 x 5 marks = 30 marks to distribute

   If your group contains 'virtual' members (ie who have not turned up or done any work at all) then please discount them from the group total.

2. Give each of your team (including yourself) comments and a mark based on **criteria agreed between all group members at the start of the assignment (these should have been uploaded to your group's file exchange area at the start of the groupwork).**

   (Egs:

   * Punctuality/Attendance at seminars/ group meetings arranged outside seminar sessions
   * Contribution to the assessment tasks
   * Ability to meet deadlines set by the group
   * Evidence of good team working skills etc)

The focus is to identify strengths, weaknesses, and areas that require improvement. Please provide some positive comments about your own and your members' involvement in the group process, also provide constructive comments for areas that they need to work on. Allocate marks to each of your group members, including yourself, **such that the total adds up to the number of marks obtained from step 1** (eg 20 marks in the case of a group with 4 members, 25 marks for a group with 5 members etc, 30 marks for a group with 6 members etc). Use the template below.

Note: the evaluation must be based on concrete evidence from team meeting minutes, product backlogs, blog entries, work uploaded to your group's area on Blackboard, and so on.

This form is **confidential** and must be submitted separately by each team member using the separate link provided. However, you are asked to indicate on the form if you are happy for your tutor to use your comments (anonymously) to compile summary feedback for each group member, which will be forwarded to each group member separately. The aim of this is to identify areas that the group member excelled in, as well as areas that he/she needs to work on, which will impact positively on any future group work.

If you do not wish your feedback to be conveyed to fellow group members, then please indicate 'NO' for 'Use comments (anonymously)'.

PEER ASSESSMENT FORM (Example)

Name of student filling out this form: xxxxx SNO: xxxxx Group Number: xxx Use Comments (anonymously) Yes/~~No~~ (please indicate which applies)		
Member	Mark	Justification for mark
xxx	7	xxx was full of ideas was a great asset to our team. He was also able to keep the structure within our plan and had a lot of experience when it came to the product design and Microsoft Powerpoint. xxxx was able to identify the importance of this group project and always go above and beyond to ensure that we had completed all necessary tasks whether it was him taking over or delegating to others.
xxx	2	xxx received the least marks as he had very little input throughout the whole process. He failed to attend two meetings and had no communication with the team. He failed to look at the meeting minutes or the product backlog on time for at least 4 weeks. At the start of our meetings, the files should have been uploaded to file exchange on blackboard already but xxxx's were not. This was very frustrating as no one actually knew if he had done any work. It wasn't until week 6 that we realised he didnt have any input in the product pitch as his absence resulted in other team members having to do his parts of the tasks which were set. He should have at least bought it to our attention so I'm unsure as to why he didn't. xxx was kind enough to let him take over part of the work that he did. xxx understood the Belbin roles so we agreed that he could do this part of the second half of the presentation. Therefore I decided to give him 2 points.
xxx	4	xxx wasn't much of a person who had ideas for the group work, but he was always open to take part in the tasks which we set for each other every week. He was also good with the research that he did. xxx got a lower mark than xxx, xxx and me simply because he was a little too quiet and didn't come up with as many suggestions as we did. He came to every meeting, but his downfall was submitting his parts of the tasks which we set to Blackboard, leaving the rest of the team unsure if he had completed. He did have more input than xxx and xxx so therefore, I have given xxx 4 points.
xxx	3	xxx received quite low marks as he failed to attend two meetings and had no communication with the team. He also failed to look at any meeting minutes or the product backlog on time on occasions, resulting in other members of the group having to do his parts of the work. From the very beginning it seemed as if he was not taking the group work seriously as he offered to take our very first meeting minutes but duplicated on some of the points, causing a mishap with the tasks set which resulted in two people doing the same task and was not willing to rectify anything. Xxx was one who had the least input for the group work as a whole.
xxx	7	I personally think I done a good job with the group project in terms of work rate and being reliable. I was also able to assist xxx and xxx with any ideas that I had. My only downfall I'd say is I wasn't able to keep my annoyance with xxx and xxx under control which resulted in me having an argument with xxx. I'm always honest when it comes to people and at that point in time, I believe I was very honest with my thoughts on their behaviour and how they were treating this assignment. I was annoyed as it was supposed to be group work between the six of us but I need to learn and try harder next time to stay calm and move forward to avoid any confrontation.
xxx	7	xxx was out of the country, and he also caught covid once he arrived so we didn't meet face to face until our second to last week, but he did not let this hinder his input into the group work. If xxx or me had any ideas, we would include the team in on our thoughts and he would always be one of the first to say his opinion. He was also thoughtful with suggestions for the product we chose and was able to come up with amazing ideas which helped solidify the product.
TOTAL:	30	

APPENDIX 7 – Guidelines and Recommendations for implementing Scrum in HE

Element and Scrum Description	Options and comments on application to student projects
Roles: Product Owner The project's key stakeholder	Options will depend on the nature of the project and degree of support available. *External owner: For external projects Using any external agent raises practical issues, e.g. availability for Scrum meetings. *Tutor: Suggests topics to be worked on by students Gives generic advice and feedback; however, this is not ideal for large cohorts as it is likely to incur high workloads. *The student group as a whole acting as the product owner for creative projects with flexible outcomes *Using a student from another group as the product owner, with other groups reciprocating. This presupposes those projects are unique and product owner status will not derive some advantage for the other team. *Alternative 'market research' student Where teams carry out 'consumer research' on the viability of an idea with students, one of the students could be recruited as product owner. This requires some long-term commitment from that student, which may not be possible to obtain.
Roles: Scrum Master Facilitating communication and leading the team through the Scrum processes	Options for students: *Single Scrum Master for the duration of the project. This ensures stability and continuity of processes but puts pressure on the student taking on this role. Also denies other students the opportunity to gain Scrum master experience *Rotating Scrum master Allows all team members to gain experience. If rotating, it must be for a minimum of a whole Sprint.
Roles: Development Team Self-organising team members charged with using their combined skills to complete a project	Options: *Teams formed by students Danger of like-minded students not having enough diversity * Randomly selected by the tutor. Likely to produce more diverse groups providing a more 'true to life' experience and avoiding the 'similarity attraction paradigm'.
Artifacts: Product Backlog A prioritised list of all the tasks that need to be completed for the project to be successful.	*At the start of the project the team (with some generic guidance from the tutor) will need to think through the different tasks that are required to complete the project successfully and list them on a spreadsheet (or other tool). This could be a list of course-grained tasks that can be decomposed later in the project. *Indication of timescale should be provided. *All versions of the product backlog should be uploaded by Scum master to the LMS and be visible by all team members.
Artifacts: Sprint Backlog A subset of the product backlog that the team agrees they will deliver in a Sprint.	*For each Sprint, a set of product backlog tasks are highlighted for completion. *For accountability, effort should be taken not to duplicate tasks, but to define specific tasks that can be clearly linked to individual group members. *Once a set of tasks have been agreed for a Sprint it cannot be changed for that Sprint. *The updated Backlog spreadsheet showing the items chosen for the Scrum is uploaded to Blackboard by the Scrum master.
Artifacts: Product increment The output of the Sprint.	*The tasks that were agreed to be delivered in each Sprint are uploaded to the LMS by individual team members, as per the Sprint backlog. *To make the job of tracking completed tasks easier, a common file naming convention should be established and followed.
Artifacts: Burndown Chart	*Once tasks have been identified, a simple burndown chart could be created using a simple visual tool such as the line chart option available within Excel. This would be updated regularly at the end of a Sprint.
Events: Daily Stand Up Daily meeting. Members report on what they did since the last	*Daily stand ups will depend on timetable constraints and are more likely to be weekly or bi-weekly 5-10 minute stand ups at the start of timetabled classes. *Students should conform to the uncomfortable condition of standing up to encourage brevity of meetings.

stand up, what's planned for today, and any problems.	*Each team member answers three questions, 1)"What have you done so far?", 2)"Have you found any problems?", 3)"What are you planning to do by the next meeting?"
Ceremonies: Sprint Planning Occurs at the start of each Sprint. The product backlog is examined, and a subset of tasks are identified for inclusion in the next Sprint.	*Sprint duration will depend on the length of the overall project, but length is typically two weeks; *For each Sprint, a set of tasks are agreed and highlighted on the Backlog for completion, team members decide on the tasks they are to complete and the name of team member and agreed completion date inserted against each task. *The updated Backlog spreadsheet showing the items chosen for the sprint is uploaded to Blackboard by the Scrum master.
Ceremonies: Sprint Review Occurs at the end of each Sprint. All team members (and product owner) are present. The Sprint deliverables are reviewed to establish whether they are complete.	*Due to timetabling restrictions, it is unlikely that a Sprint Review meeting or Sprint Retrospective can be set up during timetabled class sessions, so this requires an additional weekly or bi-weekly meeting (depending on the length of the Sprint), outside of timetabled hours. For practical purposes, the two meetings will be run as a double meeting, with Retrospective immediately following the review. *Because of the importance assigned to meetings, there should be a brief record kept of each meeting, showing date, location, attendees, and actions, posted to Backboard after the meeting. Although Scrum does not require this, it is an important element in control and transparency of the process. The meeting minutes should be uploaded to the LMS by the minute taker. *The Sprint review establishes whether the tasks that have been allocated to each team member have been posted to Blackboard and have been accepted and starts the team thinking about the next Sprint. *Those tasks that have been delivered successfully will be marked as 'completed', and the completion date added to the Sprint backlog. *Any that are outstanding will be discussed with the member to whom they were allocated (if present) and depending on the circumstances the deadline may be extended, or the task passed on to another team member for completion. The new deadline/new team member will be recorded on the Backlog. *In the Retrospective meeting students reflect on how the Sprint went with regards to processes, relationships and outputs, using techniques introduced by tutors.
Ceremonies: Sprint Retrospective Occurs at the end of each Sprint. Team members and Scrum Master have a chance to reflect on good practices that the team should adopt and to discuss what could be improved on. Scrum Master encourages all members to speak up and share their feelings.	