Learning opportunities and diversity of engineering students' background in interdisciplinary group projects

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Abstract

In line with business goals of customer satisfaction, higher education institutions of learning consider excellent student experience a priority. Teaching and learning are important aspects of satisfaction that are monitored annually by universities using tools such as the NSS. NSS results are useful for educational planning and informing consumer choices. This research measured undergraduate student experiences on an interdisciplinary project using the NSS framework. Hinged on diversity, the purpose was to investigate whether full time, part time and degree apprenticeship students with varied work experience enhance their learning studying together on an interdisciplinary project.

This research has measured, using National Student Survey (NSS) criteria, student experiences on an interdisciplinary project on a civil engineering programme. It benchmarks the quality of learning and student understanding and perceptions of learning. The method is based upon a literature review and questionnaire survey of students.

Results indicate good amounts of peer influence on learning in a simulated interdisciplinary team setting supported by a mix of diverse work experience in students' background. Sections of the NSS are extended with additional questions to capture the impact that full-time, part-time and degree apprenticeship study modes, closely associated with students' background of job experience, have on teaching and learning.

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Purpose

In line with business goals of customer satisfaction, higher education institutions of learning consider excellent student experience a priority. Teaching and learning are important aspects of satisfaction that are monitored annually by universities using tools such as the NSS. NSS results are useful for educational planning and informing consumer choices. This research measured undergraduate student experiences on an interdisciplinary project using the NSS framework. Hinged on diversity, the purpose was to investigate whether full time, part time and degree apprenticeship students with varied work experience enhance their learning studying together on an interdisciplinary project.

Findings

Results indicate good amounts of peer influence on learning in a simulated interdisciplinary team setting supported by a mix of diverse work experience in students' background.

Originality/value

Sections of the NSS are extended with additional questions to capture the impact that full-time, part-time and degree apprenticeship study modes, closely associated with students' background of job experience, have on teaching and learning.

Keywords: Diversity, study mode, work experience, NSS, interdisciplinary, student satisfaction.

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1. Introduction

Student population in popular educational destinations can be diverse in numerous ways including country of origin, religion, sex, gender and mode of study. In the United Kingdom (UK), a popular educational destination, approximately 20% of the 2019-20 total student population were international students, 49% had no religion and 57% identified as females according to the Higher Education Statistics Agency (HESA, 2020). Records for 2019/20 indicate full-time (FT) and part-time (PT) study modes of the total UK student population to be 80% and 20% respectively (HESA, 2020) with an overall course satisfaction of 84% (OfS, 2020). In such internationalised higher educational settings, the diversity of the student population poses challenges to teaching and learning. How tutors handle challenges associated with diversity, encouragement of active learning and engagement, and arouse enduring critical thinking have been areas of concern in enabling all-inclusive learning in mass higher education (Bamber and Jones, 2015). Bamber and Jones (2015), however argued that there are learning opportunities in diversity.

Regarding learning opportunities connected to different aspects of diversity, study mode is of most interest. Degree apprenticeships (DA) are a recent and important Level 6 addition to mode of study in higher education institutions, supported by substantive Government funding through the apprenticeship levy (Lester, 2020; Rothera, 2020). A total of 30,500 starts on Level 6 apprenticeship programmes were recorded in England for 2019-20 (National Statistics, 2020). Lester (2020) argues that about all English higher education institutions are registered as apprenticeship providers in the bid to engage with industry and support economic priorities. The DA programmes benefits from strong institution–employer partnerships and are suggested to aid public-sector recruitment, support progression routes and social mobility within existing workforce streams and enhance recruitment in public services and economically critical industries (Lester, 2020; Rothera, 2020). The research question, therefore, is 'what learning advantages do FT, PT and DA students bring to higher educational settings?". To explore the research question, this paper discusses our work aimed at investigating whether having FT, PT and DA students together on

an interdisciplinary module enhanced their learning. The objectives were to (i) appraise the challenges and opportunities diversity brings to learning with a focus on mode of study in interdisciplinary settings, (ii) examine the effects of FT, PT, DA modes of study in an interdisciplinary educational setting and (iii) evaluate findings and make recommendations.

The authors took advantage of the final year interdisciplinary module in the Civil Engineering department at a university in the UK and the design of the National Student Survey (NSS) to gauge perceptions of FT, PT and DA students. In the setting of this research, the latter students studying as PT and DA, have some industry experience. PT students may switch between studies and work in simultaneously integrated fashion with or without the support/consent of their employers. The DA strand of study mode is essentially a work-integrated learning approach with employers committed to providing a workplace mentor for student learners (apprentices) and making 20% off-the-job learning/training hours possible (Lester, 2020; Lillis and Bravenboer, 2020). Such groups of students tend to be well focussed, possess good interpersonal skills and highly self-driven, bringing vital work-based skills to the table and creating opportunities for cohorts with mixed backgrounds to benefit (Vaezi-Nejad, 2008; Boveda and Aronson, 2019). Probing the impact of study mode (diversity) on student satisfaction based on the NSS framework is new. The NSS and annual surveys alike have been advantageous in providing statistics for prospective customers and to aid decision-making in educational planning and setting policies (Fielding *et al.*, 2010). Research works on student satisfaction based on NSS have largely been about the interpretation of NSS items (Bennett and Kane, 2014) and students' understanding of the meaning of feedback (Mendes *et al.*, 2011). Investigations into whether mixed backgrounds of students add to their learning experience is particularly important in engineering fields where interdisciplinary team building is often encouraged. The quest therefore is to explore how the relative experience of FT, PT and DA students contributes to learning and the criteria of interdisciplinary teamworking skills advocated by engineering education accreditation boards across the globe. Related works are explored in the literature review and a description of the research approach is given in the method section. Other parts of this paper include a description of the interdisciplinary project implementation, results and analysis of the survey and

inferences on variability in survey items/factors. This is penultimately followed by an accompanying discussion on the influence of student background on interdisciplinary learning and then the conclusion section.

2. Literature review

Learning opportunities for students in higher education are vast and varies from one discipline to another. A combination of factors related to the higher education environment, economic standing of the students and social inclinations influence student experiences and satisfaction in programmes of study. Often, such factors are not solely dependent or entirely within the control of students, their teachers or the institutions of higher education. Notwithstanding each party has a role to play in driving satisfaction of customers which in this case is students. In highly internationalised educational institutions, there is bound to be a wider range of diversity in student populations. Such diverse populations, though a challenge to deal with, have important roles in both interdisciplinary group learning and problem-based learning (PBL) approaches. These aspects and means of measuring course satisfaction in student learning are discussed here.

2.1 Challenges and opportunities with diversity

The population ratio of full-time (FT) to part-time (PT) students studying in the UK have been between 3:1 and 4:1 from 2015/16 to 2019/20 (HESA, 2020). The fact that the UK is a popular international educational destination, adds additional dimensions of diversity to the student population. It is important that tutors respond to various dimensions of diversity in a positive light by encouraging active learning and engagement, while provoking critical thinking in an all-inclusive way (Bamber and Jones, 2015). The right response of tutors is made even more crucial owing to the vast nature of diversity encompassing religion, ethnicity, gender, age, sexual orientation, disability, relationships, educational attainment and mode of study (FT/PT). This list is by no means exhaustive and in recent times, has had the addition of degree apprenticeship (DA) as a common mode of study in higher education institutions (Lester, 2020; Rothera, 2020). While the challenges of coping with the variance in social dispositions and capabilities comes with the diversity of student population, there are also great opportunities to the advantage of learners and teachers alike. Figure 1 shows a summary of the authors' abstractions on

opportunities and challenges with diversity in course of this research. Thus, diversity can create better environments for peer learning among students with wider backgrounds and range of job experiences. Right diversity management practices by individuals and institutions, tailored into programmes and policies to enhance equality (Nkomo and Hoobler, 2014) is therefore important in popular educational destinations.

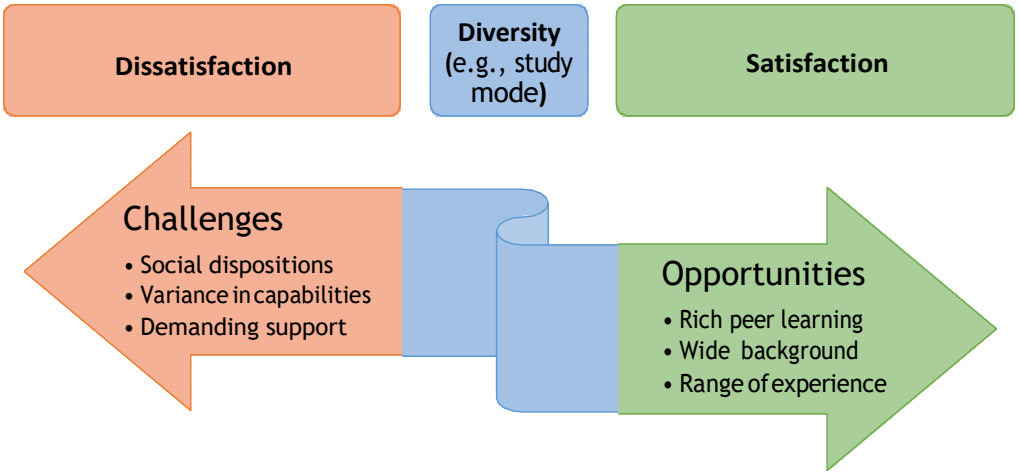


Figure 1: Challenges and opportunities with diversity in learning

It is worth mentioning here that diversity management practices, in as much as learning, can be affected by intersectionality within different diversity groups (Ro and Loya, 2015; Boveda and Aronson, 2019; Dennissen *et al.*, 2020). A term first coined by Crenshaw (1989), intersectionality refers to the varied complex interactions amongst multiple categories of differences (Davis, 2008; Holvino, 2010; Dennissen *et al.*, 2020) which could help reveal points of connections between multiple intersecting identities and personalities of social actors (Richardson and Loubier, 2008). Regarding learning within or amongst FT, PT and DA diversity groups in highly internationalised student populations, the intersecting identities can vary. For example, PT and DA students are considered to possess some level of job experience from different disciplines but it is also possible that some FT students may have worked for some period before commencing full time education. In addition, the level of work experience in terms of number of years and relevance of the job engagement/role to the subject of study can be complex deciding factors of learning gain for students. Further, international students who may fall into any of the three study mode groups could be disadvantaged or advantaged by their

social/cultural inclinations to strange learning approaches/environments and perhaps compounded by their disciplines. The understanding of the dynamics of intersecting identities in harnessing opportunities in diversity of different learner groups/disciplines is suggested as vital for tutors (Boveda and Aronson, 2019).

2.2 The role of interdisciplinary learning in higher education

There is a consensus among engineering education boards across the globe about the importance of interdisciplinary teaching and learning in the training of engineers. The Canadian Engineering Accreditation Board requires for the purpose of accreditation, and as an important graduate attribute, that students have the ability to work effectively as members and leaders preferably in multi-disciplinary teams (Canadian Engineering Accreditation Board, 2007). Also Criterion 3 of the Accreditation Board for Engineering and Technology, USA specifies that engineers must have the ability to function in multidisciplinary teams (Accreditation Board for Engineering and Technology, 2002; Rover, 2002; Rover *et al.*, 2014). Similarly, the aspect of experience working with engineering teams is specified as an important graduate capability by Engineers Australia in charge of developing and administering the Accreditation Standard for Higher Education (AMS-STD-10 Version 1.0). This is one of the essential criteria that embodies the purpose for engagement with professional Practice (AP4) stipulated in the Australian Accreditation Management System (Engineers Australia, 2017). Equally, the UK Engineering Accreditation Board stipulates Engineering Practice 11 (P11) skill and Additional General Skills 4 (G4) around working competently in engineering teams. Aspects of competencies cover awareness of team roles, ability to work effectively as a team member, understanding and working in different roles in practice and exercising the general skills of good initiative and personal responsibility in teams (Engineering Council UK, 2003).

While the essence of working effectively in a multidisciplinary setting is widely recognised as an essential engineering requirement, the challenge lies with how associated skills can be developed by engineering students in training. Beyond the options of instilling awareness of the essence of teamwork in classroom settings (lectures and discussions), institutions of higher learning have developed targeted strategies to arouse team skills in students. One good approach has been the use of

industry/work placement modules, which is suggested to be beneficial to both students and industry (Vaezi-Nejad, 2008). In engineering education and other professions alike, it is opportune for students to develop transferable skills during placements, as industry trains students tailored to specialised industrial careers or fields. Research (Matsouka and Mihail, 2016; Tennant *et al.*, 2018) suggests teamworking as one of the most important transferable soft employment skills that can be acquired by means of work/industry placements. Another approach is incorporation of group tasks and assignments into modules, to allow students to work together in their conventional student capacity to produce required outputs. However, this is argued to be inadequate in engineering education as it does not replicate multi-disciplinary settings evident in industry, as stipulated by accreditation boards (Davies and Devlin, 2007; Gallegos and Peeters, 2011). Research suggests that specialised models with clear objectives are required to develop team skills in students (Gallegos and Peeters, 2011; Murzi *et al.*, 2020). Hence, dedicated modules where students assume interdisciplinary and different professional roles, similar to those in industry, is now popular in institutions of higher education. This has become a preferred approach in developing requisite multidisciplinary team skills in engineering education.

Interdisciplinarity goes beyond using single/disciplinary methods and can be considered as harnessing both multidisciplinary and transdisciplinary approaches to solving problems (Borrego and Newswander, 2010). Multidisciplinary entails a weak connection of people from different (multiple) disciplines working together (Lattuca, 2001), while overarching theories transcending traditional disciplines remains the focus of transdisciplinary collaborations (Klein, 2001). Thus, in interdisciplinary settings, expertise from two or more disciplines should combine to address an area of common concern in alliance (Davies and Devlin, 2007). Usually, the topic/problem under investigation presents extreme complexities that become too difficult for one discipline to handle. Such is typical of many engineering problems in industry. Thus, the viewpoint from different disciplinary perspectives towards subjects/problems can impact individual professional's opinions which aligns with Standpoint theory, a modernistic approach to analysing people's perception (Kumar, 2018). Standpoint theory argues that social dispositions about a subject are products of individuals knowledge which is experiential (Ritter and Mellow, 2000). Solutions from meaningful

debates and dialogues can therefore be born out of different sufficiently robust articulated perspectives of contrast in professional practices (Ferreira *et al.*, 2009). As such, an important area of interest is how interdisciplinarity is simulated in educational environments and administered in conventional study modules or subjects. The civil engineering profession presents a good example for simulating interdisciplinary environments as it comprises different sub-disciplines such as structural engineering, hydraulics and drainage, highways and transportation, construction management, water resources and hydrology.

2.3 Promoting problem-based learning in encouraging soft skills

With its origin in medicine, the emergence, three decades ago, of problem base learning (PBL) has been useful in modelling challenges in multidisciplinary dimensions (Jabarullah and Hussain, 2019; Mann *et al.*, 2020). PBL has been noted as a good instrument for developing 'soft' skills such as communication and interpersonal relationship in students (de Villiers Scheepers *et al.*, 2018; Jabarullah and Hussain, 2019). Well modelled assessment briefs allow students to engage in real-life problem-solving tasks with open-ended answers (Chang *et al.*, 2018), and can help broaden their horizons both in integrating theory into practice and improving social skills (Ungaretti *et al.*, 2015). The PBL approach, however, is constrained to how educational institutions can integrate it into frameworks of existing traditional curricula (Mann *et al.*, 2020), and it being effective to deliver required student experiences optimally. As a form of experiential learning, PBL adequately complements numerous text-based technical knowledge requirements imparted on engineering students in traditional curricula, connected to internships/industry placements. Thus, traditional full-time students with PBL experience will be able to compare their submissions to outputs obtainable in industry, and provoke required technical improvements (Rosier *et al.*, 2016; Mann *et al.*, 2020). Where groups consist of members with broad backgrounds, reflective work and applications of latest technical solutions can be encouraged. Group members with wider and longer industry backgrounds, could become drivers and great influencers for those with less learning experience. This aspect is explored in our paper.

2.4 Gauging students' perceptions of learning and satisfaction

Surveys to gauge learning and satisfaction of students in higher education institutions are widely used in countries such as Australia, Canada, USA and UK (Bennett and Kane, 2014). In the UK, the National Student Survey has become a yearly occurrence completed by undergraduate final year students as they prepare to graduate from universities. Starting as a pilot study of 22 institutions in 2005, the integrity of the scales from the analysis of the responses and associated findings informed the continuity and spread of the NSS in England, Wales and Northern Ireland (Richardson *et al.*, 2007). NSS results have been described to be statistically robust in terms of internal consistency, construct validity and concurrent validity. As such researchers have used NSS data as a basis to make decisions for planning learning and teaching at local levels such as in the fields of Science and Engineering (Fielding *et al.*, 2010). NSS is suggested as a useful tool for gauging student experience, benchmark quality of learning, promoting students as consumers and provide useful data for the development of policies on education (Hazelkorn, 2008; Bennett and Kane, 2014). Despite the suggested benefits, the NSS is not without criticism. Yorke (2009) thinks that students' judgement of their learning may be affected by other wider university experiences thereby introducing acquiescence bias. Another critic (Law, 2010) suggests grade leniency and workload can act as remote influences on students' responses on the area/factor of feedback, and about the quality of teaching they may have received.

A total of eight factors/areas are reflected on the NSS questionnaires to capture the satisfaction of students on learning and teaching (Cheng and Marsh, 2010; Fielding *et al.*, 2010). The factors include (i) Teaching, (ii) Assessment Fairness (iii) Assessment Feedback, (iv) Support (academic) (v) Organisation (vi) Learning Resources, (vii) Personal Development, and (viii) the general aspect of Overall Satisfaction. A total of twenty-two question items are used to capture these eight factors. Depending on the focus of studies, researchers have concentrated on specific factors to fulfil research objectives. For example, Bennet and Kane (2014) considered only four aspects (teaching, assessment, feedback and overall satisfaction) to understand students' perspective of interpretation of the NSS questionnaire items. The study questioned the use of overall average values from NSS factors/items in matters of decision-making and educational management/policies as students were found to have disparate views not evident in

NSS results (Bennett and Kane, 2014). Also concentrating on the factor of feedback, Mendes et al. (2011) probed into the meaning of prompt feedback and associated student perceptions. The basis of this study was the strong argument that successive NSS results consistently highlighted feedback students receive in programmes as the lowest scored item compared to other factors of learning and teaching experience.

3. Methods

The aim of this research was to investigate whether having FT, PT and DA students together on an interdisciplinary module enhanced their learning. The accompanying first objective of appraising challenges and opportunities diversity brings to learning with a focus on mode of study in interdisciplinary settings is fulfilled via the critical review of the literature. The second objective of examining the effects of FT, PT, DA modes of study in an interdisciplinary educational setting is tackled by means of a targeted survey of students who recently completed an interdisciplinary final year module. The analysis of results from the survey using statistical tools and making inferences from discussions is directed at fulfilling the third objective of evaluating findings and making recommendations.

While the first methodological aspect of appraising previous works and gaps in the study was accomplished through literature review, the second aspect of examining students' perceptions is related to a questionnaire survey taking advantage of structured and semi-structured questions. In conducting the survey, the University's Code of Practice on Ethical Standards and relevant academic/professional guidelines have been followed to ensure anonymity and data confidentiality as required. In order not to 're-invent the wheel' and for the purpose of standardisation, NSS questions were used with slight modification. Beyond the usual demographics section, an additional question was included under the various NSS key questions/factors (see Section 2.3) to adequately relay the aim of the research and to capture more focused students' responses on the impact of mode of study. The questions focussed on how the diverse background of teams (FT, PT and DA) affect students' experience and learning. Other dimensions of diversity such as country of origin, ethnicity, disability and religion were not captured in the survey as they are outside the scope of this research. There have been several studies using the NSS

as a basis for understanding students' learning and experience including the gauging of open/remote learning programmes (Ashby *et al.*, 2011). There is another study on NSS that modified the multiple choices of the questions, reducing them from 5 to 4 to align with a bespoke analysis (Cocksedge and Taylor, 2013). In our study, the survey was targeted at two different cohorts of students that have successfully taken the Interdisciplinary module run at a UK university in the 2019/20 academic session. The first participating cohort that took the module were mostly part-time students and degree apprentices, as full-time counterparts had already graduated. The second cohort was more representative with the students' categories: FT, PT and DA participating in the survey. The total student number targeted was 16 in the first cohort and 39 in the second; a total of 55. Just 5 of 16 responded from the first cohort and 12 of 39 from the second making a total of 17 students (see Section 5.1 for more detail). The sampling strategy involved the final year Interdisciplinary Project module which has already been done by the two cohorts. Students of both cohorts were invited by separate emails to take the online survey (on Google forms) within the same time frame. Although a higher number of responses would have been better, this does not affect the exploratory nature of the study and appropriate consideration made in the interpretation of the outputs from the data analyses. The perception of the students on the influence of their background on each other and the eventual impact on learning can still be captured from the results.

Descriptive and inferential statistics have been employed in the analysis of the survey data using SPSS. While descriptive statistics is useful in understanding attributes that are apparent and the general perception of respondents, it can also facilitate analysis to support conclusive arguments (Doloi *et al.*, 2012). Further, aspects of inferential statistics are important for determining correlations in datasets and establishing normality and validity. For the normality test which helps to determine if a dataset is parametric, the Shapiro-Wilk (S-W) test is used in preference to others such as Kolmogorov-Smirnov (K-S), Lilliefors corrected K-S test and Anderson-Darling test, because of the small sample size ($n < 50$) (Ghasemi and Zahediasl, 2012). Also, there is the risk that S-W will detect non-normality for $n < 20$ sample size, so non-parametric analyses were conducted to avoid making right or wrong assumptions about distribution of the survey data. To establish correlations, the two-tailed Spearman Rho's test was used given that the direction of expected

relationship is not known, and the data violates parametric assumptions (Field, 2000). Other options for obtaining correlation coefficients, such as Pearson which is good with parametric distributions, and the Kendall Tau b which requires tied ranks; both were found not suitable in this research. Furthermore, the Kruskal-Wallis H test was deployed to determine if there were statistical significance differences among the variables since there were more than two outcomes which are unrelated (Farrell et al, 2017). The Kruskal-Wallis H is a non-parametric version of the One-Way ANOVA and provides the opportunity to determine differences across multiple datasets or occasions.

4. The interdisciplinary project implementation

In this section we relate the settings of the study and how the interdisciplinary project is conducted. Discussion encompasses a selection of projects and industry partners, characteristics of student cohorts and the module delivery approach.

4.1. Approach to project and partner selection

The design of the interdisciplinary project module is such that the focus is on achieving the simulation of real-life projects for students to work on. The approach is largely problem-based and takes advantage of collaboration of industry partners. The choice of industry partners depends on the type of project and the area of the industry in which the project is based. For Cohort 1, the project was about the design of a nuclear facility, and the industrial partners were drawn from this sector (Section 3). For cohort 2, the industrial partners were from the waste recycling and recovery industry, and the students were given the task of designing an energy-from-waste (EfW) facility. It leveraged on an EfW facility located near to the University campus. This made it possible to arrange site visits as necessary for visual learning and life experience of what was to be conceived on the project.

4.2. Background of cohorts

The diversity of student population in internationalised higher educational settings such as in the UK, comes with great opportunities, but also with its attendant challenges in learning. Elements encompassing language, background, ethnicity, class, age, sexuality, religion, disability, previous educational experience and part-time/full-time all constitute diversity (Bamber and Jones, 2015). In this research

work, the diversity area of focus is the background of students associated with their mode of study. The associated cohort of students' population is made up of FT, PT and DA. The interest is to explore if students' background in terms of job experiences aligning with their mode of study on the programme can significantly influence learning from interdisciplinary group activities.

4.3 Delivery approach

The Interdisciplinary Project runs as a core module in the civil engineering final year BEng (Hons) programme, and features in the second semester over fourteen weeks from January to May. Students are divided into groups of seven or eight ensuring that each group contains a mix of FT, PT and DA students. Within these groups students assume different professional roles similar to those in industry, in the delivery of civil engineering construction projects. The different roles were Construction Managers, Environmental and Sustainability Consultants, Architecture and Landscape Designers, Structural Engineers, Highway and Transportation Engineers, Drainage Engineers, and Geotechnical/Foundation Engineers. Student groups were given the liberty to agree on who takes up the different roles based on their interests and strengths. This helps to encourage autonomy of groups, create the sense that they are in control of the project and ensure they are happy with the tasks each is allocated (Ayres, 2015). If disputes about role/task allocation within groups arise, tutors quickly intervene to resolve such issues. The tutors, comprised of eight academics specialising in the various roles, oversaw/assessed students from the different groups taking up respective tasks.

The delivery of the module was supported by various events that encourage learning in a problem-based interdisciplinary project setting, including site visits and lectures from industry practitioners who were responsible for the live project. The study calendar is designed to encourage group interactions throughout the project duration. The outputs and elements of assessment are an inception report at about four weeks after commencement, and a final portfolio at week fourteen to include detailed proposals of designed works and a poster display, both of which are conveyed via group presentation events.

5. Research results and analysis

The results cover the demographic information of the students that responded to the survey and their perceptions of learning on the module with emphasis on contributions attributed to the mix background of study mode. Aspects of inferential statistics are covered in Section 6.

5.1 Demographic breakdown

A total of seventeen responses were received on the survey. The age range of students that responded was between 21 and 40 years and mostly dominated by male gender (88%) as typical of many civil engineering programmes (Figure 2). There was a good spread of background of students, featuring a reasonable proportion of each of the three modes of study (FT ≈ 24%, PT ≈ 41% and DA ≈ 35%) that are the diversity focus of this research investigation. More than half of respondents (60%) have between 1- and 5-years' job experience and about 20% with 6 or more years of experience (Figure 2). This appears appropriate to form a comfortable mix with approximately 20%, full time students in this case, with no job experience.

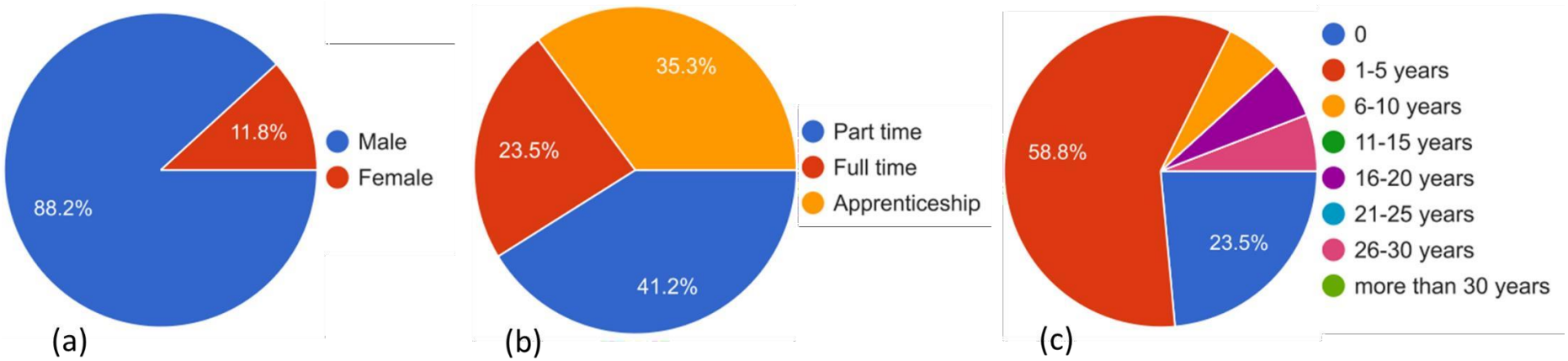
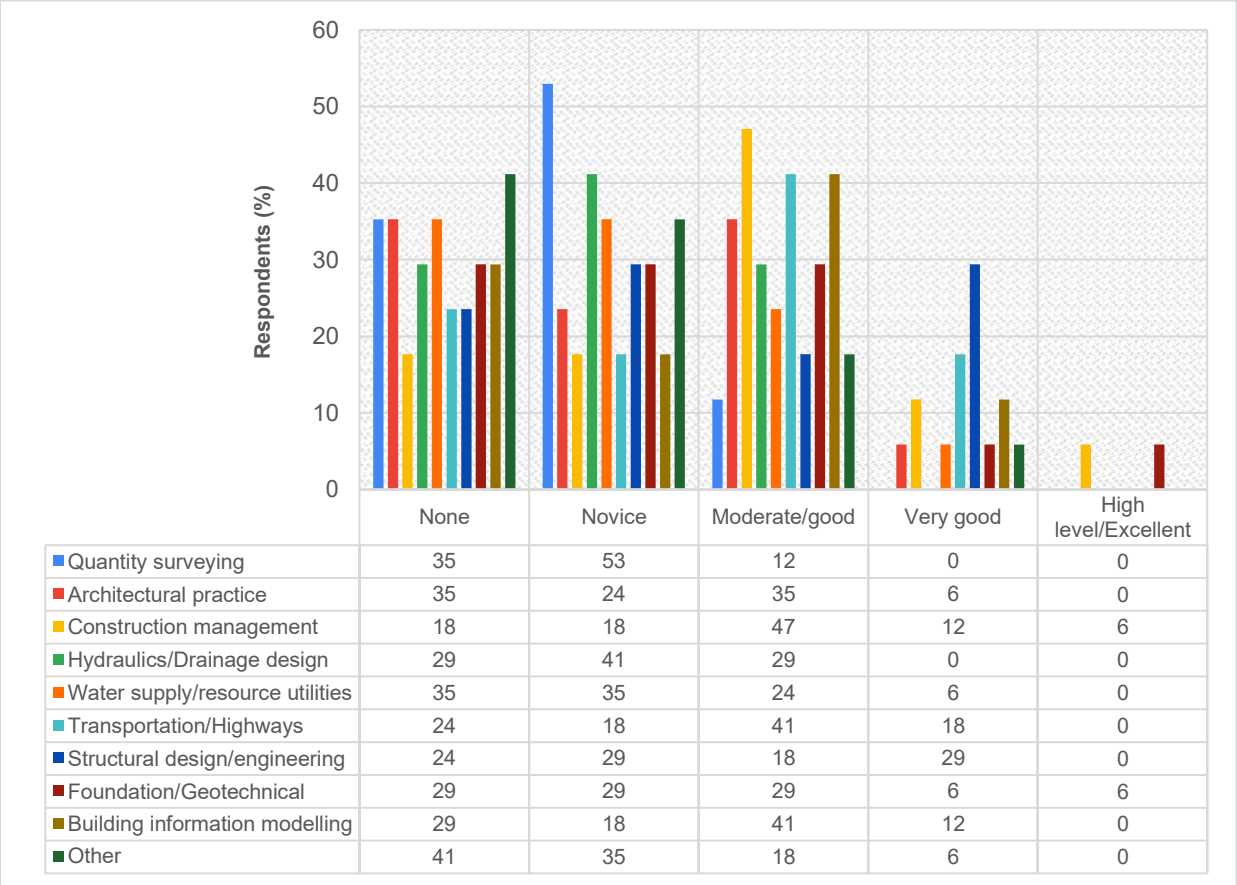


Figure 2: Demographic distribution (a) gender (b) mode of study and (c) years of job experience of students

As expected, the level of experience of PT and DA students at final stage of undergraduate studies is mostly novice to good/moderate in the various disciplines of civil engineering and construction, as depicted by Figure 3. Areas of civil engineering/construction specialisation that captured the interest of the respondents most include structural design, transportation/highway and construction management (Figure 4). These are closely followed by building information modelling (BIM) and management which is becoming the industry standard for project information management (Oti and Abanda, 2017; Tah *et al.*, 2017).



	None	Novice	Moderate/good	Very good	High level/Excellent
Quantity surveying	35	53	12	0	0
Architectural practice	35	24	35	6	0
Construction management	18	18	47	12	6
Hydraulics/Drainage design	29	41	29	0	0
Water supply/resource utilities	35	35	24	6	0
Transportation/Highways	24	18	41	18	0
Structural design/engineering	24	29	18	29	0
Foundation/Geotechnical	29	29	29	6	6
Building information modelling	29	18	41	12	0
Other	41	35	18	6	0

Figure 3:Level of experience of respondents in the various civil engineering disciplines

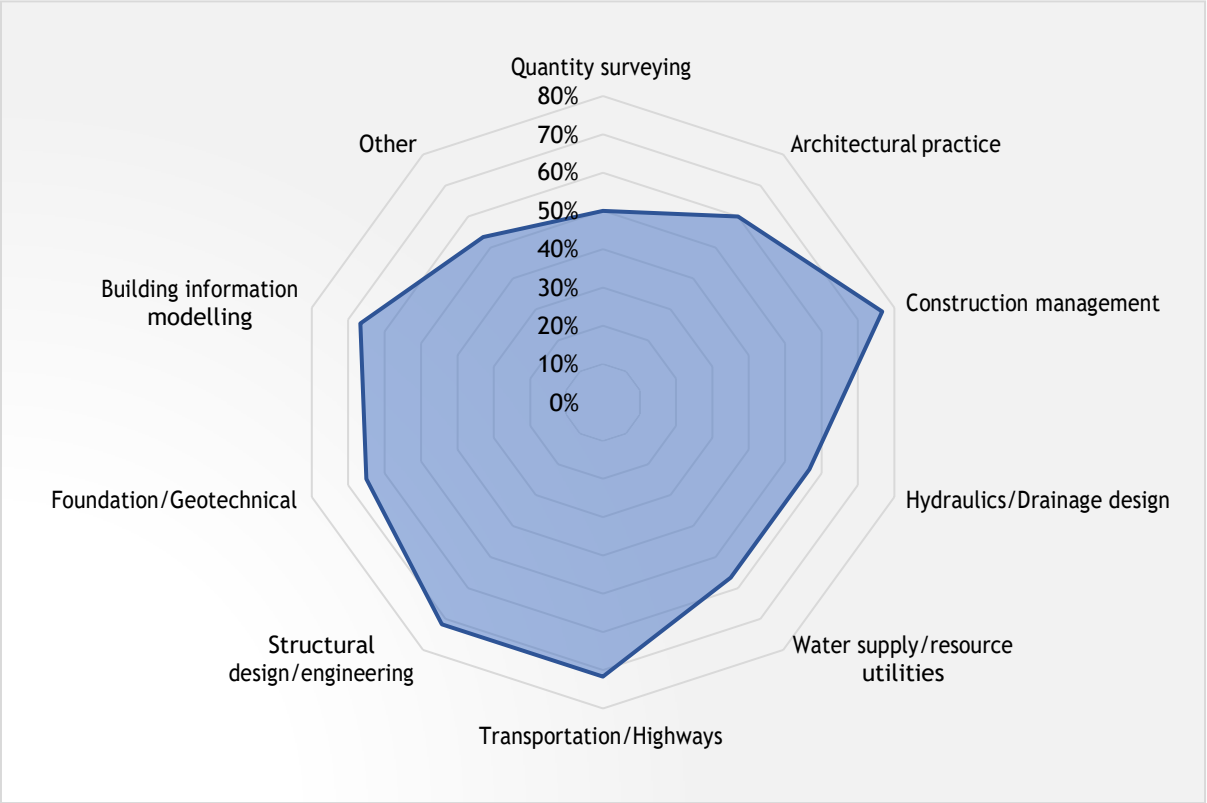


Figure 4: Interest of respondents in civil engineering/construction discipline

5.2 Influence of study mode (job experience) on learning

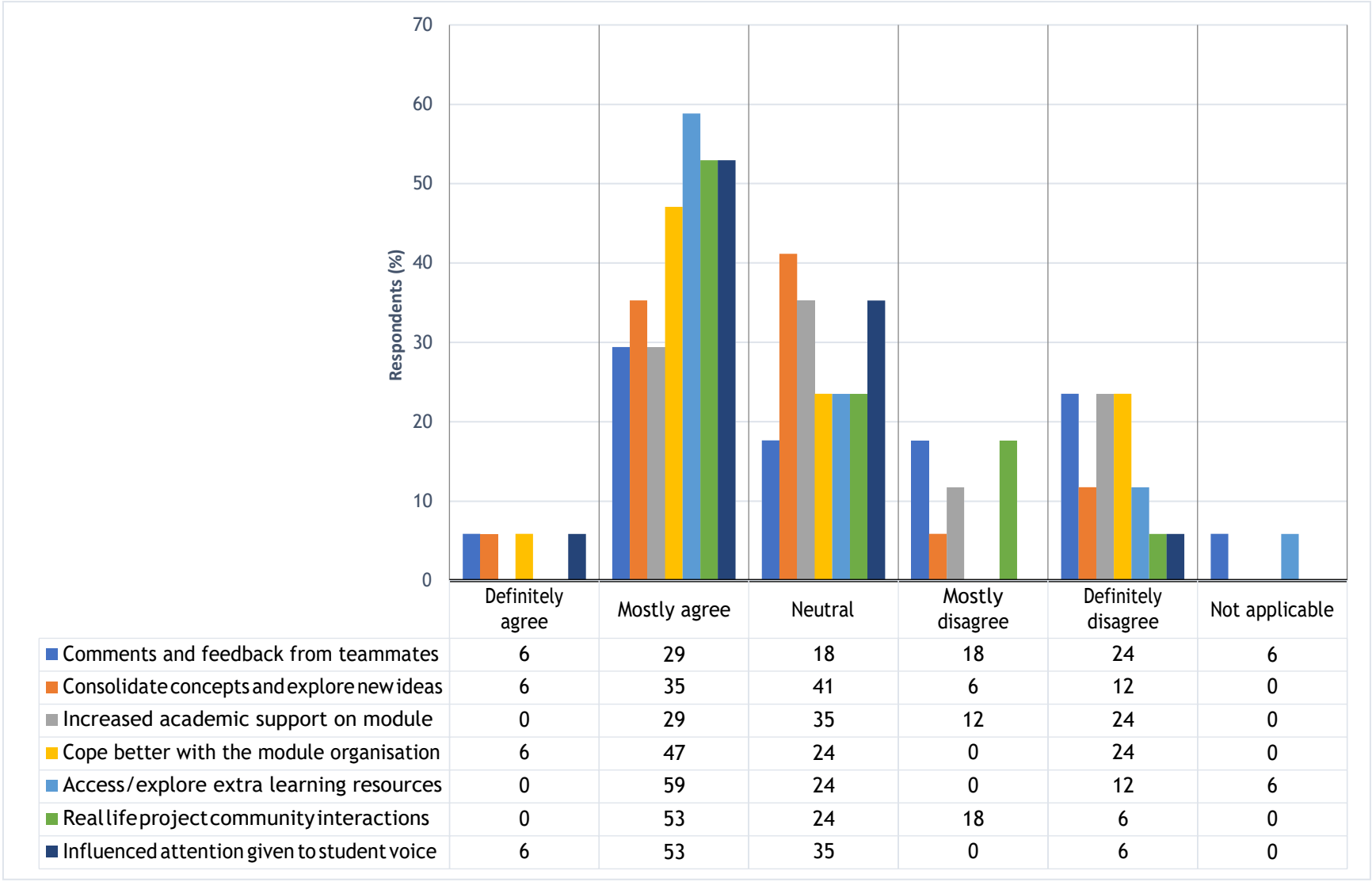
The NSS questions captured data on various areas of students' learning experience. The key areas include assessment and feedback; learning opportunities; academic support; organisation and management; learning resources; learning community; support of student voice. These key areas were covered in the questions used to gauge students' perceptions about influence the three varied backgrounds (FT, PT and DA) have on their associated learning experience. In line with the Likert scale structure, the varied response options for the statements under each question were definitely agree, mostly agree, neutral, mostly disagree, definitely disagree and not applicable respectively coded as 5, 4, 3, 2, 1 and 0.

Particularly to target diversity of study mode, seven questions were used that asked of students about 'how they would describe their learning in the context of the statements relating to the varied backgrounds of FT, PT and DA':

i. assessment and feedback for teams, and opportunities for comments and feedback from teammates (*Comments and feedback from teammates*)

ii. learning opportunities for teams to consolidate concepts and explore new ideas (*Consolidate concepts and explore new ideas*)
iii. academic input for teams providing increased support (*Increased academic support on module*)
iv. organisation and management to better facilitate ease of learning (*Cope better with the module organisation*)
v. learning resources to access and explore extra/additional learning material (*Access/explore extra learning resources*)
vi. the learning community to provide opportunities for real-life project community interaction (*Real life project community interactions*)
vii. student voice influenced the attention given to student feedback (*Influenced attention given to student voice*).

In line with questions i-vii above, Figure 5 shows the perceptions of students on how job experience of team members on the interdisciplinary project influenced their learning. As previously established in Section 5.1, team members who are PT and DA students have at least 1-5 years' job experience while most FT students have little or no such job experience. As observed from Figure 5, there is a good consensus among respondents that a mix of diversity in student background (FT, PT, DA) does influence learning. More than 50% of the respondents agree real-life project community interactions and impacts of students' voice have been greatly influenced by mix of students' job experience background. About 30% felt comments and feedback from teammates; consolidating concepts and exploring new ideas; increased academic support; module organisation and exploring additional learning resources were also engendered by the mix of background in the group projects.



	Definitely agree	Mostly agree	Neutral	Mostly disagree	Definitely disagree	Not applicable
Comments and feedback from teammates	6	29	18	18	24	6
Consolidate concepts and explore new ideas	6	35	41	6	12	0
Increased academic support on module	0	29	35	12	24	0
Cope better with the module organisation	6	47	24	0	24	0
Access/explore extra learning resources	0	59	24	0	12	6
Real life project community interactions	0	53	24	18	6	0
Influenced attention given to student voice	6	53	35	0	6	0

Figure 5: Perception on influence of mixed background on learning

6. Inferences on student's job experience background and learning

Table 1 shows results of the S-W normality test carried on the data collected for the seven factors of learning used to gauge the opportunities mixed background of study mode (FT, PT and DA) bring to students' learning. Due to the small sample size (<20) and six of the seven factors showing $p < 0.05$, non-parametric analyses were carried out going forward. The Spearman Rho correlation coefficients for the data (Table 2) which is the suitable option for non-parametric distribution indicate positive correlations and range of statistically significant bivariate associations between the paired learning factors as ordinal variables. The mean ranking of the data using the Kruskal-Wallis H test relating to the three study modes (FT, PT, DA) is shown in Table 3. The resulting statistics of the Kruskal-Wallis H test combined in Table 3 indicate a range of $\chi^2(2) = 0.073$ to 0.3927, $p > 0.05$ for all the variables; there is not statistically significant difference (Leech *et al.*, 2005) in response to the factors gauging students' perception of learning satisfaction engendered by the study modes (FT,PT and DA) against the null hypothesis (H0). By implication, the analyses suggest students generally perceive that having FT, PT and DA students in a cohort contribute positively to all the sub indicators of learning experience and overall course/programme satisfaction as further discussed.

Table 1: Normality test (N=17)

Factors/variable	Shapiro-Wilk	
	Statistic	Sig.
Comments and feedback from teammates	.923	.165
Consolidate concepts and explore new ideas	.871	.023
Increased academic support on module	.837	.007
Cope better with the module organisation	.795	.002
Access/explore extra learning resources	.687	.000
Real life project community interactions	.778	.001
Influenced attention given to student voice	.787	.001

Table 2: Correlation of learning indicative factors (N=17)

Spearman's rho Correlations								
		Comments and feedback from teammates	Consolidate concepts and explore new ideas	Increased academic support on module	Cope better with the module organisation	Explore extra learning resources	Real life project community interactions	Influenced attention given to student voice
Comments and feedback from teammates	Correlation Coefficient	1.000						
	Sig. (2-tailed)	.000						
Consolidate concepts and explore new ideas	Correlation Coefficient	.591*	1.000					
	Sig. (2-tailed)	.012	.000					
Increased academic support on module	Correlation Coefficient	.755**	.739**	1.000				
	Sig. (2-tailed)	.000	.001	.000				
Cope better with the module organisation	Correlation Coefficient	.631**	.763**	.818**	1.000			
	Sig. (2-tailed)	.007	.000	.000	.000			
Access/explore extra learning resources	Correlation Coefficient	.699**	.731**	.854**	.773**	1.000		
	Sig. (2-tailed)	.002	.001	.000	.000	.000		
Real life project community interactions	Correlation Coefficient	.281	.485*	.520*	.232	.443	1.000	
	Sig. (2-tailed)	.274	.049	.032	.369	.075	.000	
Influenced attention given to student voice	Correlation Coefficient	.542*	.510*	.278	.325	.324	.312	1.000
	Sig. (2-tailed)	.025	.037	.281	.203	.204	.223	.000
*. Correlation is significant at the 0.05 level (2-tailed).								
**. Correlation is significant at the 0.01 level (2-tailed).								

Table 3: Kruskal- Wallis H test

	Ranks		Test Statistics[a,b] , df = 2	
Factors/variable	**Study mode of students**	**Mean Rank** *	**Kruskal-Wallis H**	**Asymp. Sig.**
Comments and feedback from teammates	Full time	9.50	.362	.834
	Part time	8.14		
	Degree apprenticeship	9.67		
Consolidate concepts and explore new ideas	Full time	9.50	.175	.916
	Part time	8.43		
	Degree apprenticeship	9.33		
Increased academic support on module	Full time	8.75	.277	.871
	Part time	9.71		
	Degree apprenticeship	8.33		
Cope better with the module organisation	Full time	8.63	.073	.964
	Part time	9.36		
	Degree apprenticeship	8.83		
Access/explore extra learning resources	Full time	7.50	2.540	.281
	Part time	7.86		
	Degree apprenticeship	11.33		
Real life project community interactions	Full time	13.00	3.927	.140
	Part time	7.79		
	Degree apprenticeship	7.75		
Influenced attention given to student voice	Full time	12.00	3.372	.185
	Part time	6.86		
	Degree apprenticeship	9.50		
** Mean rank = average of the ranks for all responses.* *A higher mean rank implies more positive responses.* *A lower mean rank implies more negative responses.*			***a.** Kruskal Wallis Test*	
			***b.** Grouping Variable: Study mode of students*	

6.1 Comments and feedback to/from teammates

The concern for ascertaining individual performance in teams has warranted research exploring peer assessments and evaluation tools (Bronson *et al.*, 2007; Cestone *et al.*, 2008; Ohland *et al.*, 2012; Tucker, 2013). While some researchers (Wandel and Willey, 2011) suggest such tools encourage equal commitment of team members, others (Bronson *et al.*, 2007; Ohland *et al.*, 2012; Mentzer, 2014) see them as the means of obtaining a fair judgement of team members' effectiveness. One important aspect of team effectiveness is the ability/readiness of members to

provide/receive critical 'comments and feedback to/from teammates'. Table 2 shows it has a statistically significant and high correlation with the other five indicative factors of learning. The exception is the case with 'Real-life project community interactions' which is in the weak correlation spectrum (r_s = .281, p = .274) and statistically not-significant. Comments and feedback from teammates [Kruskal-Wallis H test of $\chi^2(2) = 0.362$, $p > 0.834$ (Table 3)] indicate that students generally (not statistically different) felt the mix background of study mode encouraged comments and feedback from teammates. As this aspect of study is limited to quantitative data without direct subjective comments about feedback from teammates, there is need for caution in statistical inferences. However, responses appear to reflect students' perceptions that interactions with teammates can influence their learning. Aspects of comments and feedback that are able to drive group effectiveness and excellence have been suggested to include critical discussions and a conducive atmosphere for questioning each other's opinions to provoke collaborative and individual learning (Haller *et al.*, 2000; Grammenos *et al.*, 2019). The statistical inference is in line with the discourse of contributing to student pedagogy, which is all about encouraging students to contribute to the learning of others and in turn value contributions from others (Hamer *et al.*, 2008; Luxton-Reilly, 2009)

6.2 Consolidate concepts, explore new ideas; and extra learning resources

Encouraging independent learning is vital in higher education (Kingsbury, 2014). It includes self-directed learning (Knowles, 1975) activities where students become personally responsible in driving their own learning. Learners with or without the help of others, are able to diagnose their own learning needs, draw up targets and identify resource materials and persons that can support them in achieving set goals. Such active learning traits in students encourage taking responsibility of their own progress (Bamber and Jones, 2015) which includes consolidating concepts they have learned and exploring aspects/ideas that are new. 'Consolidate concepts and explore new ideas' as an indicative factor of student satisfaction, has a high correlation ($r \geq 0.51$, $p \leq 0.037 < 0.05$) with most of the other factors (Table 2) evident in the responses from survey results. The degree to which the mix of job experience influenced their ability to 'consolidate concepts and explore new ideas'

gives results of $\chi^2(2) = 0.175$, $p > 0.916$ for Kruskal-Wallis H test (Table 3). The result implies that there is a likelihood mixed background of students do encourage a positive outcome of discovering and accepting new ideas. Furthermore, from Table 3, active learning does extend to the aspect of 'exploring extra learning resources' for which the Kruskal-Wallis H test yields $\chi^2(2) = 254$, $p > 0.281$. The results suggest that FT, PT and DA students share similar opinions. The ability of students to read around a subject from extra learning resources, identify and fill in learning gaps, and extend their knowledge beyond topics being treated is important in deep learning (Butcher, 2019). Deep learning remains a desired outcome in the design of constructively aligned curricula in internationalised HE settings (Mathieson, 2014).

6.3 Increased academic support and module organisation

Regarding student learners, Butcher et al (2019) identified two kinds of support: academic tutoring and pastoral care. The latter is largely accomplished through personal tutoring and University dedicated student services. The former on the other hand, entails providing students with requisite academic guidance by module tutors and usually tailored to modules or some academic challenge during courses of study. It is such academic support the respective question in the survey portrays in this research. Interestingly, the analysis results from the inferential statistics indicates students perceive there was some increased academic support on the module due to the FT, PT and DA mix in study mode background. The results (Table 2) recorded a high correlation with other five student satisfaction indicative factors (Spearman Rho's correlation coefficient, r_s, ranging from 0.52 to 0.58 and $p \leq 0.032$). There is an exception to the 'Attention given to student voice', with a weak statistical correlation ($r_s = 0.278$, $p = 0.281$), and which is similar to the ability of students to 'cope better with module organisation' ($r_s = 0.325$, $p = 0.2013$). While approaches to supporting learners can take different models, it can be integrated into module organisation and curriculum implementation. On the interdisciplinary project module support is embedded with structured time for tutorials, consultation with tutors and group activities besides normal arrangements of student-lecturer appointments.

6.4 Real life project community interactions and attention to student voice

One of the learning outcomes in the Interdisciplinary Project module is centred around the achievement of near real-life project implementation experience. In addition to working on an open-ended problem, students assume different essential roles on a civil engineering/construction project to replicate industry; thus, simulating real-life project scenarios as obtainable in PBL approaches (Chang *et al.*, 2018). It is interesting to note that fostering 'real life project community interactions' has a high correlation ($r_s = 0.520$, $p = 0.032$) with only the 'increase in academic support' received on the module; one out of the six other learning indicative factors. Although the call for learning to listen to students' voice is universal, aspects of applications are broad. Students contribute to sharpening of subjects at one end of the spectrum and at the other end provide their perspectives via formalised research programmes/study (Butcher *et al.*, 2019). These two extremes are of interest. Thus, student voice has the potential to influence decision making on modules and curricula design/delivery and has been the basis for gauging student satisfaction instigated by job experience background.

7. The importance of student background (job experience) on interdisciplinary learning and limitations

The increase in number and diversity of student populations in the UK, like many other popular educational destinations, is well acknowledged (Bamber and Jones, 2015; Butcher *et al.*, 2019). Student numbers have been rising in response to improvements in internationalisation of the higher education sector and efforts on the widening participation agenda (Butcher, 2019). There is the danger that the staff-student ratio balance to achieve optimum learning interactions can become negatively affected. In addition, dealing with diversity in increasing student populations remains challenging. There is the tendency for greater variations in students' backgrounds, with needs and support requirements, becoming more demanding and difficult. On one hand, each diversity aspect (religion, ethnicity, gender, age, disability, prior educational attainment, study mode) presents its own different and peculiar challenges which institutions of higher education have been striving to meet. On the other hand, diversity in learning garners its own 'beauty' that requires harvesting. In this research, we have focused on demonstrating how diversity in study mode, closely related to students' work experience background, can become a tool to enhance teaching and learning.

One scenario where such students' work experience background is deemed important is in group assignments and tasks. Group work is understood to be an effective way of motivating students to develop employability skills ranging from good communication, critical thinking and analytical skills, negotiation skills, to the management and resolution of conflicts (Ayres, 2015). What makes such employability skills even richer and more enduring is the range in diversity of background of group members, in this research case, work experience linked to study mode. Thus, the 'rich' diversity background of students is a high determining factor that contributes to group tasks linked to learning gains and enhanced performance in assessments. Such contributions become even more pronounced, moving from one end of conventional group formations for simple tasks, to the other end of problem-based interdisciplinary role assumptions. Interdisciplinary problem-based tasks can be designed to mirror scenarios obtainable in the field/industry to systematically enhance targeted teamworking skills. In the engineering field, the possession of interdisciplinary team skills is well recognised as an essential attribute of graduate engineers. As such, evidence of how training aligns with developing the desired learning outcomes and skills is often included as part of the sets of criteria sought by accreditation bodies of engineering education.

There may not be a better way to explore the contributions diversity in study mode and by implication job experience brings to higher education than through the lens of the NSS. The NSS has been found useful in measuring student experience and quality of learning as well as providing data for educational policy development (Hazelkorn, 2008; Bennett and Kane, 2014). Given that NSS questions are targeted at general aspects of teaching and satisfaction across disciplines, slight modifications are able to capture specific areas of diversity and its contribution to student learning as demonstrated in this study. The NSS key satisfaction indicative factors/areas include assessment and feedback; learning opportunities; academic support; organisation and management; learning resources; learning community and support of student voice. Findings in this study suggests that the presence of FT, PT and DA as an aspect of diversity in cohorts creates avenues for peer-learning through targeted group activities. This counts positively towards the eight NSS indicative factors/areas and overall course satisfaction; albeit this research is based

on a survey of a relatively small sample size and unbalanced gender characteristics of students in one institution of higher education as a limitation. Further, the study is limited to investigating whether students on different study modes linked to work experience can influence learning without delving into intersectional identities or intersectionality. Researchers (Ro and Loya, 2015; Boveda and Aronson, 2019; Dennissen *et al.*, 2020) have, however, argued that managing diversity requires a good knowledge of intersectionality as a major determinant of individual social dispositions or identities within multiple categories of differences. Indeed, issues such as level of current or previous cognate job experience and ethnic/minority inclinations could influence the learning gain of students and are therefore recommended for probing in further study. Also, open to future investigation is the level of learning gain in scenarios of wider cross-disciplinary (e.g., Engineering, Computing, Law, Urban planners, Real Estates) collaboration scenarios of learners.

8. Conclusion

The monitoring of student satisfaction in courses and programmes in popular educational destinations have continued to rely on national surveys. Alongside its role in informing educational planning and policies in countries such as the UK, the NSS has paved a way for research investigating various indicative factors contributing to student satisfaction. In this research paper based on NSS questions, we investigated the contributions to learning experience of students' modes of study, closely associated with job experience. The three modes of study, full-time, part-time and degree apprenticeship, are common in many UK universities and other popular educational destinations such as Australia, Canada and the USA. Study mode is a crucial aspect of diversity in students' background and presents opportunities which can be exploited positively in these international educational destinations. Diversity is further influenced by different degrees of intersectionality which is open to further research probing the impact of plausible scenarios of interdisciplinary learning.

Outcomes from appraisal suggest variance in social dispositions and capabilities as challenges that arise from diversity of student population, while being advantaged by better peer learning environments. Advantages with diversity are enhanced by wider students' backgrounds and range of job experiences which are essential precursors

to informed peer interactions. Survey results and accompanying inferences from a critical analysis of FT, PT, DA modes of study in an interdisciplinary educational setting provokes positive learning benefits. This research therefore recommends, a balanced mix of diverse job experience backgrounds in cohorts with well-rounded and equipped diversity management practice. In essence, the presence of students with a range of different (years, cognate and area) work experience constitutes a good scenario for interdisciplinary interactions that enhances learning. In the right simulated environment, as explored in the Interdisciplinary Project module of a civil engineering degree programme, there is ample peer influence on learning and team skill building potentially intensified by the mix of full-time, part-time and degree apprenticeship students. Such scenarios and associated team skills are very important in contributing to the competencies and employability attributes advocated by engineering education accreditation bodies across the world.

REFERENCES

Accreditation Board for Engineering and Technology (2002). Criteria for accrediting engineering programs: effective for evaluations during the 2002–2003 accreditation cycle. .

Ashby, A., Richardson, J. T. and Woodley, A. (2011). "National student feedback surveys in distance education: an investigation at the UK Open University." *Open Learning: The Journal of Open, Distance and e-Learning* **26**(1): 5-25.

Ayres, R. (2015). Lecturing, working with groups and providing individual support. *A handbook for teaching and learning in higher education: Enhancing academic practice*. H. Fry, S. Ketteridge and S. Marshall, Routledge.

Bamber, V. and Jones, A. (2015). Challenging students. *A handbook for teaching and learning in higher education: Enhancing academic practice*. H. Fry, S. Ketteridge and S. Marshall, Routledge.: 152.

Bennett, R. and Kane, S. (2014). "Students' interpretations of the meanings of questionnaire items in the National Student Survey." *Quality in higher education* **20**(2): 129-164.

Borrego, M. and Newswander, L. K. (2010). "Definitions of interdisciplinary research: Toward graduate-level interdisciplinary learning outcomes." *The Review of Higher Education* **34**(1): 61-84.

Boveda, M. and Aronson, B. A. (2019). "Special education preservice teachers, intersectional diversity, and the privileging of emerging professional identities." *Remedial and Special Education* **40**(4): 248-260.

Bronson, P., Ng, A. and Wong, K. K. (2007). *Design and Implementation of a peer assessment tool for Problem Based Learning in Engineering*. AaeE (Eighteenth Annual Conference of the Australasian Association for Engineering Education).

Butcher, C., Davies, C. and Highton, M. (2019). *Designing learning: from module outline to effective teaching*, Routledge.

Canadian Engineering Accreditation Board (2007). Accreditation Criteria and Procedures. Canadian Council of Professional Engineers. Ottawa.

Cestone, C. M., Levine, R. E. and Lane, D. R. (2008). "Peer assessment and evaluation in team-based learning." *New Directions for Teaching and Learning* **2008**(116): 69-78.

Chang, J.-C., Hsiao, Y.-D., Chen, S.-C. and Tsung-Ta, Y. (2018). "Core entrepreneurial competencies of students in departments of electrical engineering and computer sciences (EECS) in universities." *Education+ Training*.

Cheng, J. H. and Marsh, H. W. (2010). "National Student Survey: are differences between universities and courses reliable and meaningful?" *Oxford Review of Education* **36**(6): 693-712.

Cocksedge, S. T. and Taylor, D. C. (2013). "The National Student Survey: is it just a bad DREEM?" *Medical teacher* **35**(12): e1638-e1643.

Crenshaw, K. (1989). *Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics*. University of Chicago Legal Forum.

Davies, M. and Devlin, M. (2007). *Interdisciplinary higher education and the Melbourne Model*. Creativity, enterprise, policy: new directions in education, Open Polytechnic of New Zealand.

Davis, K. (2008). "Intersectionality as buzzword: A sociology of science perspective on what makes a feminist theory successful." *Feminist theory* **9**(1): 67-85.

de Villiers Scheepers, M. J., Barnes, R., Clements, M. and Stubbs, A. J. (2018). "Preparing future-ready graduates through experiential entrepreneurship." *Education+ Training*.

Dennissen, M., Benschop, Y. and van den Brink, M. (2020). "Rethinking diversity management: An intersectional analysis of diversity networks." *Organization Studies* **41**(2): 219-240.

Doloi, H., Sawhney, A., Iyer, K. C. and Rentala, S. (2012). "Analysing factors affecting delays in Indian construction projects." *International Journal of Project Management* **30**(4): 479-489.

Engineering Council UK (2003). UK Standard for Professional Engineering Competence, Chartered Engineer and Incorporated Engineer Standard.

Engineers Australia (2017). Stage 1 Competency Standard for Professional Engineer (2017), 14 June.

Ferreira, A., Sykes, O. and Batey, P. (2009). "Planning theory or planning theories? The hydra model and its implications for planning education." *Journal for Education in the Built Environment* **4**(2): 29-54.

Field, A. (2000). Discovering statistics using SPSS for Windows: advanced techniques for the beginner, 2000, Sage, London.

Fielding, A., Dunleavy, P. J. and Langan, A. M. (2010). "Interpreting context to the UK's National Student (Satisfaction) Survey data for science subjects." *Journal of Further and Higher Education* **34**(3): 347-368.

Gallegos, P. J. and Peeters, J. M. (2011). "A measure of teamwork perceptions for team-based learning." *Currents in Pharmacy Teaching and Learning* **3**(1): 30-35.

Ghasemi, A. and Zahediasl, S. (2012). "Normality tests for statistical analysis: a guide for non-statisticians." *International journal of endocrinology and metabolism* **10**(2): 486.

Grammenos, R., Garcia Souto, M., Chester, I. and Albelda Gimeno, L. (2019). *Peer assessment of individual contribution in group work: a student perspective*. https://www. sefi. be/wp-content/uploads/2019/10/SEFI2019_Proceedings. pdf, European Society for Engineering Education (SEFI).

Haller, C. R., Gallagher, V. J., Weldon, T. L. and Felder, R. M. (2000). "Dynamics of peer education in cooperative learning workgroups." *Journal of engineering education* **89**(3): 285-293.

Hamer, J., Cutts, Q., Jackova, J., Luxton-Reilly, A., McCartney, R., Purchase, H., Riedesel, C., Saeli, M., Sanders, K. and Sheard, J. (2008). "Contributing student pedagogy." *ACM SIGCSE Bulletin* **40**(4): 194-212.

Hazelkorn, E. (2008). "Learning to live with league tables and ranking: The experience of institutional leaders." *Higher Education Policy* **21**(2): 193-215.

HESA (2020). "Who's studying in HE?". Retrieved July, 2020, from https://www.hesa.ac.uk/data-and-analysis/students/whos-in-he.

Holvino, E. (2010). "Intersections: The simultaneity of race, gender and class in organization studies." *Gender, Work & Organization* **17**(3): 248-277.

Jabarullah, N. H. and Hussain, H. I. (2019). "The effectiveness of problem-based learning in technical and vocational education in Malaysia." *Education+ Training*.

Kingsbury, M. (2014). Encouraging independent learning. *A Handbook for Teaching and Learning in Higher Education*, Routledge: 191-201.

Klein, J. T. (2001). The discourse of transdisciplinarity: an expanding global field. *Transdisciplinarity: Joint problem solving among science, technology, and society*, Springer: 35-44.

Knowles, M. S. (1975). "Self-directed learning: A guide for learners and teachers."

Kumar, I. (2018). Unit-6 Standpoint Theory and Knowledge Location, IGNOU.

Lattuca, L. R. (2001). *Creating interdisciplinarity: Interdisciplinary research and teaching among college and university faculty*, Vanderbilt university press.

Law, D. C. S. (2010). "Quality assurance in post-secondary education: the student experience." *Quality Assurance in Education*.

Leech, N. L., Barrett, K. C. and Morgan, G. A. (2005). *SPSS for intermediate statistics: Use and interpretation*, Psychology Press.

Lester, S. (2020). "Creating conditions for sustainable degree apprenticeships in England." *Higher Education, Skills and Work-Based Learning*.

Lillis, F. and Bravenboer, D. W. (2020). "The best practice in work-integrated pedagogy for degree apprenticeships in a post-viral future." *Higher Education, Skills and Work-Based Learning*.

Luxton-Reilly, A. (2009). "A systematic review of tools that support peer assessment." *Computer Science Education* **19**(4): 209-232.

Mann, L., Chang, R., Chandrasekaran, S., Coddington, A., Daniel, S., Cook, E., Crossin, E., Cosson, B., Turner, J. and Mazzurco, A. (2020). "From problem-based learning to practice-based education: a framework for shaping future engineers." *European Journal of Engineering Education*: 1-21.

Mathieson, S. (2014). Student learning. *A Handbook for Teaching and Learning in Higher Education*, Routledge: 85-101.

Matsouka, K. and Mihail, D. M. (2016). "Graduates' employability: What do graduates and employers think?" *Industry and Higher Education* **30**(5): 321-326.

Mendes, P., Thomas, C. and Cleaver, E. (2011). "The meaning of prompt feedback and other student perceptions of feedback: should National Student Survey scores be taken at face value?" *engineering education* **6**(1): 31-39.

Mentzer, N. (2014). "holding students accountable IN TEAM PROJECTS." *Technology and Engineering Teacher* **74**(3): 14.

Murzi, H. G., Chowdhury, T. M., Karlovsek, J. and Ruiz Ulloa, B. C. (2020). "Working in Large Teams: Measuring the Impact of a Teamwork Model to Facilitate Teamwork Development in Engineering Students Working in a Real Project." *The International journal of engineering education* **36**(1): 274-295.

National Statistics (2020). Academic Year 2019/20 - Further education and skills. London, Department for Education (DfE), https://explore-education-statistics.service.gov.uk/find-statistics/apprenticeships-and-traineeships/2019-20.

Nkomo, S. and Hoobler, J. M. (2014). "A historical perspective on diversity ideologies in the United States: Reflections on human resource management research and practice." *Human Resource Management Review* **24**(3): 245-257.

OfS (2020). "National Student Survey – NSS, Office for Students." Retrieved July, 2020, from https://www.officeforstudents.org.uk/advice-and-guidance/student-information-and-data/national-student-survey-nss/.

Ohland, M. W., Loughry, M. L., Woehr, D. J., Bullard, L. G., Felder, R. M., Finelli, C. J., Layton, R. A., Pomeranz, H. R. and Schmucker, D. G. (2012). "The comprehensive assessment of team member effectiveness: Development of a behaviorally anchored rating scale for self-and peer evaluation." *Academy of Management Learning & Education* **11**(4): 609-630.

Oti, A. H. and Abanda, H. F. (2017). *A Review of Systems for Information Modelling in the Built Environment*. International Conference on Engineering, Applied Sciences and System Modeling, Springer.

Richardson, A. and Loubier, C. (2008). "Intersectionality and leadership." *International Journal of Leadership Studies* **3**(2): 142-161.

Richardson, J. T., Slater, J. B. and Wilson, J. (2007). "The National Student Survey: development, findings and implications." *Studies in Higher Education* **32**(5): 557-580.

Ritter, G. and Mellow, N. (2000). "The state of gender studies in political science." *The Annals of the American Academy of Political and Social Science* **571**(1): 121-134.

Ro, H. K. and Loya, K. I. (2015). "The effect of gender and race intersectionality on student learning outcomes in engineering." *The Review of Higher Education* **38**(3): 359-396.

Rosier, J., Slade, C., Perkins, T., Baldwin, C., Coiacetto, E., Budge, T. and Harwood, A. (2016). "The benefits of embedding experiential learning in the education of planners." *Planning Practice & Research* **31**(5): 486-499.

Rothera, J. (2020). Developing a Best Practice Framework for Degree Apprenticeships in Civil Engineering: Initial Findings. *Sustainable Ecological Engineering Design*, Springer: 205-220.

Rover, D., Ullerich, C., Scheel, R., Wegter, J. and Whipple, C. (2014). *Advantages of agile methodologies for software and product development in a capstone design project*. 2014 IEEE Frontiers in Education Conference (FIE) Proceedings, IEEE.

Rover, D. T. (2002). "Taking our own advice: Team teaching." *Journal of Engineering Education* **91**(3): 265.

Tah, J., Oti, A. and Abanda, F. (2017). "A state-of-the-art review of built environment information modelling (BeIM)." *Organization, technology & management in construction: an international journal* **9**(1): 1638-1654.

Tennant, S., Murray, M., Gilmour, B. and Brown, L. (2018). "Industrial work placement in higher education: a study of civil engineering student engagement." *Industry and Higher Education* **32**(2): 108-118.

Tucker, R. (2013). "The architecture of peer assessment: do academically successful students make good teammates in design assignments?" *Assessment & Evaluation in Higher Education* **38**(1): 74-84.

Ungaretti, T., Thompson, K. R., Miller, A. and Peterson, T. O. (2015). "Problem-based learning: Lessons from medical education and challenges for management education." *Academy of Management Learning & Education*.

Vaezi-Nejad, S. (2008). "Benefits of industrial placement to students and industry." *Measurement and Control* **41**(2): 49-50.

Wandel, A. P. and Willey, K. (2011). *Peer review of teamwork for encouraging equal commitment to the group effort*. Australasian Association for Engineering Education Conference 2011: Developing engineers for social justice: Community involvement, ethics & sustainability 5-7 December 2011, Fremantle, Western Australia, Engineers Australia.

Yorke, M. (2009). "'Student experience' surveys: some methodological considerations and an empirical investigation." *Assessment & Evaluation in Higher Education* **34**(6): 721-739.