Working with others and enjoying it: CS1 students' experience of small-group collaboration on a business simulation

Jyoti Bhardwaj
School of Computing
Edinburgh Napier University
Edinburgh, Scotland
j.bhardwaj@napier.ac.uk

Abstract—This Research Full Paper presents a study exploring whether CS1 entrants' views of the impact and benefits of group work were modified by the experience of small-group collaboration during their first semester at university.

We describe a first year business IS module taken by new CS entrants. The practical part of the module is intended to build students' soft skills, and is based on students participating for ten weeks in small teams on an online business simulation called SimVenture. We administered a questionnaire at the start and end of the simulation, asking whether and in what ways participants thought group work would impact on their academic success, professional prospects, social life and personal development.

Our findings show that participants began and ended the module favourably disposed towards group work. They foresaw beneficial outcomes from collaborative learning, including improved soft skills and better communication, and the opportunity to make friends; whilst they acknowledged the existence of unfair workloads and social loafing, this wasn't their experience on the module. We feel our learning design promotes co-located small-group teams, and provides a beneficial, supportive experience for students during the crucial, transitional first year.

Keywords—*CS1, simulations, collaboration, active learning, soft skills*

I. INTRODUCTION

This case study explores a cohort of first year CS undergraduates' expectations of the impact and benefits of group work, before and after their participation in a collaborative learning-centred module. The design and context of the module are explained in some detail. An active learning design has been chosen to gain the benefits of group work, despite the challenges of applying it to a large cohort, some of whom may be stereotypically averse to collaborating.

An implicit aim of the module is to encourage in a large class of new students studying a range of different disciplines, the friendships and peer-support that might be expected to arise organically in a small cohort, by designing learning events based around co-location and purposeful game-playing. The object of encouraging friendships is to nurture resilience and academic buoyancy [1], boost social capital [2], and combat the anonymity and sense of disconnection [3] that some students may feel in the large classes typical of the transitional first year [4]. The ultimate aim, which is used to justify the expense of this design in terms of staff, lab space and software, is to bolster students' engagement and attendance in a context of high drop out amongst UK computer science first years, which at 9.8% is the worst of any subject [5].

II. BENEFITS AND CHALLENGES OF PROVIDING ACTIVE AND SOCIAL LEARNING OPPORTUNITIES

The idea that environment influences the education that young people receive has a long heritage: back in the 1930s Dewey wrote, "the only way in which adults consciously control the kind of education that the immature get is by controlling the environment in which they act, and hence think and feel" [6]. López-Fernández, Tovar, Raya, Marzal, & Garcia [7] consider the three interrelated factors of student motivation, aptitude and academic conditions as having an effect on academic performance. Activity theory is well-established [8] [9] in suggesting that skills are constructed in social interactions within cultural activities that they support. Social learning theory [10], emphasises the importance of regular participation within a learning community, and Vygotsky's theory of learning [8] suggests that "zones of proximal development", social spaces created in co-located group work, are critical for the development of complex skills.

As many researchers, for example Kanaparan, Cullen, & Mason [11], attest, the key components of student engagement are behavioural, cognitive and emotional engagement [12]. Kanaparan & al identify enjoyment, interest, and gratification as three factors contributing to emotional engagement, that positively impact on students' self-efficacy and outcomes. James [13] argues the case for play, which encompasses all three factors, as an essential element of tertiary education, acknowledging that games and simulations are the kind of serious, goal-oriented [14] play "that universities are prepared to entertain".

A. Experiential Learning

Bandura's explanation [15] of mastery experience theory is helpful in supporting the benefit of using simulations, particularly embedding the play within a metanarrative to make the experience more meaningful and relevant to students [16]. Scaffolding the simulation with structured exercises followed by presentation, feedback and then another presentation allows students to undergo Kolb's 'concrete experience' of doing, 'reflective observation' upon the learning achieved, 'abstract conceptualisation' of hypothesis-driven strategies, and 'active experimentation' underpinning their decision-making [17]. As Angolia & Reed point out [18], "additional instructor effort is needed to develop external, course specific student work to supplement and enhance the simulation experience".

The use of a serious game within the framework of a co-located lab session facilitated by an instructor is expensive in terms of software and staff. In addition, James [13] suggests that games sometimes provoke resistance, even strong emotions, tied to university educators' sense of professional credibility and academic identity. Therefore, their use must be unquestionably justifiable in terms of the benefits to be gained by students. Whilst we can argue that simulations are definitive examples of active learning, they may not lead directly to a quantifiable improvement in grades. Indeed, Brom, Stárková, Bromová, & Děchtěrenko [19] observed "no differences in learning outcomes and intrinsic motivation variables" between their gamified simulation and its non-gamified versions.

B. Large Cohorts

Hyun, Ediger, & Lee [20] attest to their students' greater satisfaction with their individual and group learning process in active learning classrooms rather than in traditional classrooms. However, a major challenge to implementing active learning classrooms is that universities have been subject to 'massification' over recent years, and cohorts have grown larger [21], impacting on the physical space available. In the UK this is partly owing to institutions' greater reliance on income from students' tuition fees while government funding has gradually diminished [22]. Traditional front-facing lecture theatres are able to accommodate large numbers of students efficiently. However, they are less effective for group work [23]. Desks and tables laid out to facilitate collaboration are an inefficient use of space [24], and the lack of suitable classrooms presents a significant challenge to incorporating active learning events into the syllabus.

Students in large cohorts are therefore less likely to benefit from active learning approaches such as the emotion, energy, fluidity and ease of face-to-face exchanges, the ability to read non-verbal signs (eg of interest and approbation), and immediate feedback [25]. A further challenge is the time required to convert traditional teaching to active learning, particularly for large-enrolment classes [26]. Lambach & Kärger cite specifically the pitfalls involved in inverting the classroom, but their advice on recasting the role of the instructor into one of facilitator is particularly relevant to a module involving team-based, mainly self-directed learning.

C. Friendship

Brouwer & al [2] highlight the role of small groups in facilitating the friendships that are crucial to first year students successfully navigating the transition to university; although it is difficult to quantify, these may lessen the likelihood of students dropping out. They emphasise the social and peer capital to be gained from friendships. Dacre Pool, Gurbutt, & Houston [27] characterise emotional intelligence as a complex skill gained through friendship, that can prepare undergraduates for working life. That said, active learning events such as team-based simulation can lead to students feeling less isolated and finding it easier to interact [23]. Zhang, Meng, de Pablos, & Sun [28] make the point that group learning and engagement are increased with the use of social media-based communication.

III. SOFT SKILLS

Industry demand for CS graduates who possess soft skills is higher than ever [29]. While technical skills are important, in a dynamic job market they have limited currency compared to soft skills [30]. In an interesting study comparing the attitudes of CS graduates versus coding bootcamp alumni without degrees, Burke & Bailey proposed [31] that their "college" participants shared CS university educators' general view that soft skills were personal attributes, whilst their "camp" participants not only viewed them as learned skills, but that acquiring them through the bootcamp experience would immediately benefit them in employment.

Following a survey of large midwest US employers, Jones, Leonard, & Lang [32] determined that, in addition to programming, operating system knowledge, hardware, telecommunications, networking, and database design skills, an IS graduate should possess communication (oral and written) and team skills, problem solving, and critical thinking. Albeit Jones & al's study is limited geographically and in terms of firms' size, their review of recent studies suggests that many employers rate soft skills more highly, perceiving them as harder to acquire through training after employment. In their wider-ranging survey of computer professionals, Exter, Caskurlu, & Fernandez [33] found that of the ten most important skills and topics they thought computing graduates should have, half were from communication and teamwork areas. By contrast, eight of the bottom ten items came from technical areas. Their participants' vision of an ideal degree programme included "engagement in multiple individual and team projects under realistic conditions", with collaborative learning therefore seen as a key way to experience them. Soft skills are also a core element of the widely-cited "Partnership for 21st century skills" [34].

IV. ATTITUDES TOWARDS GROUP WORK

The focus of our study was the first year CS cohort's attitudes towards group work. Sturner, Bishop, & Lenhart [35] characterize undergraduates as already having positive attitudes toward collaboration and at least a strong desire to be seen as a "team player". In their interesting study [36] of UK undergraduates' engagement with employability, Clements & Kamau found that the mastery approach [15] was associated with proactive career behaviours.

Souza, Moreira, & Figueiredo [37] report that their participants were positive towards team-based, rather than individual, software development projects as beneficial to employability. This somewhat contradicts the popular stereotype of CS students preferring self-directed learning [38]. It also contrasts with our common mental picture of the uncommunicative geek programmer [39] who has been coding for years [40]. In fact, Sturner, Bishop, & Lenhart found that the need for communication between group members was mentioned most often in students' evaluations, which also reported issues developing from members withholding their opinions or questions out of shyness or fear [35].

Dacre Pool, Gurbutt, & Houston [27] regard the requirement to work in teams as one of the challenges experienced by students that strengthen their emotional resilience. Interestingly, Dacre Pool & al specify working in unfamiliar or shifting teams as being particularly beneficial [27], underlining their general view that attitudes towards collaboration can be changed by activities and experience, and are not necessarily innate.

Lancellotti & Boyd warn against assuming that group work will automatically generate a positive attitude: "students are often placed in teams for a class project where it is

optimistically assumed that the experience of teamwork itself will make students better at working in teams" [41]. Students' attitudes are often shaped by past group work experience, harbouring, for example, resentment towards "social loafers", who instead of doing their share and enabling everyone to reduce their efforts, which is Latané, Williams, & Harkins' original definition [42], slack more than their team mates yet benefit from their efforts. A non-slacking member thus disadvantaged may become a reluctant participant, behaving as a "diligent isolate" [43] who dislikes teamwork and often sees others as ineffective and incapable. Brown & al emphasise the strength of the instructor's influence on students' attitude towards teamwork through "tutor-to-student" activities, encouragement, and by policing social loafing [44].

The emphasis on social learning can introduce greater discomfort for students who already suffer from social anxiety [45]. Although the requirement for oral presentations is ubiquitous at all levels of education including degrees [46], students do not receive adequate instruction in this topic [47], adding to self-doubt about competence. Further, undertaking presentations, in a pair or group, or in front of an audience, can cause situation-specific "stage fright" amongst students who do not usually experience long-standing social anxiety [48]. Even a presentation some way off in the future can taint a student's attitude towards the group work element by amplifying negative self-perception [48]. Anxiety can also be caused by the group work being "heavyweight" through carrying significant marks [49].

V. RATIONALE FOR STUDY

As a result of our review of the context of university-based collaborative learning, we identified a number of phenomena and factors that would be interesting to explore in a live module, whilst acknowledging the relatively small sample and qualitative nature of the data.

Firstly, we could find out whether our sample of CS entrants fit the stereotype of unwilling collaborators, and what benefits they might or might not see in group work, whether in improved success in modules, or in their work prospects once they graduate, in their social lives at university, or their own personal development.

It would be futile trying to determine any quantifiable relationship between students' enjoyment of working in a group and engagement or persistence on the course, simply because there are so many other extraneous factors impinging on students' engagement, including academic ability, finance, attendance, part-time jobs, and motivation. However, the reputation of group work is as a bête noire of students, so it would be interesting to hear whether enjoyment did indeed feature in responses.

Further, the conditions in our university reflect many of the issues and dilemmas being researched: our educators face challenges in finding the time and staff to resource active learning events; we have cohorts of over 150 students in some first year modules [21]; our most spacious rooms are traditional tiered lecture theatres, quite unsuitable for collaborative learning [23], and this study offers an opportunity to describe our learning design, which may be of interest to others seeking to implement collaboration under similar constraints. Finally, whilst the study was not an evaluation of our module's success, any positive views of group work from students at the end of the module could be taken as a proxy endorsement of its validity.

VI. CASE EXAMPLE OF GROUP WORK USING A SIMULATION

This study is located in a module that is compulsory in the first semester of first year for students on six CS-related degrees. The module has three components: weekly lectures on business organisation and systems assessed by exam; classroom tutorials on academic writing assessed by a report; and co-located, lab-based practical sessions using the business simulation, SimVenture. For tutorials and labs, the cohort is split into six more manageable classes according to their degree.

A. Use of SimVenture Evolution, the Business Simulation

The heart of the module, which differentiates it from the other modules undertaken by these students throughout their degrees, is a total enterprise, business simulation-centred learning activity undertaken over the course of a semester in groups, and assessed by group presentation. SimVenture simulates the funding, establishment, research, design, management and operation of a bicycle manufacturing business, in which the player must make all the decisions for their firm to grow and prosper. It is a cloud-based application, created and operated by Venture Simulations, based in York, northern England [50].

We built SimVenture into the module to consolidate the business organisation principles taught in the lectures, and provide familiarity with financial reporting, supply chain and manufacturing concepts. Working in simulated quarterly cycles, the team make decisions in four areas of business (Organisation, Operations, Sales and Marketing, and Research and Development), run a quarter, see the impact of their actions on profit, cashflow and other indicators, and receive feedback on performance. The simulation rewards decisions based on market, competitor and customer research, and on response to performance feedback, rather than on guesswork. The challenge is to generate customer orders leading to sales, and generally build a successful firm.

To facilitate reporting of decisions in the presentations, SimVenture includes an in-built log which documents decisions, and which groups can review in order to construct their presentation. Groups were encouraged, however, to keep their own log of key decisions – and particularly the rationale for them – which is made easier if they designate a team member to be note-taker. The aim was for students to undergo all four stages of Kolb's [17] experiential learning cycle.

B. Active Learning Design

We chose a game-like simulation in recognition of the positive relationship between enjoyment and learning [11]. We designed the SimVenture sessions as a mixture of facilitated and (team-based) self-directed learning through additional exercises [18]. According to Taylor, Backlund, & Niklasson [51], continued involvement by the instructor during the course of the simulation can improve outcomes. Their study describes a continuum from entirely self-directed to coaching-by-gaming, with very close involvement. Our design was some way between the two extremes, the lab tutor beginning each session with roughly twenty minutes of whole-class teaching, in which students focus on an exercise using a particular area of the simulation. The lab tutor, accompanied by a student demonstrator, would go round each group, noting

down attendance, deterring social loafing [42] and troubleshooting. For example, students might be directed to explore the finance menu to complete an exercise that teaches them how to understand a balance sheet. This is intended to expand their familiarity with the simulation, inform their game playing, and embed knowledge of business practices. Whilst the lab sessions allow some formal teaching, the module is designed for most of the game playing and preparation for assessments to take place outside timetabled hours, and students have 24/7 access to machines in the library and in the 400-seat campus computer lab.

Unlike Burke & Bailey's educators [31] we regarded soft skills as learned and learnable, not personal attributes. Along with the implicit objective of friendship and peer support, the module's desired outcomes stated briefly in the module descriptor are "interpersonal skills, including oral presentation, collaborative working, technical and business writing, conflict resolution". No assumption was made of individuals students' soft skills attributes and experience, because of their heterogeneous national and educational backgrounds. They were mainly young Scottish entrants, along with many from the EU, and some from the rest of the UK and further afield.

C. Simulation Team Composition

We wished to accommodate students' choice to pick their team members, whilst preventing anyone from remaining unpicked owing to their shyness or even the prejudices of fellow students [52] [53]. We also needed to economise on SimVenture licences. The instructor compromised by dividing them into teams of three as soon as they took their seats in the first lab, reasoning that those who were already friends would have sat down near one another. By imposing teams, formation was swift, the instructor appeared impartial, and no-one was left unpicked.

To optimize the active learning element [20], and to allow room for a small team to gather comfortably around a single screen, SimVenture was timetabled wherever possible in a relatively small lab where workstations are clustered in four groups of six machines [23]. Had social distancing measures been in place, as they will be in the next, post-pandemic presentation of the module, then larger labs would be used, so that students would sit at their own machines and use screen sharing to enable collaboration and collective decision-making. The newly-formed teams were encouraged to exchange mobile phone numbers to enable informal social media contact [54] mainly by WhatsApp, such as friends might use [2], but as the semester wore on, many teams took up communicating via Slack [28], which is used by the student computing societies. In a socially distanced setting, these tools would become even more valuable in helping to strengthen relationships and ensure engagement by all team members.

D. Assessment

The simulation element was assessed by two group presentations in weeks 8 and 11 of the semester. The presentations were the means of assessing the "product of collaboration" [14]. Because there was no opportunity to teach presentation skills formally [47], students were given guidance in the whole-class teaching segment, and each group was given in advance the assessment criteria and a copy of the feedback sheet that would be used to mark them. Students were advised to dress formally, but if they didn't have business clothes, they could aim for a "team-like appearance"

creatively and relatively cheaply. Marks for personal presentation also encompassed individual and collective demeanour, such as fidgeting [48] or appearing inattentive whilst other team members are speaking. This was not lightweight teamwork [49], because the two presentations contributed 40% of the final module mark.

The audience in the assessment room was limited to the module leader only, to avoid exacerbating the anxiety surrounding oral presentations [48].

E. Importance of Feedback

Feedback was delivered by the module leader face-to-face immediately after the presentation [25] by means of handwritten notes on the marksheet (carbon copied to keep a record) awarding marks for structure, company identity, individual and team performance, explanation of decision making, problem solving, high quality slides, summary data intelligently presented in self-created Excel charts and other criteria.

The "top copy" of handwritten feedback was taken away by the members to discuss amongst themselves and be elaborated upon by the SimVenture lab facilitator [51]. Though there was less than five minutes of face-to-face time available before the next group would enter and do its presentation, teams that contained a known free-rider needed to be asked in what proportion they would award their group mark. When committed group members see "social loafers" or free-riders receive the same marks as them, it can sour their group work experience [55]. Discussion also performs the same beneficial interaction between student and tutor as the face-to-face, interactional model of study amongst face-to-face collaborating students [25].

VII. GROUP WORK EXPECTATIONS STUDY

We undertook a study using a purposive sample of first year students belonging to a Scottish university school of computing. The students were in their first semester of a range of undergraduate courses: Business Information Technology, Cyber Security and Forensics, Computer Systems and Networks, Computing, and Software Engineering. They were all enrolled in a compulsory Information Systems in Organisations module, which in the academic session 2019/20 involved 103 students.

At the first SimVenture sessions (T_1), before team formation, we administered a paper questionnaire including four semi-structured questions with a box beneath each for answers. As made clear in the consent form, participation was voluntary; although every student present in lab during the first week responded, there were a number of absences owing to late arrival at the university and sickness. We administered the same paper questionnaire at the final SimVenture sessions (T_2), by which time several students had withdrawn from the course or transferred to other modules.

A. Questionnaire

As Gress, Fior, Hadwin, & Winne explain [14], measurement and assessment in computer-support co-operative learning can take one of three forms: assessing the individual about the individual, assessing the individual about the group, and assessing the group as a whole". Our case study assesses the individual about the individual. When wording the questions our aim was to keep questions short and unambiguous. We realized some students might attribute a

negative connotation to the verb 'impact', but that this might also occur with the similarly neutral verb 'affect', and that trying to avoid leading the respondents would lead to lengthy circumlocutions. We wished to cover the key topics without planting terms like 'soft skills', 'employability, 'friends', and 'competence' in the four questions:

At university:

1) Do you think group work will impact on your academic success, and if so, in what ways? [11]

2) Do you think group work will impact on your professional prospects, and if so, in what ways? [30]

3) Do you think group work will impact on your social life, and if so, in what ways? [2]

4) Do you think group work will impact on your personal development, and if so, in what ways? [27]

The first question arose out of our conjecture, based on the popular stereotype of CS students [39], that we would have a considerable core of less socially-minded students for whom working with fellow students would not be their primary motivation. We speculated that a number of them might instead be instrumentally motivated by some potential benefit to their module marks, or later during the rest of their degree.

Question 2 was intended to find out whether the sine qua non of soft skills on the CS curriculum to enhance employability was seen as valuable or relevant by the students themselves.

The third question was aimed at establishing whether our desire for group work to foster social support and friendships was shared by the students.

Finally, Question 4 was intended to uncover the experiential benefits students thought they might gain from group work; we hoped these would go beyond academic skills and give us some insight into the less concrete results students want from group work.

B. Coding in NVivo 12

Of the 103 students enrolled on the module at the start of the semester, 90 responded at T_1, and 97 at T_2. The analysis is based on the 81 students who answered both times. We paired the T_1 and T_2 respondents by matching the student matriculation numbers on the cover of each questionnaire, anonymized them by substituting a code for the matriculation number, and transcribed the open-ended responses. We used thematic analysis by first importing the transcribed questionnaires into Nvivo 12 Pro [56], then assigning codes, called 'nodes' in Nvivo, to the questionnaire data.

Deriving our data from written answers to direct questions resulted in shorter and more structured responses than would, for example, focus groups or interviews, and the four main themes that were identified through open coding [57] aligned closely with the questions and were named "Academic success"; "Personal development"; "Professional prospects"; and "Social life". Of these, the first three generated responses from almost all 81 respondents at both stages, as can be seen in figures 1 and 2. Coding was completed to discover which additional themes would emerge from students' responses.

Fig. 1. Nvivo 12 Screen Showing Themes from T_1 Responses

VIII. RESULTS

Once coding was complete, it was clear that the numbers of references per node scarcely differed between T_1 and T_2, but themes emerged that reflected common concerns for students and sometimes instructors. These were expressed sometimes hurriedly in the questionnaire. There is often surprising consistency between a student's answers at the start and the end of the simulation, but it is also possible to discern growing awareness and achievement, particularly in the areas of improved skills, confidence and friendships.

A. Academic Success

Our participants were generally positive [35] about the impact of group work on their academic success at university. This student is typical in remaining positive at T_2:

"Directly by group assessment. Indirectly by group study." (T_1)

"Group work for assessments has a great impact. In this group it has been beneficial." (T_2)

This student's experience of group work on the module has led to a more nuanced view:

"Group work will help, as people think differently and discussing things will help you understand more." (T_1)

"Yes, can work better as a team as more ideas, but can also impact development due to disagreements taking up time." (T_2)

B. Professional Prospects

Question 2 was answered by almost all our participants, and most expressed very similar views, perhaps gained prior to their arrival at university, that group work was important in the workplace [37] and for employability [33]:

"Yes, because team work is a crucial skill that many employers look for across a wide range of jobs." (T_1)

"Yes, as team work is a vital ability that employers look for." (T_2)

This student, for example, confirmed at T_2 that it would benefit them in their chosen career [33]:

"Yes, because I'm interested in software development and that whole subject is based on teamwork." (T_1)

"Yes, because software engineering is project based, so it involves lots of programmers that have to co-operate." (T_2)

Fig. 2. Nvivo 12 Screen Showing Themes from T_2 Responses

This student changed his/her skeptical view [43]:

"No, because I always study for myself." (T_1)

"It helped me to practise presentations, so for sure." (T_2)

C. Social Life

Given the prominence of social learning [10] in the rationale for the module, it was a little disappointing that this question was answered less frequently– of the 81 participants, 58 answered at T_1, and 57 at T_2. However, most of them were positive that group work would lead to more social connections:

"Get to know people better." (T_1)

"It helps you to get to know your fellow students." (T_2)

"Yes, I believe that working in groups will introduce me to new people; improve my social life." (T_1)

"Yes, it may help me to understand others more and respect their individual opinions." (T_2)

A considerable minority mentioned friendship (see section H); however, some were ambivalent:

"It might. Getting new faces to meet." (T_1)

"Kind of. I mean obviously yes, since I connected with others, but I don't see group work as the primary form of making new relationships." (T_2)

D. Personal Development

Nearly all participants answered this question, and interpretations were varied. Many responses were candid [27]:

"It will definitely do. Working with peers and finding solutions to problems together is very important." (T_1)

"It will make me a better person. New qualities that will improve my personality." (T_2)

"Might. Meeting new perspectives adds to one's personality." (T_1)

"I am learning a lot about myself, how I participate in group work and how I deal with stressful situations." (T_2)

and some constructive:

"I will learn from others, taking positive aspects and making them my own." (T_1)

"Yes, I am more and more capable of speaking up in a group situation." (T_2)

Many responses talked about improving confidence (see section E).

E. Confidence

The theme of confidence emerged as a theme from participants' responses to Q3 and Q4. Several expected or gained greater confidence in giving presentations [47]:

"I will feel confident presenting myself more than previously, and able to take my work life forward, therefore my personal development." (T_1)

"More confident at speaking and improve my ability to pull as part of that team." (T_2)

Others reported greater self-efficacy [27]:

"Yes, it will have a positive impact as I will be developing better social skills." (T_1)

"Yes, develop more skills and build confidence." (T_2)

"Yes, it will improve my confidence and my understanding of the work, as I will see different opinions and be forced to develop as a student." (T_1)

"Yes, positively, as it has boosted my confidence and improved my thought process when faced with future projects." (T_2)

F. Shared Effort

Fourteen participants expressed concerns at T_1 about team members sharing workload fairly, with slightly fewer – 11 – at T_2 [42]. Almost all responses were to the "Academic success" question. One expressed outright hostility towards loafers and, interestingly, the diligent isolates [43]:

"There were always some individuals who didn't work or collaborate. Same experience always therefore I hate it." (T_1) [This participant's T_2 response was by contrast blandly unemotional.]

Most expressed caution against group work rather than hostility, and some changed their view:

"Yes, it depends on the group. If all the members are hard workers, then the impact will be extremely positive. If it is the opposite, then maybe you can see yourself slowed down." (T_1)

"It helped me learning that things can get complicated but by working together all goes fine in the end." (T_2)

G. Anxiety

Three participants raised their anxiety candidly at T_1 [48], but none of them mentioned it at T_2, for example:

"Allow me to be more confident in dealing with others, as I have slight social anxiety." (T_1)

"More confident for taking the lead in social activities." (T_2)

"Yes, it can be beneficial to mental health, as it builds on confidence and can reduce issues such as anxiety or depression." (T_1)

"Yes, because we need to be comfortable with talking to people." (T_2)

H. Friendship

Almost all answers that directly mentioned friendship did so in response to Q3 "Do you think group work will impact on your social life, and if so, in what ways?":

"Could make some close friends." (T_1)

"Yes, as I made friends." (T_2)

Friendships can be valuable support when navigating the crucial first semester [2]:

"It will allow me to make new friends. Moving to a new city is daunting and this should help." (T_1)

"Yes, because it allows you to make and improve friendships." (T_2)

I. Communication

Contrary to the view that soft skills are an innate, personal attribute [31], participants viewed the key soft skill of communication as a *learnable* skill acquired during group work:

"Yes, it will enhance my communication and listening skills which will help improve myself overall." (T_1)

"Yes, develop communication skills." (T_2)

This participant valued being put into a group [53] because they find communicating difficult, as evidenced at T_1:

"Yes, as someone who isn't great at socialising, being able to work in a group will help with my ability (or inability) to communicate with others." (T_1)

"Yes, being put into groups is easier than having to introduce yourself." (T_2)

IX. DISCUSSION

Most of the responses we received were characterized by a marked openness towards learning from others and using the experience of group work for self-improvement. This positivity towards, and desire to benefit from, group work, especially when expressed at T_2, confirmed our fundamental decision to incorporate group work into this module. However, we needed to look at specific themes in our data to find support for our aims.

For example, we risked displeasing students by not allowing them to pick their teammates, in our desire to minimise the chance of any student being, or even feeling, excluded. However, the near-absence of responses complaining about group composition supported our position of benign dictatorship in imposing teams [52].

The module design, as made explicit in the descriptor, listed key soft skills taught through group work as a learning outcome. Participants made the link between, for example, presentation and teamwork skills and employability in responses to Question 2. Gratifyingly, students, like us, saw attributes such as the ability to communicate well, less as an unchangeable characteristic, and more as an aspect of self-development that could be improved experientially [27].

Having read the literature on unfairly distributed workloads [55] and social loafing [42], when we asked our participants at the start of the module for ways in which they thought group work would impact on their academic success, we thought only naïve group work novices would think it would improve their future performance. Perhaps sceptically,

we expected most of our participants' pre-university experience to disillusion them regarding the academic merits of group work. On the contrary, "marks" and "grades" were mentioned in only seven and six responses respectively at T_1, and even less frequently at T_2. Students were in fact more likely to use indirect and less instrumental academic terms, such as "learn" and "learning", which occurred in 30 responses, and mention more frequently ways in which group work would help them improve *themselves* rather than their marks.

That is not to say that the issue of unfairness, whether in workload, effort or grading, was not raised; it occurred in 26 responses. However, we found that students were constructive, and most often balanced positive statements and negative ones, for example: "When working in groups you can learn things from other people, but you can also be held back if people aren't working and putting in as much effort". Furthermore, students were *not* more averse to group work after experiencing it.

Despite us partly meeting the staff, space and software supply challenges involved in providing for a large cohort of students, by obliging three students to share a single computer, and therefore a single software licence, not a single one of our students, accustomed to a personal smartphone and laptop, complained or even mentioned having to take turns and share access to SimVenture. We turned necessity into a virtue, by creating zones of extremely proximal development [8], and met our aim of providing a collaborative experience in a large module, notwithstanding our limited resources.

Finally, our implicit aim in adopting a small-group configuration was to foster supportive relationships. We pictured ourselves as the freshers we once were, walking into a crowded lecture theatre, scanning the room for someone we might know well enough to sit next to. We were gratified by the words "friend" or "friends" being mentioned 50 times in the responses. We cannot say for certain that all these references are the result of collaboration on SimVenture, as although the students' first semester syllabus contained no other major group work element, there were doubtless many class-based tasks, such as working on a problem with the person sitting next to you, which could contribute to a feeling of fellowship, or could underline the importance of friendship.

X. CONCLUSIONS

Our aim in this project was to explore whether the experience of participating in a group work module made a discernable difference in students' expressions of their expectations of group work. We were looking out for greater negativity or indeed positivity, or a more nuanced understanding of the future benefits of group work. Although this study was not intended as an evaluation of the module itself, a preponderance of negative comments at T_2 would have indicated students' dissatisfaction with the group work experience, and we were pleased that students did not by and large become jaded or cynical about group work.

This was a small sample of first years expressing their views having experienced only one module; whilst we did see individuals modify their view between T_1 and T_2, there was little difference between the two samples overall. A major concern with the study was that, by focusing it on four quite specific questions, we were narrowing the scope of response we would receive, and answers would not depart from the terms we had used, which would fatally undermine the overall

qualitative approach. However, even though our questions were tightly-structured and hence produced some focused and predictable data, the nature of students' response to all four of our questions was broader and less emphatic than we had expected. We were able to hear students' own views, some of which were quite revelatory, and around quite personal themes such as confidence, friendship and their future selves.

Far from conforming to the stereotype of reluctant collaborators, these CS students proved open to group work and appreciative of its benefits, particularly in boosting their soft skills. Whilst those who felt they lacked such skills were apt to consider them personal shortcomings, almost all expressed a belief that such skills could be acquired.

Our broader aim in detailing the active learning design and the simulation used in our group work module, was to show that, despite belonging to a large cohort of 100+, our students were given the opportunity to benefit from small-group interaction. We would suggest that the benefit to students who remain receptive towards the group work so necessary for employability, is worth the investment of staff, lab and software resources. As one of our participants said at T_2, "It has taught me to work with others and enjoy it".

REFERENCES

[1] A. J. Martin and H. W. Marsh, "Academic buoyancy: Towards an understanding of students' everyday academic resilience," *Journal of school psychology,* vol. 46, no. 1, pp. 53-83, 2008.

[2] J. Brouwer, E. Jansen, A. Flache and A. Hofman, "The impact of social capital on self-efficacy and study success among first-year university students," *Learning and Individual Differences,* vol. 52, pp. 109-118, 2016.

[3] J. Bamford and L. Pollard, Cultural Journeys in Higher Education: Student Voices and Narratives, London: Emerald Group Publishing, 2019.

[4] M. N. Giannakos, I. O. Pappas, L. Jaccheri and D. G. Sampson, "Understanding student retention in computer science education: The role of environment, gains, barriers and usefulness," *Education and Information Technologies,* vol. 22, no. 5, pp. 2365-2382, 2017.

[5] HESA, "Non-continuation: UK Performance Indicators 2018/19," 27 February 2020. [Online]. Available: https://www.hesa.ac.uk/data-and-analysis/performance-indicators/non-continuation-1819.

[6] M. Dewey, Democracy and Education, New York: The Free Press, 1966.

[7] D. López-Fernández, E. Tovar, L. Raya, F. Marzal and J. J. Garcia, "Motivation of Computer Science Students at Universities Organized around Small Groups," in *2019 IEEE Global Engineering Education Conference (EDUCON)*, 2019.

[8] L. Vygotsky, Mind in Society: The Development of Higher Psychological Processes, Cambridge, MA: Harvard University Press, 1978.

[9] A. N. Leontiev, Activity, personality, and consciousness, Englewoods Cliffs: Prentice-Hall, 1978.

[10] A. Bandura, Social learning theory, New Jersey: Prentice Hall, 1977.

[11] G. Kanaparan, R. Cullen and D. Mason, "Effect of self-efficacy and emotional engagement on introductory programming students," *Australasian Journal of Information Systems,* vol. 23, 2019.

[12] J. J. Appleton, S. L. Christenson, D. Kim and A. L. Reschly, "Measuring cognitive and psychological engagement: Validation of the Student Engagement Instrument," *Journal of school psychology,* vol. 44, no. 5, pp. 427-445, 2006.

[13] A. James, "Making a case for the playful university," in *The power of play in Higher Education*, Cham, Palgrave Macmillan, 2019, pp. 1-19.

[14] C. L. Gress, M. Fior, A. F. Hadwin and P. H. Winne, "Measurement and assessment in computer-supported collaborative learning.," *Computers in Human Behavior,* vol. 26, no. 5, pp. 806-814, 2010.

[15] A. Bandura, Self-efficacy: The exercise of control, New York: Freeman, 1997.

[16] R. Kumar, A. Zusho and R. Bondie, "Weaving cultural relevance and achievement motivation into inclusive classroom cultures," *Educational Psychologist,* vol. 53, no. 2, pp. 78-96, 2018.

[17] D. Kolb, Experiential learning as the science of learning and development, Englewood Cliffs, NJ: Prentice Hall, 1984.

[18] M. Angolia and A. Reed, "A case for early semester utilization of business simulations," *Journal of Applied Research in Higher Education,* vol. 11, no. 1, pp. 90-101, 2019.

[19] C. Brom, T. Stárková, E. Bromová and F. Děchtěrenko, "Gamifying a Simulation: Do a Game Goal, Choice, Points, and Praise Enhance Learning?," *Journal of Educational Computing Research,* vol. 57, no. 6, pp. 1575-1613, 2019.

[20] J. Hyun, R. Ediger and D. Lee, "Students' Satisfaction on Their Learning Process in Active Learning and Traditional Classrooms," *International Journal of Teaching and Learning in Higher Education,* vol. 29, no. 1, pp. 108-118, 2017.

[21] R. A. Ellis and P. Goodyear, The education ecology of universities: Integrating learning, strategy and the academy, Abingdon: Society for Research into Higher Education; Routledge, 2019.

[22] L. Dyson, "The knowledge market," *Soundings,* vol. 60, no. 60, pp. 57-70, 2015.

[23] A. Naeem Syeda, R. Engineer and B. Simion, "Analyzing the Effects of Active Learning Classrooms in CS2," in *Proceedings of the 51st ACM Technical Symposium on Computer Science Education*, 2020.

[24] P. Nair, Blueprint for tomorrow: Redesigning schools for student-centered learning, Cambridge, MA: Harvard Education Press, 2014.

[25] S. Pillay and J. Reynold, "The pains and gains of blended learning - social constructivist perspectives," *Education & Training,* vol. 56, no. 4, pp. 254-270, 2014.

[26] D. Lambach and C. Kärger, "Inverting the Classroom in Large-Enrollment Classes: A Beginner's Guide," *Journal of Political Science Education,* pp. 1-12, 2019.

[27] L. D. Pool, D. Gurbutt and K. Houston, "Developing Employable, Emotionally Intelligent, and Resilient Graduate Citizens of the Future," in *Employability via Higher Education: Sustainability as Scholarship*, Cham, Springer, 2019, pp. 83-97.

[28] X. Zhang, Y. Meng, P. O. de Pablos and Y. Sun, "Learning analytics in collaborative learning supported by Slack: From the perspective of engagement," *Computers in Human Behavior,* vol. 92, pp. 625-633, 2019.

[29] A. Mann, J. Rehill and E. T. Kashefpakdel, "Employer engagement in education: Insights from international evidence for effective practice and future research," Education Endowment Foundation, London, 2018.

[30] T. Fettes, K. Evans and E. Kashefpakdel, "Putting skills to work: it's not so much the what, or even the why, but how….," *Journal of Education and Work,* pp. 1-13, 2020.

[31] Q. Burke and C. S. Bailey, "Camp or College?," in *Proceedings of the 50th ACM Technical Symposium on Computer Science Education*, 2019.

[32] K. Jones, L. N. Leonard and G. Lang, "Desired skills for entry level IS positions: Identification and assessment," *Journal of Computer Information Systems,* vol. 58, no. 3, pp. 214-220, 2018.

[33] M. Exter, S. Caskurlu and T. Fernandez, "Comparing computing professionals' perceptions of importance of skills and knowledge on the job and coverage in undergraduate experiences," *ACM Transactions on Computing Education (TOCE),* vol. 18, no. 4, pp. 1-29, 2018.

[34] P21 Network, "Partnership for 21st Century Skills," 2009.

[35] K. K. Sturner, P. Bishop and S. M. Lenhart, "Developing collaboration skills in team undergraduate research experiences," *Primus,* vol. 27, no. 3, pp. 370-388, 2017.

[36] A. J. Clements and C. Kamau, "Understanding students' motivation towards proactive career behaviours through goal-setting theory and the job demands–resources model," *Studies in Higher Education,* vol. 43, no. 12, pp. 2279-2293, 2018.

[37] M. Souza, R. Moreira and E. Figueiredo, "Students Perception on the use of Project-Based Learning in Software Engineering Education," in *Proceedings of the XXXIII Brazilian Symposium on Software Engineering,* 2019.

[38] R. McCartney, J. Boustedt, A. Eckerdal, K. Sanders, L. Thomas and C. Zander, "Why computing students learn on their own: Motivation for self-directed learning of computing," *ACM Transactions on Computing Education (TOCE),* vol. 16, no. 1, pp. 1-18., 2016.

[39] A. T. Wynn and S. J. Correll, "Combating gender bias in modern workplaces," in *Handbook of the Sociology of Gender*, 2nd ed., Cham, Springer, 2018, pp. 509-521.

[40] M. Collain and D. Trytten, "You don't have to be a white male that was learning how to program since he was five," in *Proceedings of the 50th ACM Technical Symposium on Computer Science Education*, 2019.

[41] M. P. Lancellotti and T. Boyd, "The effects of team personality awareness exercises on team satisfaction and performance: The context of marketing course projects," *Journal of Marketing Education,* vol. 30, no. 3, pp. 244-254, 2008.

[42] B. Latané, K. Williams and S. Harkins, "Many hands make light the work: The causes and consequences of social loafing," *Journal of personality and social psychology,* vol. 37, no. 6, p. 822, 1979.

[43] L. Marshall, V. Pieterse, L. Thompson and D. M. Venter, "Exploration of participation in student software engineering teams," *ACM Transactions on Computing Education (TOCE),* vol. 16, no. 2, pp. 5-38, 2016.

[44] D. M. Brown, I. Charity and A. Robson, "Hitting the Ground Running: Group Simulations Within Business School Cohorts," in *Employability via Higher Education: Sustainability as Scholarship*, Cham, Springer, 2019, pp. 389-413.

[45] V. Hämäläinen and V. Isomöttönen, "What Did CS Students Recognize as Study Difficulties?," in *2019 IEEE Frontiers in Education Conference (FIE)* , 2019.

[46] S. Van Ginkel, J. Gulikers, H. Biemans and M. Mulder, "Towards a set of design principles for developing oral presentation competence: A synthesis of research in higher education," *Educational Research Review,* vol. 14, pp. 62-80, 2015.

[47] L. R. Murillo-Zamorano and M. Montanero, "Oral Presentations in Higher Education: A Comparison of the Impact of Peer and Teacher Feedback," *Assessment & Evaluation in Higher Education,* vol. 43, no. 1, p. 138–150, 2018.

[48] A. Tsang, "The relationship between tertiary-level students' self-perceived presentation delivery and public speaking anxiety: A mixed-methods study," *Assessment & Evaluation in Higher Education,* pp. 1-13, 2020.

[49] C. Latulipe, N. B. Long and C. E. Seminario, "Structuring flipped classes with lightweight teams and gamification," in *Proceedings of the 46th ACM Technical Symposium on Computer Science Education*, 2015.

[50] Venture Simulations, "Accelerate Engaged Learning with SimVenture Evolution," 2020. [Online]. Available: https://simventure.com/evolution/. [Accessed 20 February 2020].

[51] A. S. A. Taylor, P. Backlund and L. Niklasson, "The coaching cycle: A coaching-by-gaming approach in serious games," *Simulation & Gaming,* vol. 43, no. 5, pp. 648-672, 2012.

[52] F. Jahanbakhsh, W. T. Fu, K. Karahalios, D. Marinov and B. Bailey, "You want me to work with who? Stakeholder perceptions of automated team formation in project-based courses," in *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, 2017.

[53] L. M. Braender and M. I. Naples, "Evaluating the impact and determinants of student team performance: Using LMS and CATME data," *Journal of Information Systems Education,* vol. 24, no. 4, p. 3, 2019.

[54] E. Popescu, "Providing collaborative learning support with social media in an integrated environment," *World Wide Web,* vol. 17, no. 2, pp. 199-212, 2014.

[55] W. A. Neu, "Unintended cognitive, affective, and behavioral consequences of group assignments," *Journal of Marketing Education,* vol. 34, no. 1, pp. 67-81, 2012.

[56] QSR, "Unlock insights in your data with powerful analysis," 2020. [Online]. Available: https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home.

[57] P. Kinnunen and B. Simon, "Building theory about computing education phenomena: a discussion of grounded theory," in *Proceedings of the 10th Koli Calling International Conference on Computing Education Research*, 2010.