Facilitating computing students' transition to higher education

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ABSTRACT

Students who progress to higher education from further education colleges are faced with academic, social, and logistical challenges during their transition. In general, they find university life more challenging compared to students who have been at university for two years already. The Associate Student Project (ASP) is an intervention programme within the School of Computing that provides support to students who make this transition. This support includes access to online resources, orientation events, university lectures and workshops, throughout their two years at further education college. This study aims to measure the impact of the ASP through a survey on academic behavioural confidence and a comparison of the grade point average of three student groups: independent direct entrants (n=53), associate students (n=27), and native students (students who entered university at first year, n=75). Analysis revealed that, while independent direct entrants (IDE) were less confident about their studies than native students (NS), there was a closer parity of confidence between native and associate students (AS). In addition, AS' confidence on tasks that relate to requesting information is higher than the other groups, perhaps due to the ASP's emphasis on providing good information to AS and encouraging dialogue. Associate students found interventions that provide insight into university life prior to their transfer useful. Additionally, the grade point average of AS was not found to be significantly different in comparison to native students. This paper reports on the success of these interventions in building student confidence and explores the impact for transitional students.

CCS CONCEPTS

• Social and professional topics → Computing education

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1 Introduction

There have been several calls to increase diversity in computer science and one of the ways to do this is by widening access to higher education (HE). Widening participation in HE continues to be a focus for the Scottish Government. The participation gap between students from the most and least advantaged areas is a concerning but improving statistic [4]. In a report by the Scottish Funding Council [29], 26.1% of first degree entrants entered university via further education (FE). The report also identified that 41.8% of the first degree entrants who are from the most deprived areas entered university via FE colleges. One of the pathways introduced to widen participation in Scotland is the "2+2 model". This pathway, of studying two years at an FE college and two years at university, is gaining wider acceptance [31]. In this model, students complete the Higher National Diploma (HND) at college, enter the university with full credit and advanced standing, and continue their degree at university from Year 3. Since 2013, some Scottish institutions have received additional funding to support students on this four-year pathway. The 2+2 model, despite its increasing popularity, poses significant challenges for HE institutions in retention and performance. There are concerns that students from FE are not adequately prepared for university study [6, 20]. Previous research identified that direct entrants (students who enter university directly at Year 2 or Year 3 after transferring from FE) face academic, social, and logistical challenges [8,14,20].

Students who transfer from FE to university were found to experience "transfer shock", where they experience a drop in

academic performance [11,26]. Reynolds found a large negative effect in attending college for two years, then university for two years, in comparison to attending university for the traditional four-year honours degree. Direct entrants were found to have a lower likelihood of completion than native students (traditional students who started university at first year) [26].

Studies on FE to HE transitions in computer science degrees also found a gap in performance between native and direct entrants, with native students having higher grades [13]. One of the factors that affect the transfer pathway is curriculum alignment [25], which can have a knock-on effect on how students approach studying for their HE modules. The non-alignment of modules offered in FE colleges with HE modules means that direct entrants need to put in extra work to be able to catch up with the background knowledge required for their HE computing modules. In a study of computer science graduate students, the lack of clear pathways to transfer from FE to HE (and lack of help to navigate pathways) were found to affect student transfer and successful completion of a degree in computing [17].

Interventions that promote social integration were found to promote successful student transition [1,37]. Massi et al.'s study on student engagement of direct entrants and native students found that students with higher levels of social integration also had higher levels of achievement [19]. Activities that involve advising, orientation programs, networking, and mentoring, among other transitional support, were found to help improve the learner journey. However, while these early interventions facilitate the transfer from FE to HE, direct entrants do not immediately settle into their new institutions. Direct entrants were found to have lower levels of confidence in comparison to native students and a considerable level of anxiety, having left the more supportive FE environment [7,21]. As such, looking at students' confidence in diverse academic situations provides useful information to the Associate Student Project.

In a logistical sense, many direct entrants will have attended their local college and the move to university will involve travel over a greater distance, sometimes commuting, resulting in increased expenditure in both time and money [21]. Like commuter students there can be a lack of appreciation for the tiring, expensive and stressful nature of commuting caused by parking issues, traffic jams, and cancelled services. Once on campus, this can also be exacerbated by the lack of suitable 'places' in which to spend time [35].

Positive learner identity correlates with successful higher education experience [18]. Students' confidence needs to be sufficient to enter university and persevere with challenging third year modules, while realistic expectations about university life are linked with success [12,16,24]. Nicholson et al. found that "higher competence beliefs predict improved achievement and learning outcomes" [24:287], but, more specifically, students benefit from realistic expectations of the balance between their own agency in learning and the lecturers' role. Nicolson et al. [24] advocate activities which help students enter university with realistic expectations about learning and teaching. This paper investigates the impact of providing support interventions to direct entrants by comparing academic confidence and progression of direct entrants who received transitional support (associate students) with other (independent) direct entrants and native students. Specifically, the current paper aims to answer the following research questions:

1. Are there differences in academic behavioural confidence between associate students (AS), independent direct entrants (IDE), and native students (NS)?
2. How do associate students perceive the usefulness of the interventions offered as part of the Associate Student Project?
3. Are there differences in the average grades of AS, IDE, and NS?

2 Theoretical framework

Transitioning to a new academic environment poses various challenges for students. Students perceive HE to have a different academic culture in comparison to what they have experienced so far. Siegel and Zarb's [32] investigation of computer science students transitioning into HE found that issues related to potential failure, adequate preparation, and time management are the main concerns for students. Although the group in Siegel and Zarb's study were secondary school students, the same issues around navigating the HE learning environment were also found to be true for directs entrants and transitioning first year students [3,6,15].

The successful transition from FE to HE of direct entrants requires both academic and social integration [36]. New students, particularly those who join existing cohorts, have to make connections with university faculty and unpick academic requirements (i.e., academic integration). They often struggle to fit it, citing specific concerns around making friends (i.e., social integration) [9]. Social integration can be defined as the social interactions the student experiences formally (through institutionally provided activities) or informally (through interaction with fellow students) [34]. Social integration can occur naturally when students are living and studying on campus. Social and academic integration are affected by factors such as living at home, taking time out to earn enough to continue studying, and family and care responsibilities. For various reasons (e.g., age, economic reasons, commitments), direct entrants are more likely to be impacted by these factors, reducing their capacity to commit to university [21].

As new university students, direct entrants need to quickly become familiar with a new environment that has different requirements, systems, and values to their previous college. Whereas native students have an extended period of induction, university entrants at Year 3 are required to adjust in a short period of time. To be successful, they must adapt to new teaching styles and engage with the university, attending lectures and labs, asking questions and understanding assessment requirements. While students may have experienced these tasks in their previous institutions, there is a perceived difference in academic culture that goes hand in hand with these tasks; for example, increased independent study and course requirements [15]. Previous studies

have suggested that support provided by the university to direct entrants can mitigate some issues of transition [13,14].

Confidence in educational settings has been of interest to HE institutions for many years. Previous research with undergraduate computing students suggested that students were most confident about their future academic success when they were Year 1 entrants and became less confident as they progressed through their studies [22]. The Academic Behavioural Confidence Survey is conceptualised by Sander and Sander as testing the "extent to which students have a strong belief, firm trust, or sure expectation of how they will respond to the demands of studying at university" [28:19]. As students move from college to university, their perceived academic ability can influence a positive adjustment [5]. The confidence of transitional students can be built by allowing them to experience success in a similar context, through interventions on their FE campus and within the university. Of particular interest to this study is academic behavioural confidence, which examines behaviours related to study, such as confidence in independent study, attaining grades, attending taught sessions, and asking questions relating to course materials [24].

3 The Associate Student Project (ASP)

The ASP is a collaboration between a Scottish university's School of Computing and local FE colleges, funded by the Scottish Funding Council since 2013. The aim of the programme is to support students who study two years at FE college (gaining their Higher National Diploma) and then continue straight into the third year of a computing degree at university, with credit for the student and no loss of time. Collaborations with participating FE colleges establish agreed progression routes to degree courses. This aims to align the content of specific FE courses, with the computing courses offered in first and second year undergraduate courses at university, as part of the articulation agreement. For example, a student achieving HND Networking in college could enter the third year of the BEng Computer Security and Forensics course at university, with the appropriate skills and knowledge. The ASP manages this process and articulation agreements concerning the number of university places available through these routes each year.

Associate students transfer via this articulation route, with the support of the ASP. They are identified as associate students at the start of their college (HND) programme; matriculated as both university and college students; and guaranteed a university place (with a suitable HND pass). AS are direct entrants who have received transitional support from the ASP prior to (and throughout) transferring to university. In this study, independent direct entrants (IDE) are students who have transitioned without this additional support.

Unlike IDE students, the associate students were encouraged to visit the university, during their two years at college, and talk to current students and academic staff about their expectations. AS could learn about and discuss the difference in the pace of work, the workload, the amount of independent learning required, and the specific programming languages or software used in their courses through university staff and students visiting their colleges and events at university. Academic writing workshops were provided, reflecting the move from the more technically-oriented HND to university modules which required more written reports. A mentor programme paired associate students with students who had successfully made the transition from college to university, providing advice at a peer-level. AS were also given opportunities to attend university lectures, see how lecturers and students relate in a lecture and experience the difference in teaching styles. Associate students were enrolled on online learning modules to allow them to gain familiarity with the course materials that native students have access to.

For the face-to-face events, students selected which interventions to attend; there was no requirement to take part. Thus, student participation in numbers varied. For example, attendance in the orientation programme given to incoming third year students for the academic year 2018/19 was 101 and attendance in a guest lecture on artificial intelligence at an FE institution, which would potentially be of interest to students across computing subjects, was 15. Meharg et al. provide more details about these interventions [21, 22].

Table 1. Comparison of demographic data of associate and native students

Demographic Data		Independent DE	Associate Students	Native Students
Gender	Female	16.1%	9.63%	16%
	Male	83.9%	90.37%	84%
Age	18-20	31.5%	32.09%	67.2%
	21-24	34.8%	20.86%	21.8%
	25-29	15.4%	18.18%	6.0%
	30+	17.6%	28.88%	5.0%
SIMD	SIMD<20	16.2%	14.13%	8.3%
	SIMD 20-40	24.4%	26.63%	13.8%
	SIMD 40-60	21.8%	19.57%	19.6%
	SIMD 60-80	16.2%	19.57%	25.9%
	SIMD 80-100	21.5%	20.11%	32.5%

SIMD (Scottish Index of Multiple Deprivation), with relatively more deprived areas below SIMD50 and relatively more advantaged areas above.

The programme of interventions offered is specifically designed to support students to develop their academic and social confidence as learners in the university context. In developing these interventions, the programme team has built on the knowledge gained through the UK "What Works?" programme [10], and studies in community colleges in the USA [36] and in Australia [2]. In addition, the programme has been continuously improved by feedback from the students.

The demographic data of associate students over the first three years of the programme's implementation is shown in Table 1. The table shows that around 47% of AS are aged over 25, which is a considerably higher proportion in comparison to native students (11%) and independent direct entrants (33%). The Scottish Index of Multiple Deprivation (SIMD) categorises addresses, via their postcode, according to a suite of social and economic indicators of deprivation [30]. SIMD 20 refers to the most deprived 20%. Around 40% of the AS and IDE were from relatively deprived areas (below SIMD40), compared to 22% of native students.

4 Methodology

A survey measuring students' confidence, using Sander and Sanders' [28] Academic Behavioural Confidence scale (ABC), was administered to students within the School of Computing. Sander and Sanders' Academic Confidence Scale, later known as the Academic Behavioural Confidence (ABC) Scale, was chosen to help understand students' experiences, and potentially measure the effect of ASP interventions, because it covers a range of university situations. These situations cover six factors (subscales): *grades*, *studying*, *verbalising*, *attendance*, *understanding*, and *requesting*. Students were asked to rate their confidence about 24 university situations, using a 5-point scale (from "not at all confident" to "very confident"). Here, confidence is self-rated and domain-specific [33]. A high level of internal reliability (Cronbach's alpha = 0.88) was reported for the 24 item scale [28].

An invitation to participate in the survey was sent out to all undergraduate School of Computing students, at all year levels. A total of 526 university students participated in the survey during the years 2016 and 2017. For the current analysis, data is drawn from third and fourth year students (n=155) who completed the survey. The students were divided into three groups: *independent direct entrants* (IDE; n=53) are students who enter the university in Year 2 or later; *associate students* (AS; n=27) are direct entry students who are part of the ASP and received an intervention programme to help them transition to university life; *native students* (NS; n=75) are students who entered university in first year. A demographic of the sample is shown in Table 2. The disproportion of gender distribution is representative of the female students within the School of Computing, which is 17%.

The mean score for each subscale was computed by averaging the item-level ratings for each subscale. A one-way analysis of variance (ANOVA) was conducted to compare the group differences in each of the three ABC subscales: *studying*, *understanding*, and *verbalising*. For the subscales *requesting*, *attendance*, and *grades*, the non-parametric Kruskal-Wallis test was conducted, as assumptions of ANOVA were not met for these respective subscales. The Kruskal-Wallis test was used to compare group differences at item level with an adjusted p-value of $p<.002$ to account for multiple testing. Descriptive statistics were used to analyse associate student perception of the interventions provided. To compare academic achievement, the Grade Point Averages (GPAs) for the grades received for Year 3 and 4 subjects (level 9 and 10 modules in the Scottish Credit and Qualifications Framework) were compared using ANOVA.

Table 2. Survey participant demographic

		IDE	AS	NS	Total
Gender	Male	42	23	62	127 (82%)
	Female	11	4	13	28 (18%)
Age Group	Under 21	11	6	29	46 (30%)
	21-24	19	10	30	59 (38%)
	25+	23	11	16	50 (32%)
Total		53	27	75	155

5 Results

5.1 Academic confidence

A summary of the groups' ABC mean scores grouped into their respective subscales is presented in Table 3. A score of 5 reflects high confidence, whilst a score of 1 reflects no confidence. Most of the subscale scores, except for the independent direct entrants' score on verbalising (mean = 2.89; sd=.88), were above 3.0 which represents the neutral mark.

Having met the assumptions of normality and homogeneity of variance, a one-way ANOVA was conducted for the subscales: verbalising, studying, and understanding. Student confidence in verbalising was statistically different for the three groups, p=.024. Bonferroni post hoc analysis revealed a significant difference in IDE and native students' scores (p=.027). The difference between associate and native students was not significant nor was the difference for associate students and IDE on this subscale. At item level, however, there was a significant difference on the item *Give a presentation to a small group of students* using the adjusted p-value of p=.002 after Bonferroni correction. AS and IDE both scored significantly lower than native students.

For the subscale *understanding*, associate students had slightly higher confidence than the other two groups (AS=3.59; IDE=3.53, NS=3.44) but these differences were not statistically significant. The subscale for *studying* was also not significant, with native students scoring slightly higher than the other groups (NS=3.56; AS=3.31; IDE=3.27). Significant difference was found for the item *manage your work to meet coursework deadlines* with native students being more confident on this aspect than the other two groups (NS=3.93; AS=3.40; IDE=3.37)

Assumption of normality was not met for the subscales *grades*, *attendance* and *requesting*, so, the non-parametric, Kruskal-Wallis test was used. There was a significant difference in the distribution of the scores between groups for the subscale *grades*, $\chi2(2) = 10.593$, p=.005; Post-hoc analysis with Bonferroni correction revealed a significant difference in scores of independent direct entrants and native students (p=.011) but not between AS and IDE, neither for independent direct entrants and native students.

Table 3. ABC scores at item and scale level between groups

ABC Item	IDE	AS	NS	p-value
Grades	3.39 (.76)	3.43 (.69)	3.78 (.54)	.005+
Produce coursework at the required standard	3.61	3.48	4.09	.001*
Pass assessments at the first attempt	3.75	3.28	4.19	.0001*
Produce your best work under examination conditions	2.84	3.08	3.09	.353
Produce your best work in coursework assignments	3.57	3.72	4.09	.010
Attain good grades in your work	3.39	3.48	3.81	.017
Write in an appropriate academic style	3.16	3.52	3.42	.286
Attendance	4.35 (.59)	4.36 (.68)	3.9 (.89)	.005+
Be on time for lectures	4.37	4.48	4.03	.094
Be on time for lectures	4.37	4.48	4.03	.033
Attend tutorials	4.35	4.32	3.74	.003
Requesting	3.61 (.77)	4.13 (.94)	3.95 (.81)	.027
Ask for help if you don't understand	3.43	4.31	3.77	.010
Ask lecturers questions about material they are teaching, in a one to one setting	3.79	3.94	4.13	.355
Studying	3.27 (.81)	3.31 (.92)	3.56 (.72)	.098
Manage your work to meet coursework deadlines	3.37	3.40	3.93	.002*
Study on your own in independent / private study	3.51	3.48	3.96	.017
Remain adequately motivated throughout	3.18	3.08	3.09	.916
Plan appropriate revision schedules	3.02	3.28	3.26	.460
Understanding	3.53 (.61)	3.59 (.57)	3.44 (.74)	.685
Follow the themes and debates in lectures	3.68	3.88	3.85	.684
Prepare thoroughly for tutorials	3.29	3.44	3.23	.779
Understand the material outlined and discussed with you by lecturers	3.57	3.63	3.68	.868
Read the recommended background material	3.57	3.44	3.00	.027
Verbalising	2.89 (.88)	2.99 (.99)	3.33 (.91)	.024+
Respond to questions asked by a lecturer	2.41	2.68	3.03	.026
Engage in academic debate with your fellow students	3.10	3.52	3.39	.194
Ask lecturers questions about material they are teaching, during a lecture	2.94	3.00	3.04	.898
Give a presentation to a small group of fellow students	3.12	2.76	3.86	.0001*
Make the most of the opportunity of studying for a degree at university	3.86	3.94	3.72	.710

Note: + significant at p<.05

* significant at p<.002 (after Bonferroni correction)

There was a significant difference in the groups' confidence scores in *attendance*, $\chi 2(2) = 10.559$, p=.005. Post-hoc analysis revealed a significant difference in scores of independent direct entrants and native students (p=.015) but not for the other group combinations. In all the items related to attendance, there was a high confidence in completing these tasks from both independent direct entrants and associate students.

A significant difference in the groups scores in *requesting*, $\chi 2$ (2) =7.205, p=.027 was found. AS were more confident than the other groups (AS=4.13, NS=3.95, DE=3.61) but post-hoc analysis did not show significant group differences after Bonferroni correction. AS have high confidence on the task *ask for help if you don't understand* (AS=4.31, NS=3.77, DE=3.43) but after Bonferroni correction, this difference was not significant (p=.010).

5.2 Student perceptions of ASP

Associate students were also asked how useful they found the different interventions and support offered by the ASP on a scale of three (1=not useful and 3=useful). Median scores for these events are shown in Table 4. An option to state that they had not participated in these events was also available. As attendance at these events is not mandatory, not all associate students in the survey have participated in these events. Even so, the usefulness of the events, from those who have attended and completed the survey, was ranked highly, particularly for events that provided AS with a glimpse of university life; for example, being enrolled in the virtual learning environment (VLE) allowed associate students, while at college, to gain familiarity with the modules that their native students counterpart were taking.

Table 4. ASP event/intervention evaluation

Event/Intervention	Median	N
Using university VLE pages to find out more about the course	3	19
Meeting university staff at college (getting information and asking questions)	2	19
Attending a university lecture at university campus	3	13
Using the university computer centre, library or other facilities	3	13
Contact with students and university staff using Facebook	3	13
Attending a lecture at college taught by a university lecturer	3	12
Attending a university workshop at university campus	2	9
Meeting university students at college	3	7
Attending UCAS workshop at college	2	7

5.3 Preliminary results on academic achievement

An independent t-test of the grade point average (GPA) of the students who took part in the survey was compared using ANOVA. As not all students provided data to track the grade

point average, only 89 out of the 150 respondents were compared (NS=52; IDE=22; AS=15). Assumptions for ANOVA were met. There was a significant difference in the GPA of students from the three groups $F(2,86)=3.131$, $p=.049$. Native students have a GPA of 66.50 (sd=1.00), associate students' GPA was 64.60 (sd=2.62) and independent direct entrants' GPA was 61.59 (sd=1.52). Post hoc testing was significant for native students and direct entrants, $p=.044$.

6 Discussion and conclusion

The survey analysis indicated differences between academic behavioural confidence of native students, associate students and independent direct entrants. For tasks related to grades, studying and verbalising ideas, NS have higher confidence scores than IDE and AS. These differences were not always statistically significant, but worth noting, as this finding echoes literature findings on gaps in performance between direct entrants and native students [26]. Direct entrants (including AS) face transitional issues which have knock-on effects on their confidence [6]. In the current study, the AS, who received additional support throughout their transition process, had closer parity in confidence with NS than other IDE, which suggests a narrowing of the gap for those who transition to university from college with support. In addition, associate students' confidence on tasks that relate to requesting information are higher than the other groups, perhaps due to the ASP's emphasis on providing good information to AS. Independent direct entrants and associate students were also found to have higher academic confidence in tasks related to attendance. Reasons for this may be related to age, as direct entrants tend to be older than NS, or could also be related to the academic culture that direct entrants have transitioned from.

AS' feedback on the programmes offered was positive; events that provide information about university academic life were found most useful. For example, allowing associate students access to the virtual learning environment of the university can help students become familiar with the requirements, content, and structure of university modules, lessening the impact of possible "transfer shock." Previous studies have shown that the support received by college students as they move to university has a positive effect on their transition process [14,17,23,27]. In Lanaan et al.'s study, student encounters with university staff while they were at college was a significant factor affecting student transition [14]. Narayanan et al. describe how a clear transition pathway and support provided to computer science direct entrants while at a community college, led to successful degree completion [23]. The current study reflects these studies and suggests that the transitional support provided by the ASP may have had a positive effect on associate students' confidence scores. However, it is worth noting that student take-up of these events varied. Around 70% (19 out of 27) of the AS surveyed gave feedback on *using university VLE* in comparison to the 26% (7 out of 27) who gave feedback on the event *meeting university students at college*. While both events have the same median scores, the difference in take up suggests a need to consider which aspects affect student take-up of the interventions and how interventions can be made more attractive or accessible to students.

The finding of the current study in relation to academic achievement suggests a difference between the three groups with the magnitude of the difference being higher between native students and independent direct entrants. This echoes findings of Kwik et al. [13] that found direct entrants tend to have lower GPA scores than native students. The non-significant difference between associate and native students suggests some parity between the two groups. This finding also suggests the positive effect of the content alignment agreement between the partner FE and HE, where content delivered at FE is negotiated with the partner HE. However, this investigation is preliminary and further research is currently underway to compare student achievement, including course completion and awards achieved at the end of the programme.

HE degrees starting at college are a good route for many students and a good way for universities to widen participation. Beyond academic content, how students identify themselves, the groups and associations they perceive, and the experiences they encounter, all affect their future actions and success. Understanding these helps us to support them. Some of the challenges faced by direct entrants are faced by many widening participation students (e.g., confidence, expectations, logistics). Many of the interventions provided by the ASP could usefully be mainstreamed. It is also important that confidence in requesting tasks (e.g., "ask for help if you don't understand") should be reflected by a responsive environment, with regular opportunities for communication, including after the initial transition.

Several limitations are identified, including sample size, the self-reporting nature of the instrument and the possibility of maturation effect as part of including fourth years in the sample. In addition, the use of a three-point Likert scale limits the range of student feedback on the interventions. The use of the GPA to compare the three groups may also introduce some bias, as not all students in the survey were undertaking the same programme. In addition, the data has not captured students who have withdrawn from their studies. We have noted the different interventions but have not measured the effects of each of these interventions on academic confidence and achievement. Successful transition is not just about the initial transfer experience but also about successfully supporting students up to course completion. This is an aspect, beyond the data in this study, that we are currently researching. Future work includes analysis of students' feedback about the different interventions, comparison of course awards, and graduate feedback, to understand and assess how the Associate Student Project contributes to the students' journey to their degree.

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