Analysis of Tinto's student integration theory in first year undergraduate computing students of a UK Higher Education Institution

Abstract

Purpose- Retention is one of the key performance indicators in university quality assurance processes. This study identifies causes leading to low retention rates for first year undergraduate computing students in a UK Higher Education Institution.

Design/methodology/approach- The study applies Tinto's Student Integration Theory, and connects it with behavioural patterns of students. Data was collected from 901 students using Pascarella and Terenzini's questionnaire (integration scales). This data was combined with student enrolment information and analysed using the Structural Equation Modelling (SEM) technique.

Findings- The study results indicate that Tinto's Student Integration Theory is useful in analysing student retention, but this accounts for only a modest amount of variance in retention. Nevertheless, important relationships amongst student's initial and later academic goals and commitments have been identified through this new approach to analysing retention. The largest direct effect on retention was accounted for by initial goals and institutional commitments, followed by later goals and institutional commitments. In addition, the results show that academic and social integration constructs can have an influence on the student retention processes. When all, or some, of these relationships are operating towards students' benefit, appropriate services or programmes, such as student support systems, can have their maximum benefit.

Originality/value- The authors mapped behavioural related retention factors using a learning community lens. The study explored students' social and learning experiences within the context of a UK Higher Education institution by employing Tinto's model. This is the first time the model has been tested in this context.

Keywords: Higher Education Institutions, Universities, Student Retention, Academic Integration, Social Integration, Learning Communities

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Introduction

It has long been argued that the first year university experience has a critical influence on a student's intention to complete their undergraduate studies (Upcraft et al., 2004; Kuh et al., 2005). A major part of existing research in this area is based on Tinto's (1975) and Astin's (1975) work (Whittaker, 2008; Ryan, 2013; Mertes, 2015), with Tinto's (1993) Student Integration Theory for early departure of students from higher education the most influential publication in this area (Heaton-Shrestha et. al., 2009). According to Tinto (1993), students who become a part of their campus academically and socially are more likely to stay in their study programme. A big part of the students' connection to their campus is through engagement in learning communities. Learning communities represent groups of students who may take common courses together, share common academic interest or live in the same residence (SATS, 2007). Fostering learning communities has been shown to support increased student learning and retention (Shapiro and Levine, 1999). Knowing this, it is important to determine how first year students interact with and succeed in a university environment. This becomes more crucial as universities become more diverse and administrators work to improve first year students' retention and graduation rates. Traditionally studies involving Tinto's (1993) Student Integration Theory have been conducted in the US but, at a time of significant change in UK higher education, there are important lessons that can be learnt in terms of supporting and developing UK students. In this study, Tinto's (1993) Student Integration Theory has therefore been used to understand better the behavioural patterns of first year undergraduate students at a UK Higher Education Institute (HEI).

In addition, a rise in tuition fees combined with a challenging economic outlook both nationally and internationally means that there has never been greater pressure for students to make the right choice of course and institution in order to successfully enter the graduate employment market. From an institutional perspective, UK Higher Education faces the challenge of understanding and meeting the expectations of more demanding students without additional funds (HEPI, 2013). In this new more competitive environment, UK HEIs are therefore tasked with maintaining, and indeed improving, their academic experience and student engagement at the increasingly high levels demanded by students.

A particular area of interest regarding course choice within the UK is computing, where the UK government believes that it will need a future generation which is both skilled and passionate about computing. If the UK wishes to remain a world leader in research and technology, current retention challenges facing computing departments in UK HEIs need to be addressed; inspiring more students to study computing and improving skill levels to produce highly employable graduates. There was a significant increase in enrolment numbers in the early years of this century, mirroring a large increase in computing-related jobs within the UK economy, but the overall trend has led to only a modest increase in enrolments, and retention has remained disappointingly poor in computing courses (HESA, 2014a).

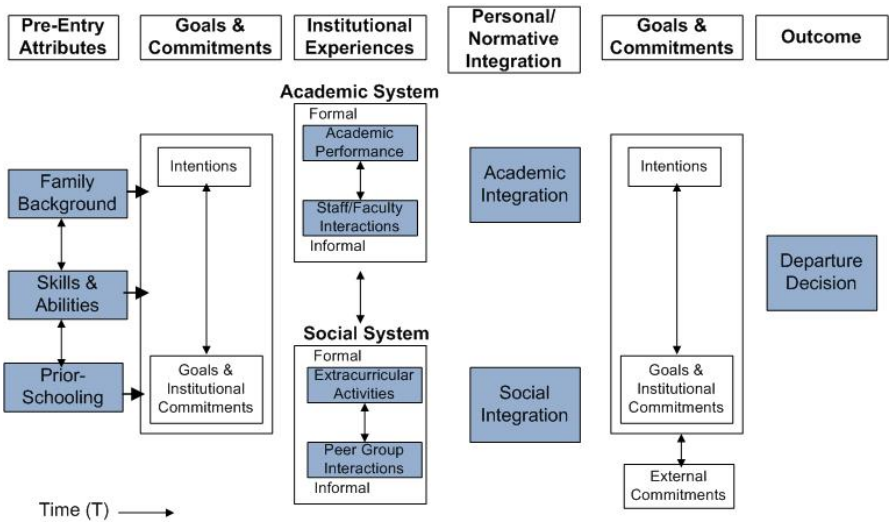
In addition, computing courses in UK HEIs face decrease in enrolment and retention compared to other popular subject areas such as medicine and education (HESA, 2015). Alongside s concerning non-continuation rate, computing courses have shown only modest average growth in enrolments over the last two decades, with a 30% increase from 1996-7 to 2011-12, compared to an average increase of 59% in the other subjects (Matthews, 2014). According to the 2015-16 Higher Education Statistics Agency (HESA) statistics the three subjects with the largest increases in absolute numbers were biological sciences (up by 61,945 or 42.6%), business and administrative studies (up by 46,145 or 15.9%), and engineering (up by 26,985 or 20.4%). During the same period two of what had been the largest subject areas, subjects allied to medicine and education, fell by 23,635 (8.0%) and 25,105 (12.7%) respectively, and computer courses fell even more, by 36,795 (28.7%) (HESA, 2015). Moreover, there has been considerable growth in the number of students entering all science, technology, engineering and mathematics (STEM) degrees except computing (HESA, 2015). Similarly, according to Gordon's (2016) Higher Education Academy report, STEM disciplines generally had a higher rate of withdrawal due to academic failure (38%) and retention in computing courses was the worst of all disciplines (91%).

The general aim of this study therefore was to map behavioural – related retention factors using a learning community lens applied to first year undergraduate computing students of a UK HEI. In particular, this study explored students' social and learning experiences within the context of the Computing Department of a middle-ranked UK institution. In this context, the UK learning communities, in which students participate as a cohort, were investigated in terms of supporting their development and providing an environment that supports good pedagogic practice. Finally, given the recurrent of student retention challenges a single year was used to provide a snapshot of the challenges.

Tinto's Student Integration Theory

Tinto's (1993) Student Integration Theory is the most widely cited retention theory (see Figure 1). Tinto (1993) has suggested three main conditions which need to be met in order to achieve student persistence. The **first condition** is that students should have access to retention programmes which aim to support them rather than the institution. The **second condition** is that retention programmes need to not only focus on a particular student population, such as low-income or minority students, but instead focuses on all students. The **third condition** is retention programming. A successful retention programme must offer a degree of integration for students in both social and academic communities.

Figure 1: Tinto's (1993) Student Integration Theory



Source: Modified from Leaving College: Rethinking the Causes and Cures of Student Attrition. 2nd edition. Chicago: The University of Chicago Press, p. 114. Copyright 1987, 1993 by The University of Chicago Press.

The main points of Tinto's (1993) Student Integration Theory are social and academic integration in relation to a student's commitment to the institution and/or outside efforts. As can be seen in Figure 1, students bring to university prior schooling, skills and abilities. When these three things are combined, they lead to a set of commitments, goals and intentions from and to an institution. In other words, students are aware of what they want to achieve prior to their enrolment in their first academic year. This means that institutions must set out student expectations which in turn aid student success. It is also very important that students have the ability to develop social and *academic integration* skills in both informal and formal ways.

Formal *academic integration* includes researching topics in the library, attending labs and classes, and engagement in various activities related to academic success. Informal academic engagement is equally important and

includes student interaction with both staff and faculty. Student interaction with staff and faculty members outside the class hours can have a positive effect on student retention. Such interactions can have a normalising effect on students' socialisation to the attitudes and values of their institution. Interactions like these can also lead to an increased bond between students and their university (Pascarella and Terenzini, 1983). In terms of *social integration*, informal social integration involves interaction with peers, whilst formal social integration involves extracurricular activities. Higher levels of interaction can lead to higher levels of student persistence and graduation (Tinto, 1993).

According to Tinto's (1993) Student Integration Theory, if students manage to have informal and formal social and academic integration, they can re-examine their commitments, goals and intentions from and to the institution, and see them as external commitments. External commitments are considered to be personal desires, family, jobs and peers mainly outside the university environment. Based on these commitments, and levels of success and integration, students can decide if they want to remain at university. Dropping out, in this context, means the student leaves that particular university, rather than abandoning higher education altogether. Tinto also states that when students access university, they incorporate a set of background characteristics. These characteristics involve individual attitudes, pre-entry attributes, and family background. Individual attitudes include gender, race, age and aptitude. Pre-entry attributes include characteristics such as qualifications and achievements. Family background characteristics include family education level, family expectations and family social status. This set of characteristics directly affects students' initial goals and institutional commitments. Students' goal commitments address the extent to which they are motivated to enter university and students' institutional commitments describe the extent to which they are committed to graduating from a particular university.

Nonetheless, even if Tinto's (1993) Student Integration Theory is sound, Guiffrida (2006) stated that Tinto's theory requires students to move beyond their past traditions and affiliations in order to accept the associations and traditions of the higher education environment. Students who manage to affiliate with the higher education environment eventually complete their studies and graduate from university. However, not all students are able to affiliate. Those who do not reach an adequate level of affiliation tend to drop out of university and so integration with the institution is key. In this context, *Initial goal and institutional commitments* influence student integration within the academic and social system of their university (Tinto, 1993). *Academic integration* includes normative and structural dimensions. Normative integration involves an individual's identification with an academic system's attitudes and values structures (for example interacting with faculty members outside of the classroom). Structural integration relates to meeting the university's specific standards, for instance curriculum structures. *Social integration* indicates the extent of compatibility between a university's social system and an individual student. Tinto (1993) also notes that interactions with faculty and administrators, extracurricular activities, and informal group associations are classed as *social integration* mechanisms. During the final analysis, it is the interaction between the student's commitment to both university completion and the university itself that define whether the student chooses to leave (Tinto, 1993).

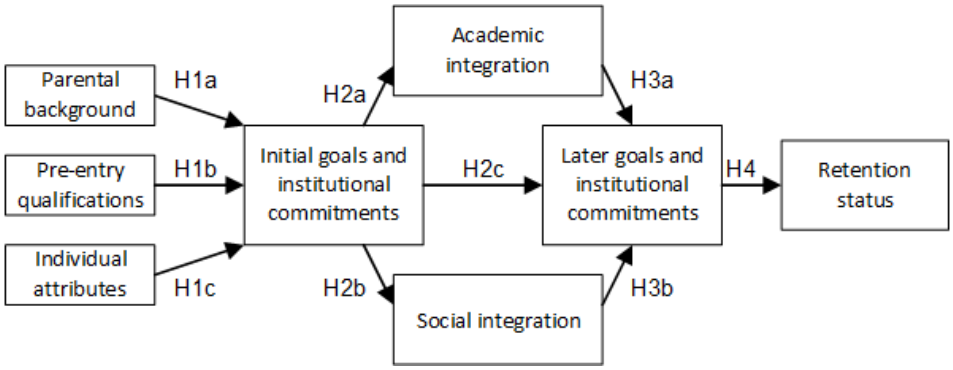
Research Approach

Despite the popularity of Tinto's (1993) Student Integration Theory, an important part that is missing from the model is to understand how student retention and persistence applies at various types of institution. Braxton et al. (2004), for example, questioned the validity of Tinto's Student Integration Theory at non-residential institutions and also highlight issues related to institution size. For instance, what might be an effective intervention in a small institution with 1,500 students and focuses on architectural studies might not be applicable for a large scale institution with a more computing-oriented focus. Similarly, a small size institution might lack appropriate resources to administer a successful intervention when compared to a larger institution or may alternatively provide a more supportive and personalised environment. Of course, the relevance of Tinto's Student Integration Theory beyond the US is also a key consideration, as is Tinto's consideration of the importance of finance in student retention, which is clearly relevant to the UK higher education environment (Brunsden et al., 2000; Whittaker, 2008).

Even though there are many studies that have previously investigated factors that affect student retention in HEIs, there are few quantitative studies that have applied the Structural Equation Modelling (SEM) method to test Tinto's Student Integration Theory. Specifically, the most cited studies that have tested Tinto's Student Integration Theory in US HEIs are Braxton, Vesper, & Hossler (1995), Braxton, Sullivan, & Johnson (1997) and Braxton & Lee (2005). In the UK HEI context, only one study can be found to test the predictive validity of Tinto's Student Integration Theory. This research study was administered by Brunsden et al. (2000) on two different courses – a Bachelor course in computer studies at an English HEI and a Bachelor course in Psychology at a Scottish HEI. Given this, it would be dangerous to assume that commonly agreed factors such as family background, demographics and pre-entry qualifications can be controlled for in a UK HEI context and so this study has considered and tested all potential factors arising from Tinto's Student Integration Theory through a series of nine hypotheses, which are outlined below.

The current investigation was conducted in a UK university that offers undergraduate academic studies for a period of three to four years (some courses include a placement/internship year). A modified version of Tinto's (1993) Student Integration Theory (Figure 1), which has already been tested by researchers in similar studies in the US (Braxton, Vesper, and Hossler, 1995; Brunsden et al., 2000; Braxton and Lee, 2005), was adopted for this study, to test its appropriateness within a UK context. The model used in this study is presented in Figure 2. Respondent data regarding family background, pre-entry qualifications (A level scores, skills and abilities) and individual attributes (race, age, gender, nationality etc.) was combined with the responses to the questionnaire to test the model, as these characteristics have been identified as affecting *initial goals and institutional commitments*. *Initial goals and institutional commitments* affect academic and social integration (institutional experiences), with both directly affecting *later goals and institutional commitments* and students' decisions to drop out or persist with their studies. Initial *goals and institutional commitments* and *later goals and institutional commitments* represent characteristics the student possesses at the time of entry and a student's disposition in terms of intentions and motivational factors. as well as the acknowledgment that external commitments to others and entities outside of the institution, such as family, friends, and work obligations, have an ongoing effect throughout the time spent in university. The external forces can either be supportive or have a negative influence on a student's goals and commitments, subsequent interactions with the institution, and ultimately, his or her departure decision (Tinto 1993). This is the first time this type of data analysis has been used to test Tinto's model extensively in a UK HEI context.

Figure 2: Initial Student Integration Model based on Tinto's (1993) Student Integration Theory



The quantitative data analysis was conducted via the use of a SEM method utilising the Analysis of Moments Structure (AMOS) software package. The quantitative approach was used to collect data from all first year students of the examined UK HEI, providing a comparison between computing students and other students, and enabling identification of variations which may explain differences in retention rates. Using the Initial Student Integration Model (see Figure 2) the following four sets of hypotheses (totalling nine individual hypotheses) were developed by the authors.

1. Students' family background (H1a), students' students' pre-entry qualifications (A level scores, skills and abilities) (H1b) and students' individual attributes (race, age, gender, nationality etc.) (H1c) will be associated with their initial goals and institutional commitments.
2. Students' initial goals and institutional commitments will be associated with their academic integration (H2a), *Social integration* (H2b) and later goals and commitments (H2c).
3. Students' *Academic integration (H3a) and Social integration (H3b)* will be associated with their *later goals and institutional commitments*.
4. Students' *later goals and institutional commitments* will be associated with their retention status (H4).

Method

Participants. Out of total population of 5,557 students, data was collected from 901 students, of which 171 were computing students. Table 1 shows the characteristics of both the participants and the first year student population as a whole, in terms of their pre-entry qualifications (A level scores), attrition rate and university enrolment. For the respondents, their student identifier enabled further comparisons to be made across a range of demographic factors.

Table 1: Comparisons between the Participants and the Population

	Participants N= 901	Population N = 5,557	p-value
Pre-entry qualifications (A Levels score)	85.51	85.88	Ns * (0.114)
Attrition rate:			.0001
Persist	846 (94.00%)	5022 (90%)	
Dropout	55 (06.00%)	535 (10%)	
University enrolment:			.0001
Department of Accountancy & Finance	82 (9%)	231 (4%)	
Department of Architecture and 3D Design, and Art	83 (9%)	381 (7%)	
Department of Education, and Initial Teacher Education	53 (6%)	502 (9%)	
Department of Health Sciences	55 (6%)	544 (10%)	
Department of Informatics	171 (19%)	315 (6%)	
Department of Engineering and Technology	84 (9%)	438 (8%)	
Department of Behavioural & Social Sciences	85 (9%)	530 (10%)	
Department of Chemical & Biological Sciences, and Pharmacy	81 (9%)	607 (11%)	
Department of Music and Drama, History English Languages & Media, and Music Humanities and Media-General	72 (8%)	596 (10%)	
Department of Fashion and Textiles	70 (8%)	270 (5%)	
Department of Law, People Management and Organisations, Logistics Operations and Hospitality Management, and Strategy Marketing and Economics	65 (7%)	1143 (21%)	

* $\rho > 0.10$

Procedure and materials. The data was collected using two questionnaires based on the Institutional Integration Scales items designed by Pascarella and Terenzini (1980). The four foundations measured in the current study were initial goals and commitments, social integration, academic integration, and later goals and institutional commitments. An initial engagement questionnaire was developed to collect information about students' initial goals and institutional commitments at the beginning of their first academic year. This was the First Engagement Questionnaire and it included 5 items. In the second semester, when respondents would have had enough time to develop academic and social experiences, a second questionnaire, the Engagement Questionnaire, was used. This included 29 items that measured students' academic and social integration, as well as later goals and institutional commitments. In both questionnaires, the scales used a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree) with coefficient alpha reliabilities on scales ranging from 0.71 to 0.84 (see Figure 3 in Appendix: First Engagement Questionnaire & Figure 4 in Appendix: Engagement Questionnaire). The authors generated individual questionnaire links for the students using Qualtrics, which is an online questionnaire software and insight platform (Qualtrics, 2017). The students were invited to complete the questionnaire via email. In addition, the students were reminded and encouraged to complete the questionnaire during the lecture sessions. The questionnaires were distributed and administered by central services of the university due to data confidentiality issues.

Information such as first year undergraduate students' family background education, pre-entry qualifications (A level scores, skills and abilities) and individual attributes (race, age, gender, nationality etc.), was collected, with informed consent, based on students' unique institutional identifier. All participant data was combined with their responses via their student identifier and this was then removed to anonymise responses before analysis. Initial goals and institutional commitments was measured by 'Institutional and Goal Commitments' of Institutional Integration Scales (Pascarella and Ternzini, 1980). This scale comprised of 5 items, which were included in the 'First Engagement Questionnaire'. Academic integration was measured by 'Academic and Intellectual Development' scale that included 7 items, while the 'Faculty Concern for Student Development and Teaching' scale included 5 items. The academic integration construct was included in the 'Engagement Questionnaire'. Social integration was measured by 'Interactions with Faculty' scale that included 5 items and the 'Peer-Group Interactions' scale included 7 items. This construct was also included in the 'Engagement Questionnaire'. Later goals and institutional commitments was evaluated by using the 'Institutional and Goal Commitments' scale. Again, this construct was collected from the 'Engagement Questionnaire'. Retention was based on whether a student re-enrolled, or not, for the second year of his/her academic studies. It was collected from the university admissions office and was coded as: 1 = persistent and 0 = voluntary drop out.

Data Preparation. The Pascarella and Terenzini's (1980) Institutional Integration Scales embedded a combination of positively and negatively worded items. In preparation for SEM analysis the negatively worded items were reverse scored so that all item answers reflected non-negative student integration. Furthermore, in preparation for SEM analysis all data was inspected for any missing values, outliers and normality of distribution, based on guidelines specified by highly regarded researchers in the field such as Hair et al. (1998), Tabachnick and Fidell (2007) and Cohen et al. (2013). After applying the Listwise Detection technique all missing value cases were deleted. The types of missing values were Missing Completely at Random (MCAR) and after these were removed the data remained as 761 full responses. According to Anderson and Gerbing (1988) a sample size between 100 and 150 is the minimum acceptable size for conducting SEM, a value which is comfortably exceeded in the current study.

Data Analysis

The data analysis was conducted using SEM (Kaplan, 2008). Anderson & Gerbing (1988) and Bollen & Long (1993) propose a two-phase SEM procedure, which was employed in the current study in order to estimate parameters. In particular, this was a measurement model (first phase), which was accompanied by a structural model (phase two). The measurement model was a confirmatory factor analysis (CFA) whose purpose was to define the relationships between latent and observed variables. The structural model then indicated the relationships amongst latent variables. In other words, it defined the latent variables that directly or indirectly cause changes in the values of other latent variables in the model (Lomax and Schumacker, 2012). The CFA was applied using the AMOS software program with four latent variables (*academic integration*, *social integration*, *initial commitments* and *later goals and commitments*) and 34 observed variables (Byrne, 2013).

The reasons for adopting SEM in the current study were fourfold. Firstly, SEM offers the opportunities of estimating and testing the relationships amongst constructs. Secondly, SEM is capable of assessing and correcting measurement errors. The third reason is that SEM permits the use of multiple measures in order to represent constructs. Finally, the fourth reason is because SEM takes a confirmatory approach to the data analysis, rather than an exploratory one (Brown, 2014).

Measurement Model for CFA

Most measurement models can be developed in five steps. Specifically, these are: (1) model specification, (2) model identification, (3) model estimation, (4) testing model and (5) model modification (Bollen and Long, 1993). In the current study, it was applied as follows.

In the current study, the model specification was based on Braxton et al. (1995) Model of Student Retention. Then, as a second step, model identification addressed if there is a unique set of parameters that is consistent with the data sample, or not. Traditionally, there are three levels of model identification in order to estimate the parameter(s) of a model: under-identified, just-identified and over-identified (Lomax and Schumacker, 2012). In this study, all measurement and structural models were over-identified. In the third step the authors employed the Maximum Likelihood (ML) estimation method to estimate the model parameters because the data were normally distributed. The data came from Likert-scale surveys measuring epistemological beliefs (Schommer, 1998) and learning processes (Schmeck, Ribich, and Ramanaiah, 1977).

The fourth step was to check how well the data fitted the model. If the fit is good then the specified model is supported by the data sample while if the fit is poor then the model needs to be re-specified in order to achieve a better fit. The evaluation procedures used to test the fit of the model were two-fold: the fit of individual parameters and the fit of the entire model. The first evaluation procedure was conducted in two parts. The first part was to define the feasibility of individual parameters' estimates values (correlation exceeding one, non-positive definite correlation matrix, and negative variance) (Byrne, 2013). In the current study none of these issues were identified. The second part in assessing the goodness of fit of the individual parameters was to test their statistical significances (t-values ≥ 1.96) (ibid). The second evaluation procedure in testing the goodness of fit of the measurement model was to assess the goodness of fit of the entire model. Even if the AMOS software program offers a variety of fit indices, in this study, the authors employed major indices proposed by Byrne (2013). Specifically, these were: **i)** Chi-square (χ^2) test, **ii)** the Normed chi-square (χ^2/df), **iii)** Goodness-of-Fit index (GFI), **iv)** Adjusted Goodness of-Fit Index (AGFI), **v)** Comparative Fit Index (CFI), and **vi)** Root Mean Square Error of Approximation (RMSEA).

The fifth, and final step, was modification of the model. In the current study, the authors had to modify the model until the fit indices indicated an acceptable level. The AMOS software program provides three techniques that can help to modify the model. Firstly, the Modification Index describes the expected drop in overall χ^2 values. Larger Modification Index for a particular fixed parameter would indicate that a better model fit would occur by permitting this parameter to be free. Secondly, the Expected Parameter Change statistic (EPC) is identified, which signifies the estimated change in the magnitude and direction of every fixed parameter if it was to be free. Thirdly, the standardized residuals with larger values indicate that a particular relationship is not well interpreted by the model (Brown, 2014).

Confirmatory Factor Analysis for Initial and Later Goal and Institutional Commitments

The Initial and *Later goals and institutional commitments* were measured using Pascarella and Terenzini's (1980) goal / institutional scale which was embedded in both First Engagement Questionnaire and Engagement Questionnaire. Essentially, this scale is synthesised by six items (Pascarella and Terenzini, 1980). Nevertheless, one of the items in the scale was removed because it could not be applied in the UK higher education context. This item was 'I have no idea what I want to major in' as this didn't have the same meaning for students in UK higher education. As a result, the *initial commitments* and *later goal and institutional commitments* measurement model consisted of 2 factors and 10 observed variables.

The *initial commitments* and *later goal and institutional commitments* measurement model results did not fit the data well. As seen in Table 2 the results based on this model indicated a poor fit, with 4 observed variables having very poor reliabilities (low squared factor scores of 0.53, 0.43, 0.41, and 0.43), and the initial measurement model was therefore modified.

The first modified *initial commitments* and *later goal and institutional commitments* measurement model was elaborated through the deletion of the preceding four observed variables from the initial measurement model. The outcome generated a moderate lack of fit between the model and the data. As a result, the model was modified again.

The Modification Index indicated that a correlation of the error terms could statistically improve the model fit (Bollen and Long, 1993, p. 297). Byrne (2013) has recommended that 'correlated error terms between item pairs are usually an indication of a high degree of overlap in item content'. He also noted that 'allowing the error terms of each pair to be correlated appears to be both statistically acceptable and conceptually meaningful', because these observed variables are the same variables. In this case they are measuring students' commitments in the First Engagement Questionnaire and the Engagement Questionnaire.

The second and final modified *initial commitments* and *later goal and institutional commitments* measurement model allowed error terms to be correlated and, as can be seen in Table 2, this time the outcome generated a good fit between the model and the data.

Table 2: Initial and Later Goal and Institutional Commitments measurement models

Initial measurement model	chi^2 (χ^2) = 178.74 with p < 0.05 (statistically significant)					
	df	χ^2/df	GFI	AGFI	CFI	RMSEA
Fit Statistics	40	4.47	.92	.86	.83	.12
First modified measurement model	chi^2 (χ^2) = 60.04 with p < 0.05 (statistically significant)					
	df	χ^2/df	GFI	AGFI	CFI	RMSEA
Fit Statistics	9	6.74	.94	.88	.93	.14
Second and final measurement model	chi^2 (χ^2) = 38.71 with p < 0.05 (not statistically significant)					
	df	χ^2/df	GFI	AGFI	CFI	RMSEA
Fit Statistics	16	2.41	.98	.96	.97	.08
Benchmark		<3.00	>.90	>.90	>.90	≥.05 (good fit), .05-0.8 (adequate fit), 0.8-0.10 (mediocre fit)
Note: df = degree of freedom; χ^2/df: ratio of likelihood (χ^2) to degrees of freedom= χ^2/df; GFI: Goodness-of-Fit index; AGFI: Adjusted Goodness of-Fit Index; CFI = Comparative fit index.; RMSEA = Root Mean Square Error of Approximation						

Analysing the standardised residual covariances for the second and final model, which are displayed in Table 3, revealed that none of the values exceed the limit-point of 2.58. Specifically, the top value was – 1.52, which validated that the second and final model was a good fit of the data. Table 4 shows the final results of the CFA for the *initial goal and institutional commitments* and *later goal and institutional commitments*.

The second and final *initial goal and institutional commitments* measurement model included 4 observed variables and the *later goal and institutional commitments* included 2 observed variables. All of the observed variables, as presented in Table 4, exhibited factor scores ranging from 0.68 to 0.78 and were statistically significant. This demonstrates good genuineness. The reliability of the observed variables ranged from 0.49 to 0.61, signifying a good reliability level.

Table 3: Standardised Residual Covariances (Final Model)

	LC4	LC1	IC5	IC4	IC2	IC1
LC4	.3572					
IC5	.4138	.0000				
LC5	-.6225	-1.5212	.0000			
IC4	.6134	1.5172	.1262	.0000		
IC3	-.4127	-.4388	.2268	-.3273	.0000	
IC1	.0585	.0000	-.5215	.1914	.3113	.0000

Table 4: CFA for the Initial and Later Goal and Institutional Commitments (Final Model)

Variables	Factor scores	Observed variables reliability	Variance error
IC1	0.68	0.49	0.51
IC2	0.69	0.49	0.51
IC4	0.78	0.64	0.36
IC5	0.75	0.56	0.44
LC1	0.77	0.60	0.40
LC4	0.78	0.61	0.39

Confirmatory Factor Analysis for Social integration

The measurement of the *social integration* was conducted using two of Pacarella and Ternzini's (1980) scales. These were Interaction with Faculty and Peer-Group interactions. The Interactions with Faculty scale had 5 items and the Peer-Group interactions scale had 7 items. The initial *social integration* measurement model therefore consisted of 2 factors and 12 observed variables.

The outcome of the initial *social integration* measurement model signified that the model fitted the data well (see Table 5). Nevertheless the outcome showed that 5 observed variables had very poor reliabilities, with squared factor scores of 0.50, 0.44, 0.45, 0.41, and 0.35. As result, the model was modified.

The first modified *social integration* model removed these 5 variables from the initial model and generated a moderate fit between the model and the data. Consequently, the model had to be modified again. The Modification Index revealed a correlation of error terms could statistically improve the model fit. These items were 'Since coming to this university, I have developed close personal relationships with other students' and 'The student friendships that I have developed at this university have been personally satisfying'. It was identified that the two observed variables were connected with the common construct *social integration*, as well as having similar words. Therefore their error terms were correlated as a statistically acceptable and conceptually meaningful modification (Bollen and Long, 1993, p. 297; Byrne, 2013).

The second and final modified *social integration* model was elaborated by permitting the error terms between the aforementioned items to be correlated. As can be seen in Table 5, the second modified model generated a good fit between the model and the data.

Table 5: ***Social integration*** **measurement models**

Initial measurement model	chi² (χ^2) = 100.23 with p < 0.05 (statistically significant)					
	df	χ^2/df	GFI	AGFI	CFI	RMSEA
Fit Statistics	45	2.22	.95	.93	.91	.07
First modified measurement model	chi² (χ^2) = 75.19 with p < 0.05 (statistically significant)					
	df	χ^2/df	GFI	AGFI	CFI	RMSEA
Fit Statistics	14	5.15	.96	.92	.92	.11
Second and final measurement model	chi² (χ^2) = 40.60 with p < 0.05 (not statistically significant)					
	df	χ^2/df	GFI	AGFI	CFI	RMSEA
Fit Statistics	14	2.90	.98	.95	.96	.08
Benchmark		<3.00	>.90	>.90	>.90	≥.05 (good fit), .05-0.8 (adequate fit), 0.8-0.10 (mediocre fit)
Note: df = degree of freedom; χ^2/df: ratio of likelihood (χ^2) to degrees of freedom= χ^2/df; GFI: Goodness-of-Fit index; AGFI: Adjusted Goodness of-Fit Index; CFI = Comparative fit index.; RMSEA = Root Mean Square Error of Approximation						

The analysis of the standardised residual covariances for the second model, which are displayed in Table 6, identified that none of the values exceed the limit-point of 2.58. The top value was 2.23, which validated that the second model was a good fit of the data. In Table 7 the final results of the CFA for *social integration* are presented.

The second and final *social integration* measurement model included 7 observed variables. As presented in Table 7 all of the observed variables exhibited factor scores that ranged from 0.70 to 0.79 and were statistically significant, showing good genuineness. The reliability of the observed variables ranged from 0.40 to 0.73, which signified a moderate reliability level.

Table 6: Standardised Residual Covariances (Final Model)

	SI4_PGI	SI3_PGI	SI2_PGI	SI1_PGI	SI3_IwF	SI2_IwF	SI1_IwF
SI4_PGI	.0000						
SI3_PGI	.0655	.0000					
SI2_PGI	-.5116	.0627	.0000				
SI1_PGI	-.1242	.5103	.0000	.0000			
SI3_IwF	.9309	.9564	1.5240	-1.1056	.0000		
SI2_IwF	.1689	-1.5631	-.1879	-.4587	-1.2342	.0000	
SI1_IwF	-.7441	-1.3922	.7421	.6153	-1.1343	2.2345	.0000

Table 7: CFA for the *Social integration* (Final Model)

Variables	Factor scores	Observed variables reliability	Variance error
SI1_PGI	0.72	0.44	0.56
SI2_PGI	0.71	0.42	0.58
SI3_PGI	0.77	0.66	0.34
SI4_PGI	0.79	0.73	0.27
SI1_IwF	0.70	0.40	0.60
SI2_IwF	0.70	0.41	0.59
SI3_IwF	0.71	0.51	0.49

Confirmatory Factor Analysis for Academic Integration

The measurement of the *academic integration* was conducted using two of Pacarella and Ternzini's (1980) scales. These were Academic and Intellectual Development, and Faculty Concern for Student Development and Teaching. The Academic and Intellectual Development scale had 7 items, with the Faculty Concern for Student Development and Teaching scale having 5 items. The initial *academic integration* measurement model therefore consisted of 2 factors and 12 observed variables.

The outcome of the initial *academic integration* measurement model signified that the model fitted the data well (see Table 8). Nonetheless the outcome revealed that 7 observed variables had very poor reliabilities with squared factor scores of 0.43, 0.32, 0.48, 0.46, 0.44, 0.31, and 0.38. The model was therefore modified.

The first and final modified *academic integration* model removed the 7 observed variables, and from the initial model as can be seen in Table 8, the outcome generated an excellent fit between the model and the data.

Table 8: ***Academic integration*** **measurement models**

Initial measurement model	chi^2 (χ^2) = 98.52 with p < 0.05 (statistically significant)					
	df	χ^2/df	GFI	AGFI	CFI	RMSEA
Fit Statistics	58	1.70	.95	.93	.91	.05
First and Final modified measurement model	chi^2 (χ^2) = 5.20 with p < 0.05 (not statistically significant)					
	df	χ^2/df	GFI	AGFI	CFI	RMSEA
Fit Statistics	4	1.18	.98	.97	.98	.02
Benchmark		<3.00	>.90	>.90	>.90	≥.05 (good fit), .05-0.8 (adequate fit), 0.8-0.10 (mediocre fit)

Note: df = degree of freedom; χ^2/df: ratio of likelihood (χ^2) to degrees of freedom= χ^2/df; GFI: Goodness-of-Fit index; AGFI: Adjusted Goodness of-Fit Index; CFI = Comparative fit index.; RMSEA = Root Mean Square Error of Approximation

The analysis of the standardised residual covariances for the first (and final) modified model, which are displayed in Table 9, identified that none of the values exceeded the limit-point of 2.58. Specifically, the top value was – 0.95, which validated that the first modified model was a good fit of the data. The final results of the CFA for the *academic integration* are presented in Table 10.

The final *academic integration* measurement model included 5 observed variables. As presented in Table 10 all of the observed variables exhibited factor scores that were ranged from 0.70 to 0.75 and were statistically significant. This is evidence of good validity. The reliability of the observed variables ranged from 0.48 to 0.56, which signifies a moderate reliability level.

Table 9: Standardised Residual Covariances (Final Model)

	AI5_AID	AI3_AID	AI1_AID	AI5_FC	AI4_FC
AI5_AID	.0000				
AI3_AID	.2051	.0000			
AI1_AID	-.0885	-.0974	.0000		
AI5_FC	-.9551	.5252	.0378	.0000	
AI4_FC	-.8819	.0241	.6155	.0000	.0000

Table 10: CFA for the *Academic integration* (First/Final)

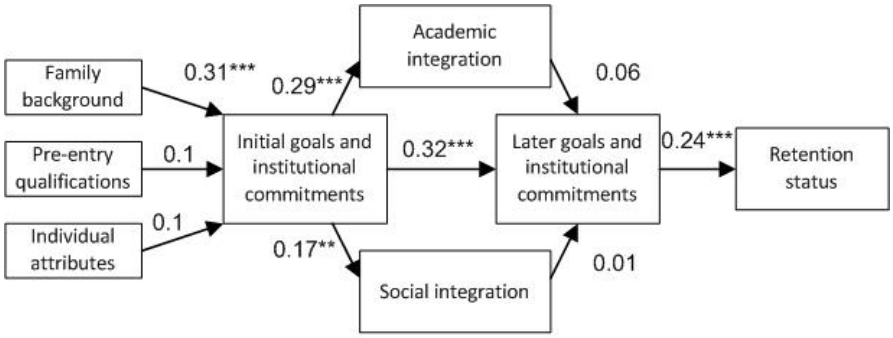
Variables	Factor scores	Observed variables reliability	Variance error
AI4_FC	0.73	0.54	0.46
AI5_FC	0.70	0.48	0.52
AI1_AID	0.72	0.52	0.48
AI3_AID	0.75	0.56	0.44
AI5_AID	0.70	0.48	0.52

Structural Model Analysis

As previously described, the second phase, after the measurement model had been established and confirmed, was to test the structural model through the use of AMOS program. The structural model characterises the relationships between the constructs or the latent variables, and defines those latent variables that indirectly or directly cause alterations in the values of other latent variables in the model (Byrne, 2013). A set of structural models were developed as part of the analysis.

The previously presented Initial Student Integration Model (see Figure 2) is the initial path of the theoretical structure model. The outcome of the structural model analysis revealed that the χ^2 of 514.36 with 198 df was statistically significant with $p < 0.05$, which suggested an inappropriate fit. Byrne (2013) noted that the χ^2 is highly sensitive to sample size and frequently recommends a poor fit with large sample size. The remaining fit statistics revealed a moderate fit between the theoretical model and the data with slightly lower than the commonly acceptable values of 0.90 (χ^2/df = 2.60; GFI= 0.87; AGFI=0.84; CFI=0.81; RMSEA =0.08).

Figure 5: The standardised path coefficients diagram for the initial theoretical structural model



Note: 5% (less than 1 in 20 chance of being wrong), 1% and 0.1% (P < 0.05, 0.01 and 0.001) OR when using the asterisk system, significant at:
P < 0.05 *
P < 0.01 **
P < 0.001

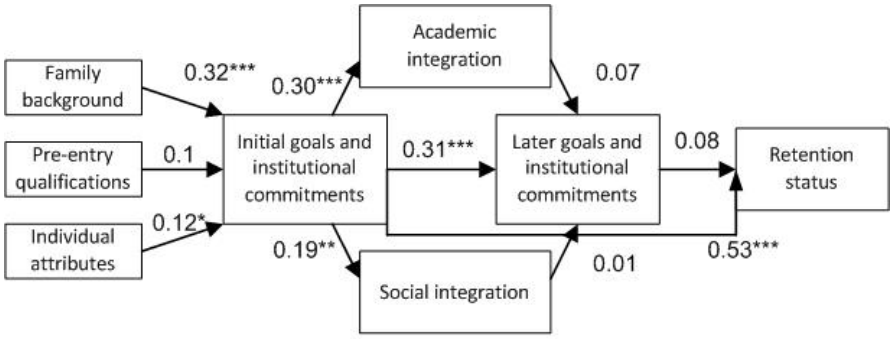
Figure 5 shows the standardised path coefficients for the initial theoretical structural model, with 5 out of 9 hypothesised paths significant with $p < 0.05$, were paths from *family background* to *initial goals and institutional commitments, initial goals and institutional commitments* to *academic integration*, *initial goals and institutional commitments* to *social integration*, *initial goals and institutional commitments* to *later goals and institutional commitments* and *later goals and institutional commitments* to *retention status*. The remaining 4 hypothesized paths which were not significant were the paths from *individual attributes* to *initial goals and institutional commitments*, *pre-entry qualifications* to *initial goals and institutional commitments*, *social integration* to *later goals and institutional commitments* and *academic integration* to *later goals and institutional commitments*. This initial theoretical structural model interpreted 15% of the *initial goals and institutional commitments* variance, 12% of the *academic integration* variance, 6% of the *social integration* variance, 15% of the *later goals and institutional commitments variance* and 8% of the *retention status* variance.

According to the Modification Index technique an improved model fit could be achieved through the addition of extra structural paths. Any large Modification Index indicates that freeing the parameter could result in a better fit. The value of the Modification Index is the equivalent of the change in χ^2 between a model in which the parameter is fixed (the original model) and one in which it is free (the model that would result were it freed). Specifically, any value larger than 3.84, the critical value of χ^2 on one degree of freedom, indicates a significant

improvement in omnibus fit if the parameter is freed (Sörbom, 1989). It is important to note that SEM needs to be driven by theory and so any modifications need to be justified with supporting theories (Byrne, 2013). According to Jöreskog and Sörbom (1988) a path with a large Modification Index should be estimated and modified in step. In the current study, the largest Modification Index (71.15) was detected in a path from *initial goals and institutional commitments* to *retention status*. This indicates that the participant students' *initial goals and institutional commitments* had a direct effect on their retention. A similar finding had been identified by Munro (1981) in his American study. Specifically, he discovered a significant direct effect for commitment on retention for first year, full-time, undergraduate higher education students. As a result, in this study, the first modified structural model was elaborated through the addition of one path from *initial goals and institutional commitments* to *retention status*.

The outcome of the first modified structural model revealed that the χ^2 of 491.13 with 212 df was statistically significant with $p < 0.05$, which suggested a non-appropriate fit. Furthermore, the remaining fit statistics showed a slightly lower value than the commonly acceptable values of 0.90 (χ^2/df = 2.31; GFI= 0.88; AGFI=0.86; CFI=0.85; RMSEA =0.07). In general, the fit statistics revealed a moderate fit between the theoretical model and the data. In Figure 6 the standardised path coefficients are represented for the first modified theoretical structural model.

Figure 6: The standardised path coefficients diagram for the first theoretical structural model

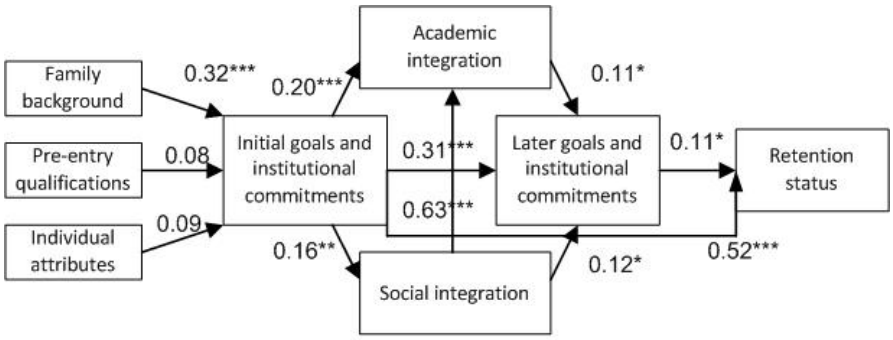


Note: 5% (less than 1 in 20 chance of being wrong), 1% and 0.1% (P < 0.05, 0.01 and 0.001) OR when using the asterisk system, significant at:
P < 0.05 *
P < 0.01 **
P < 0.001

Through the review of the Modification Index, it was discovered that the first modified structural model could have achieved a better fit if more paths were to be added. Specifically, the largest Modification Index (81.16) was identified via a path from *social integration* to *academic integration*. This indicated that the participant students' *social integration* had a direct effect on their academic integration. In addition, this effect showed consistency with other researchers' results, such as Williamson and Creamer (1988) and Nevill and Rhodes (2004). The second modified structural model was therefore elaborated via the addition of a path from *social integration* to *academic integration*. the outcome of the second modified structural model revealed that despite a χ^2 of 390.08 with 213 df, it was statistically significant with $p < 0.05$, and all the remaining statistics were within acceptable values (χ^2/df = 1.83; GFI= 0.91; AGFI=0.90; CFI=0.91; RMSEA =0.04). As a result, a good fit between the second modified structural model and the data was identified. This model was the final modified structural model with no extra paths recommend for addition via a Modification Index.

Figure 7 shows the standardised path coefficients for the second modified theoretical structural model. The model presents 9 hypothesised paths at least significant with $p < 0.05$ and only two paths, *individual attributes* to *initial goals and institutional commitments*, and *pre-entry qualifications* to *initial goals and institutional commitments,* which were not proved to be significant.

Figure 7: The standardised path coefficients diagram for the second theoretical structural model



Note: 5% (less than 1 in 20 chance of being wrong), 1% and 0.1% (P < 0.05, 0.01 and 0.001) OR when using the asterisk system, significant at:
P < 0.05 *
P < 0.01 **
P < 0.001***

The second modified structural model interpreted 16% of the *initial goals and institutional commitments* variance, 45% of the *academic integration* variance, 35% of the *social integration* variance, 13% of the *later goals and institutional commitments* variance and 34% of the *retention status* variance.

SEM indicates indirect effects as well as direct effects. The indirect effects are those that are mediated by at least one variable. The total effects are the sum of the direct and indirect effects. In Table 11 all direct, indirect and total effects of every latent variable are addressed.

Table 11: The standardised path coefficients diagram for Indirect, Direct, and Total Effects of Path Coefficients

	Initial goals and institutional commitments			Academic integration			Social integration			Later goals and institutional commitments			Retention status		
	IE	DE	TE	IE	DE	TE	IE	DE	TE	IE	DE	TE	IE	DE	TE
Family background	-	.3214	.3214	.0640	-	.0640	.0512	-	.0512	.0992	-	.0992	.2016	-	.2016
Pre-entry qualifications	-	.0833	.0833	.0160	-	.0160	.0128	-	.0128	.0248	-	.0248	.0416	-	.1621
Individual attributes	-	.0914	.0914	.01828	-	.01828	.01462	-	.01462	.02833	-	.02833	.0575	-	.0575
Initial goals and institutional commitments	-	-	-	.1008	0.2060	.3068	-	.1643	.1643	.0160	.3112	.3272	.0311	.5210	.5521
Academic integration	-	-	-	-	-	-	-	-	-	-	.1100	.1100	.0101	-	.0101
Social integration	-	-	-	-	.6310	.6310	-	.	-	.0630	.1205	.1835	.0063	-	.0063
Later goals and institutional commitments	-	-	-	-	-	-	-	-	-	-	-	-	-	.1158	.1158

As shown in Table11 the participant students' retention status acknowledged indirect effects from *family background*, *pre-entry qualifications*, and *individual attributes* via *initial and later goals and institutional commitments, academic integration* and *social integration*. The participant students' retention status also acknowledged an indirect effect from *initial goals and institutional commitments* via *academic integration*, *social integration* and *later goals and institutional commitments*. Finally, there were no indirect effects on the participant students' retention status from *academic integration* and *social integration*. In the sections that follow the authors present the final step of the quantitative data analysis, where all the hypotheses were tested.

Testing Hypothesis

The outcomes of the analysis showed that 7 out of 9 hypotheses were statistically significant. Table 12 provides an analysis of the testing strategy previously described for each individual hypothesis. The statistical significance is defined by: t-values ≥ 1.96 and the average coefficient alpha reliability values above 0.7 latent variables (standardised path coefficient) (Terenzini et al., 1985, Markus, 2012; Byrne, 2013).

Table 12: Hypotheses results

H1a	**1st Hypothesis**: students' pre-entry qualifications (A levels score, skills and abilities) will be associated with their initial goals and institutional commitments.
	Hypothesis not supported: Standardised path coefficient: 0.08 and t-value: 1.54.
H1b	**2nd Hypothesis**: students' family background will be associated with their initial goals and institutional commitments.
	Hypothesis supported: Standardised path coefficient: 0.32 and t-value: 3.90.
H1c	**3rd Hypothesis**: students' individual attributes (race, age, gender, nationality etc.) will be associated with their initial goals and institutional commitments.
	Hypothesis not supported: Standardised path coefficient: 0.09 and t-value: 1.67.
H2a	**4th Hypothesis**: students' initial goals and institutional commitments will be associated with their academic integration.
	Hypothesis supported: Standardised path coefficient: 0.30 and t-value: 4.61.
H2b	**5th Hypothesis**: students' initial goals and institutional commitments will be associated with their social integration.
	Hypothesis supported: Standardised path coefficient: 0.16 and t-value: 2.41.
H2c	**6th Hypothesis**: students' initial goals and institutional commitments will be associated with their later goals and commitments.
	Hypothesis supported: Standardised path coefficient: 0.32 and t-value: 4.36.
H3a	**7th Hypothesis**: students' academic integration will be associated with their later goals and institutional commitments.
	Hypothesis supported: Standardised path coefficient: 0.11 and t-value: 1.98
H3b	**8th Hypothesis**: students' social integration will be associated with their later goals and institutional commitments.
	Hypothesis supported: Standardised path coefficient: 0.18 and t-value: 2.71.
H4	**9th Hypothesis**: students' later goals and institutional commitments will be associated with their retention status.
	Hypothesis supported: Standardised path coefficient: 0.11 and t-value: 2.16.

The structural model analysis also discovered 2 extra paths that were statistically significant. first, the path from *initial goals and institutional commitments* to *retention status* revealed a significant positive association, which was evident from the standardised path coefficient of 0.52 and the t-value of 7.08. second, the path between *social integration* and *academic integration* showed a significant positive association with a path coefficient of 0.63 and t-value of 8.53.

In summary, a CFA analysis was employed in order to test the fit of the measurement model, and also the validity and reliability of each latent variable was inspected. The phases of the modified structural model development were then presented through an explanation of every step's procedure. The outcomes indicated that the final modified structural model interpreted 34% of the variation in retention. Finally, the SEM was applied in order to test the hypotheses. In the following sections, an extensive discussion regarding the outcomes, limitations and implications of the current study is presented.

Discussion

The main theory that guided the current study was Tinto's (1993) Student Integration Theory. The quantitative data analysis outcomes indicated that Tinto's Student Integration Theory provided a modest explanation of the student retention process in the UK university which was examined. Thus, major constructs of this theory, such as *academic integration* and *social integration*, did not differentiate significantly between those who showed persistence and those who dropped out. Furthermore, the results indicated that Tinto's Student Integration Theory elucidated only a modest amount of the variance in student retention (34%).

All of the relationships in the model are insightful. This confirms that, for instance, the positive effect of developing relationships with academic faculty and classmates, the negative impact of missing classes, and the positive effect of interacting with instructors, are all justified as predictors of persistence. The amount of explained variance in the model, although modest, is at a level comparable with similar research projects, as described in the previous paragraph, as well as with other researchers' studies who conducted similar research on persistence (Berger and Milem, 1999; Ziskin, Gross, and Hossler, 2006). Pascarella and Chapman (1983), recommended two potential explanations for the modest explanatory power of Tinto's (1993) Student Integration Theory. The first explanation could be a function of inadequate operational definition of the model variables. Another explanation could be that at least some critical student retention predictors might not be specified by the model. An additional possible explanation might be that Tinto's Student Integration Theory was developed in order to interpret the student retention process in the context of US higher education, and there are many differences between the UK and the US higher education systems. For instance, in UK higher education the undergraduate degrees last for 3 years (4 when including a placement/internship year) and students do not select a major module because it is predefined in their first academic year. Despite the aforementioned limitations, the following outcomes were indicated.

The results showed that the family background was significantly related with the students' *initial goals and institutional commitments*. This revealed that students whose parents had high levels of formal education were more likely to have high levels of *initial goals and institutional commitments*. This is consistent with Tinto's theoretical expectations as well as other researchers' work, such as Pascarella, Duby & Iverson (1983), Braxton, Vesper & Hossler (1995), and Braxton, Milem & Sullivan (2000). Furthermore, the participant students' family background predicted positive and indirect student retention. On the other hand, characteristics such as students' *pre-entry qualifications* and *individual attributes* (A level scores) were not significant predictors of *initial goals and institutional commitments*. These findings were also found to be consistent with several studies conducted at other UK and non-UK institutions, which addressed similar conclusions (Pascarella and Terenzini, 1983; Terenzini et. al., 1985; Braxton and Brier, 1989; Bray, Braxton and Sullivan, 1999).

In addition, the results revealed that the *initial commitments* had a significant effect on *later goals and initial commitments*. This indicated that the participant students who had high levels of *initial commitments* were predicted to have high levels of *later commitments*. Again, this proved to be consistent with Tinto's (1993) Student Integration Theory, as well as other studies conducted by other researchers in UK and non-UK institutions (Pascarella and Terenzini, 1983; Braxton, Milem and Sullivan, 2000; Braxton, Bray, and Berger, 2000). Similarly, *Initial goals and institutional commitments* proved to be a significant *academic integration* predictor, followed by a modest significance regarding *social integration*. This revealed that students with high levels of *initial commitments* were more likely to have high levels of *academic* and *social integration*. Similar findings were also reported in previous studies that were conducted by Pascarella and Terenzini (1983) and Mallette and Cabrera (1991).

Moreover, it was hypothesised that students' *academic integration* and *social integration* had a positive effect on their *later goals and institutional commitments*. The results showed that both types of integration did perform a modest role in expressing either *later commitments* or student retention. An important identification of the prior

research findings was that they were consistent with Tinto's (1993) Student Integration Theory and other researchers' investigations (Munro, 1981; Pascarella and Terenzini, 1983; Braxton, Vesper, and Hossler, 1995; Berger and Milem, 1999). This finding revealed why student *academic integration* and *social integration* can have an important role in predicting student retention, and as such, can have a significant influence on the student retention process. Finally, students' *later goals and institutional commitments* revealed positive effects on student retention. This suggests that students who present high levels of *later commitments* were more likely to persist than those with low levels. This can be tested through tracking students who continued their studies. The authors could only identify a subset of this, therefore this hypothesis was partially proven. Despite that, this finding was consistent with Tinto's (1993) Student Integration Theory, as well as other studies conducted in other institutions (Braxton, Bray, and Berger, 2000; Braxton, Milem and Sullivan, 2000). A further discussion regarding the current study's limitations is provided in the following section.

Conclusion

Overall, the results suggest that Tinto's (1993) Student Integration Theory was useful in analysing student retention at the university that was involved in this study. However, not at its maximum potential, as the variables in the model accounted for only a modest amount of variance in retention. In addition, only two variables had a direct effect on retention. The largest direct effect on retention was accounted for by *initial goals and institutional commitments*, followed by *later goals and institutional commitments*.

Whilst the students' perspective provides a valuable insight into levels of engagement as they affect the students themselves, they may for example view issues in terms of the actions others may take to resolve a situation rather than how they may do things differently. Therefore, the reported areas represent only the students' expressions of the factors influencing their view of their studies. The messages emerging from the participant first year undergraduate students at the UK institution studied were:

- Computing students expressed more satisfaction with organised courses where requirements are clearly explained by their instructors. Furthermore, they prefer expectations to be explicitly identified and instructors to support them in meeting these expectations.
- Computing students believe that when they participate in small to medium study groups their academic experience is improved.
- Computing students value good teaching support during their tutorial/ laboratory exercise sessions and non-academic staff were found to be providing good support.
- Computing students expect their course to be less lecture-oriented and more tutorial/laboratory exercise oriented classes, when comparing themselves to students in other disciplines.

Consistent with previous studies, in the current study Tinto's (1993) Student Integration Theory explained only a modest proportion of the variance in student retention. This suggests that the most important predictors identified may not be properly addressed by this theory. Therefore, a more in-depth research study would be strongly recommended in order to specify these predictors. Such an effort would need a larger sample from multiple institutions. The retention issue can also be better understood when investigated longitudinally over the period of 2-3 years. In addition, the current study was based on factors derived from Tinto's Student Integration Theory. Further research could therefore examine additional factors such as alternative learning and teaching methodologies, as well as new technologies that could aid the employment of such methods (i.e. cloud computing, big data). This could also improve the variance proportion explained in any future explanatory model of student retention at the UK university examined. The approach used within this study of combining questionnaire responses with enrolment data and analysing the combined data through SEM provides a new way of looking in more detail at both first year and whole study student behaviour patterns and their links to retention, progression and attainment.

The data analysis is limited by the size of the sample, with indicative findings presented in this report. Whilst the results of this study cannot be generalised as they are focused only on the first year undergraduate computing students at the selected institution, the consistency of issues between students of different disciplines increases confidence in the commonality of issues raised, and suggests further research with a larger sample and longitudinally would have significant merit. This would facilitate richer data collection and increased survey response rates. Therefore, it could also help with understanding better how student behaviour and choices impact on students' levels of engagement. Student profiles could also be considered, for example, membership of a low-participation group. Finally, a study of different choice points during the student journey could be undertaken. Examples of such choice points could be: whether a student was accepted via the clearing process, whether they had initially chosen to study a different subject, or had chosen a place at a significantly different geographical location.

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Appendix

Figure 3 First Engagement Questionnaire

Your Student ID number is: .....

Engagement Questionnaire	Strongly Disagree (1)	Disagree (2)	Undecided (3)	Agree (4)	Strongly Agree (5)
1. It is important to me to graduate from university.	❍	❍	❍	❍	❍
2. I am confident that I made the right decision in choosing to attend this university.	❍	❍	❍	❍	❍
3. It is likely that I will re-enrol at this university.	❍	❍	❍	❍	❍
4. It is not important to me to graduate from this university	❍	❍	❍	❍	❍
5. Getting good grades is not important to me.	❍	❍	❍	❍	❍

Figure 4 Engagement Questionnaire

Your Student ID number is: .....

Engagement Questionnaire	Strongly Disagree (1)	Disagree (2)	Undecided (3)	Agree (4)	Strongly Agree (5)
1. Since coming to this university, I have developed close personal relationships with other students.	❍	❍	❍	❍	❍
2. My non classroom interactions with faculty have had a positive influence on my personal growth, values and attitudes.	❍	❍	❍	❍	❍
3. Few of the faculty members I have had contact with are generally interested in students.	❍	❍	❍	❍	❍
4. I am satisfied with the extent of my intellectual development since enrolling in this university.	❍	❍	❍	❍	❍
5. It is important to me to graduate from university.	❍	❍	❍	❍	❍
6. The student friendships that I have developed at this university have been personally satisfying.	❍	❍	❍	❍	❍
7. My non classroom interactions with faculty have had a positive influence on my intellectual growth and interest in ideas.	❍	❍	❍	❍	❍
8. Few of the faculty members I have had contact with are generally outstanding or superior teachers.	❍	❍	❍	❍	❍

9. My academic experience has had a positive influence on my intellectual growth and interest in ideas.	❍	❍	❍	❍	❍
10. I am confident that I made the right decision in choosing to attend this university.	❍	❍	❍	❍	❍
11. My interpersonal relationships with other students have had a positive influence on my personal growth, attitudes, and values.	❍	❍	❍	❍	❍
12. My non classroom interactions with faculty have had a positive influence on my career goals and aspirations.	❍	❍	❍	❍	❍
13. Few of the faculty members I have had contact with are willing to spend time out of class to discuss issues of interest and importance to students.	❍	❍	❍	❍	❍
14. I am satisfied with my academic experience at this university.	❍	❍	❍	❍	❍
15. It is likely that I will re-enrol at this university.	❍	❍	❍	❍	❍
16. My personal relationships with other students have had a positive influence on my intellectual growth and interest in ideas.	❍	❍	❍	❍	❍
17. Since coming to this university, I have developed a close, personal relationship with at least one faculty member.	❍	❍	❍	❍	❍
18. Most of the faculty I have had contact with are interested in helping students grow in	❍	❍	❍	❍	❍

more than just academic areas.					
19. Few of my courses this academic year have been intellectually stimulating	❍	❍	❍	❍	❍
20. It is not important to me to graduate from this university.	❍	❍	❍	❍	❍
21. It has been difficult for me to meet and make friends with other students.	❍	❍	❍	❍	❍
22. I am satisfied with the opportunities to meet and interact informally with faculty members.	❍	❍	❍	❍	❍
23. Most of the faculty I have had contact with are genuinely interested in teaching.	❍	❍	❍	❍	❍
24. My interest in ideas and intellectual matters has increased since coming to this university.	❍	❍	❍	❍	❍
25. Few of the students I know would be willing to listen to me and help me if I had a personal problem.	❍	❍	❍	❍	❍
26. I am more likely to attend a cultural event (for example, a concert, lecture or art show) now than I was before coming to this university.	❍	❍	❍	❍	❍
27. Getting good grades is not important to me.	❍	❍	❍	❍	❍
28. Most students at this university have values and attitudes different to my own.	❍	❍	❍	❍	❍
29. I have performed academically as well as I anticipate I would.	❍	❍	❍	❍	❍