

# RETENTION OF COMPUTING STUDENTS IN A LONDON-BASED UNIVERSITY DURING THE COVID-19 PANDEMIC USING LEARNED OPTIMISM AS A LENS: A STATISTICAL ANALYSIS IN R.

**Abstract.** The aim of this research project is to investigate the low retention rate among the foundation and first year undergraduate students from the School of Computing and Digital Media in a London based university. Specifically, the research is conducted during the Covid-19 pandemic using learned optimism as a lens. The research will aid the university to improve retention rate as the overall dropout has been increasing in the last few years. The current study employed an exploratory investigation approach by using statistical modelling analysis in R to predict behavioural patterns. The quantitative data analysis conducted aims to support the efforts of the School of Computing and Digital Media of a London based university to re-evaluate its retention strategies in foundation and first year computing students. The main outcomes of the analysis is that students with a foreign qualification are optimistic, while students with other or not known qualification are mildly pessimistic. In addition, students with a BTECH, Higher Education diploma or A level qualification are generally more pessimistic especially if they are also black ethnicity, or are also not black ethnicity, aged under 34 and British.

**Keywords:** Learned Optimism, Student Retention, Computing, R Programming, Quantitative Research, Data Analysis.

## 1 Introduction

The UK higher education providers have a good reputation around the world due to the high standards of quality provided and the extensive choice of subjects [38]. The Times Higher Education publishes the World University Rankings every year assessing an institution's performance based on four areas such as Teaching, Research, Knowledge Transfer, and International Outlook. The ranking published by the group is trusted by students, teachers, industry experts and governments as the ranking includes more than 1500 universities across 93 countries in the world. There are 4 universities from the United Kingdom that are featured in the top 20 universities in the world, with two universities based in London. The University of Oxford has been ranked as the number 1 university worldwide undisputedly for the last 5 years and University of Cambridge is ranked at 6. London based universities such as Imperial College and UCL are ranked at 11 and 16. In addition, these universities are ranked in the top 20 universities in the world offering computer science-based courses [39].

The student initial entry rate into higher education has been increasing every year. In 2018/19 the initial entry rate rose to 52% among 17–30-year-old students compared to 42% in 2006/07 [14]. At the same time the student dropout rate has also been increasing each year. Specifically, London-based universities have a higher dropout rate compared to the national average. The gap between London and national average has been widening every year along with the increase in dropout rates. This statement is justified based on the research reports published by Social Market Foundation in July 2017 [32] and Mayor's Skill Strategy in June 2018 [23].

Computing courses have registered the highest percentage of dropouts compared to all other streams of higher education from 2014 to 2018 entries. Even though the computer science-based courses register the highest dropout rates, the percentage of dropout has seen a slight decline in the last few years. Based on the data for student dropout following the year of entry for the full-time undergraduate courses published by HESA, 7 out of the 10 universities in the UK that have the highest percentage of student dropout rates are based in London. The London based university studied has been ranked at 11<sup>th</sup> for the highest percentage of student dropouts for the 2018-2019 year of entry. The percentage of dropout has been increasing every year and 23% of the total 2365 entrants have discontinued from the university during the 2018-2019 year of entry [7].

The current research aims to identify the various factors causing the decrease in retention rates in foundation and first year computing courses. Specifically, a survey was conducted among the foundation and first year students to collect relevant data for the study. The data was then analysed using R to identify the optimism levels in students against different levels.

## **1.1 A Profile of the School of Computing and Digital Media**

The London based university studied is one of the public research universities formed in the year 2002 as a merger between two other universities. The study to discover the optimism levels of students was conducted between 18th of April to 18th of May 2021. 64% of the students who study in the university belong to the Black, Asian or Minority Ethnic (BAME) background [10].

The School of Computing and Digital Media registered a dropout rate of 22% for the year 2018-2019 in the first year of undergraduate computing courses. The survey was conducted among the foundation and first year students from the School of Computing and Digital Media. The survey was conducted during the period of pandemic where the students did not experience on-campus learning and all the learning was through an online mode of teaching.

## **1.2 Aim of the study**

The current research will help the university to reduce the dropout rate as the overall dropout has been increasing in the last few years. The current study employed an exploratory investigation approach by using statistical modelling analysis in R to predict behavioural patterns. The quantitative data analysis conducted aims to support the efforts of the School of Computing and Digital Media of a London based university to re-evaluate its retention strategies for foundation and first year computing students.

## **1.3 Objectives**

The motive of this research is to identify the optimism levels of the students in the foundation and first year undergraduate courses in the School of Computing and Digital Media using Learned Optimism as a lens. The objectives set for this research to achieve the motive of the research are as follows:

- Literature review on the areas that contribute towards this research in analysing the optimism levels among the students.
- Conduct a survey to calculate the optimism levels among the foundation and first year undergraduate students from the School of Computing and Digital Media of the university studied.
- Analyse the information about admission rates, dropout rates for the all first-year undergraduate courses in the UK and a London based university.
- Analyse the information about admission rates, dropout rates for the first-year undergraduate courses based on computing studies in the UK and a London based university.
- Identify and discuss the factors that lead to low retention rates.
- Perform statistical analysis using R from the data collected through the survey and identify the optimism levels among the students based on their qualifications, age, gender, ethnicity, and level of study.
- Interpret the results based on the statistical analysis and put forward recommendations based on the results to improve the optimism levels among the students.

The current paper is structured as follows: Literature Review, Research Methodology, Data Collection, Data Analysis, Implications, Limitations, Recommendations for further research, and Conclusion.

## **2 Literature Review**

In this section, the Learned Optimism, student retention rates for the first-year undergraduate courses in the United Kingdom, foundation and first year courses from the School of Computing and Digital Media of the university studied and the factors behind the dropout rates for the computing courses in the UK are discussed.

### **2.1 Learned Optimism**

Two studies in 2012 and 2013 identified several factors that contribute towards student retention. The factors are transitioning, learning and teaching, supporting students, participation and belonging, utilisation of data and information communication technology, and strategic change. More recently, the emphasis has shifted towards how student participation and how a sense of belonging in higher education affects student retention and how technology, both in terms of supporting students and in analysing and linking data to retention strategies, can be more effectively harnessed, and applied [1].

The survey is aimed at discovering the student experience during or after the first or foundation years focused on computing courses of the London based university studied. The survey aims to identify the areas where the university can improve the student experience and engagement. The survey is adapted from Seligman's 'Learned Optimism' to identify the behavioural pattern among the students and analyse the relationship with the retention rates.

Seligman focused a great deal of his work on pessimism. However, his motive shifted the other way and he started focusing on the optimistic side of individuals [31]. He is considered the founding father of Positive Psychology and introduced the concept of 'Learned Optimism'. Learned Optimism uses a technique called the 'ABCDE' model.

Albert Ellis a psychologist and researcher developed a model to understand the reaction of an individual to an adversity (Guide 3, 2021). The model named as the 'ABC' model is based on:

- Adversity (A) – The situation that calls for a response.
- Belief (B) – How we interpret the event.
- Consequence (C) – The reaction that is triggered by the belief.

The ABC model is one of the most used during the Cognitive-behavioural therapy (CBT) for treating mental health issues [30]. The ABC model was developed into the 'ABCDE' model by Seligman which was introduced in his book "Authentic Happiness" in 2002. The 'ABCDE' model is a technique used in Learned Optimism. Seligman suggests that the 'ABCDE' approach can be used by identifying a pessimistic thought and then view as if that thought was suggested by someone who would want to make our life miserable on purpose [36]. The 'ABCDE' model has two extra factors, specifically:

- Dispute (D) – The effort we expend to argue or dispute the belief.
- Energy (E) – Realizing the change in energy after self-disputing the belief successfully.

To overcome a negative thought, a person can either distract their thoughts to something else that would make them avoid the negative thought or dispute the belief that is making them feel pessimistic. According to Seligman, to dispute a belief one can deploy four possible methods. These are:

- I. Evidence
- II. Alternatives
- III. Implications
- IV. Usefulness

A person can use evidence to factually argue against the disbelief and justify that the pessimistic thought serves no purpose and does not affect them. An alternative analysis is to identify the causes for the belief and then act on the causes that are relevant. Such analysis would allow the person to think in a broad optimistic perspective. The implication is that it allows the person to continue the activity with a positive attitude that a negative event or belief would prevent them from doing. Usefulness allows the person to realise how useful it is to continue with the negative belief. An example is that the person must question themselves how useful it is to think about the problem and if thinking about it can do any good. This allows the person to validate the belief whether it has any meaning to it or not. A person can also use distraction rather than disputing thoughts to effectively continue an activity [35].

According to Seligman, a person can increase their happiness levels by disputing their negative beliefs. The final part of the 'ABCDE' model is Energization. The successful dispute or distraction that causes the negative belief to either fade away or become invalidated creates a positive behavioural change in a person [35]. The 5 stages of the model can be implemented and that would in turn help to reduce negative thoughts or overthinking and increase optimism.

According to Boykin, this technique can be suggested to students to handle challenging tasks more optimistically in their academic and everyday life. The same technique can also be used by any professional to handle challenges in their day-to-day life and during a recovery phase [9].

## 2.2 Student Retention in Higher Education

In 1992, the polytechnics and the central institutions in the UK were given university status through the Further and Higher Education Act 1992. These universities are referred to as the 'Post-1992 universities'. This led to an increase in the student population and wider student diversity. Moreover, the increasing emphasis on higher education as a free-market business has highlighted the need to ensure that students are both recruited and retained [4].

The Department for Education (DfE) in the United Kingdom has published a statistical report called the Higher Education Initial Participation (HEIP) report annually since 2014. The HEIP report contains the entry rates into higher education for students aged between 17-30 years old. Based on the latest report published in November of 2020, the student initial entry rates have increased to 52% for the 2018/19 year while the initial entry rate was 42% for the 2006/07 year. The data shows that there is a 10% increase in the initial entry rate in higher education in the last 12 years in the United Kingdom.

However, the rate of students being retained is reducing, this is proved by the increasing student dropout rates. According to the reports published by the HESA, the student dropout rate has been increasing along with the increase in student admissions in the UK. The total number of full-time undergraduate entrants for the academic year of entry 2018/2019 was 426,485 compared to 403,125 in the academic year of 2014/2015. Together with the increase in the full-time entrants, the dropout rate has also increased from 31,155 students in 2014/2015 to 35,255 in 2018/2019. This can be interpreted as the student retention rate having decreased from 92.3 % to 91.7 % after the first year of study. The data was recorded on a criterion of students who dropped out of full-time undergraduate course after 50 days of commencement of the course.

London has been witnessing a higher student dropout rate compared to the other regions of the United Kingdom. According to the report 'Skills for Londoners', a skills and adult education strategy report published by the Greater London Authority on behalf of Sadiq Khan, Mayor of London, on June 2018, the universities based in London have a higher dropout rate at 10% compared to the UK average of 8% [23].

The percentage of drop out from London based universities is increasing when compared to the outcomes of the research carried out by the Social Market Foundation. The dropout rate was at 7.73% for London based universities compared to the England average at 6.30% for the academic year of entry in 2016/17 [33]. The universities have a benchmark that estimates a percentage of students expected to discontinue their study before the end of the course based on the demographics of the student population. Out of 33 universities in London, 19 universities have a high dropout rate higher than the benchmark rate in 2016/17 [26].

There have been several studies to identify the reason for the increasing dropout rate from the universities in the UK. According to a news article published by *The Times*, the educational critics hold the universities responsible for the increase in dropout because of relaxing the admission eligibility to accommodate more students including those who fail to meet the required skills for the course. Other critics suggest that the students required greater assistance to adapt to the transition from school to university. The Office for Students has pointed out that the unconditional offers issued by the universities are the driving force behind this increase of dropout rates in the UK [6]. Universities with lower student satisfaction scores in the National Student Survey have higher drop-out rates on average [27].

A news article published in the *Guardian* states that the universities feel that the students starting their course during the pandemic might not be able to cope up with the demands of the course. They feel that the students would be in a stressful phase worried about paying for rent and food during the pandemic [15]. This section discussed about the student retention in higher education throughout the UK. The entry and dropout rates for the universities from the official government agencies indicated that there is an increase in both the student entry and dropout rates. London based universities have a higher dropout rate compared to the universities from other regions. In the following section, student retention at the London based university studied is explained.

**Student Retention at the School of Computing and Digital Media.** In contrast with increasing entry rates in universities in recent years, the London based university of the current study has seen a decline in entry rates. The university registered 3125 students for the full-time undergraduate courses in the year of entry 2014/15. In the year 2018/19, the university registered 2365 students, which is 24% less than in 2014/15. However, the student dropout rate has been increasing despite the fact the entry rate for the university has decreased. In the year 2014/15 the university recorded 17% of the students who attended 50 days of the course but dropped out of higher education after the first year of study for undergraduate courses. The university witnessed a 5% increase in the dropout rate at 23% for the year of 2018/19. The rate of dropout has been surpassing the benchmark set for the university every year [7]. As seen in Table 1, the percentage of dropouts has been increasing every year. The following section explains the core reason of why dropout rates in computing-based courses are the highest compared to other courses.

**Table 1.** Non continuation following year of entry [7].

Year of entry	Number of entrants	Percentage of Dropouts	Benchmark
2014/15	3125	17.6	12.6
2015/16	2895	18	13.4
2016/17	3005	20.4	13.9
2017/18	2325	19.1	13.8
2018/19	2365	22.6	13.5

### 2.3 Student Retention in Computing Students

The full-time undergraduate courses that have computer science as the main subject have recorded the greatest number of discontinuation rates amongst all courses in the UK. The data published on the HESA has been categorized into two age groups, young and mature. According to the HESA any student above the age of 21 is a mature student for the undergraduate courses [16]. Among young students, the rate of drop out for the courses that have computing as the main subject has reduced compared to the previous years but remains highest compared to the other courses. Among mature students, the dropout rate for the courses with computing as the main subject was the highest in the year 2014/15 at 18%. Since then, the rate has come down to 17% and courses that have business and administrative studies registered the highest dropout rates.

**Table 2.** Student dropout rates in Computing students from universities in UK [7].

Year	Young	Mature
2014/15	11	18.2
2015/16	10.6	17.5
2016/17	9.9	17.7
2017/18	9.8	17.5
2018/19	9.2	16.5

**Student Retention of the School of Computing and Digital Media.** The dropout rates for the first-year students in computing was analysed based on the results published by the school office from the year 2016/17 to 2019/20. The dropout rate has been determined based on the number of students who were registered for the course and the number of students who withdrew from the course.

In the academic year of 2016 and 2017 as shown in Fig. 1 and Fig. 2, 52 students enrolled for the first year BSc (Hons) Computer Science course with 31 in the September intake and 21 in the January intake. 12 students withdrew from the course with 6 each from both the intakes at 19% and 29% making it a collective of 23% dropout for the academic year.

Academic Year	2016/17	Today's Date	Apr 30, 2021
Last Data Refresh:	Apr 30, 2021 at 04:05 PM		

**BSc (Hons) Computer Science UDCMPSCI**

Level 4

Route Code	Course Code	Module Results	All Students													
			Reg*	Not Attempted	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev	Reg	NA	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev
CMPSCI	UDCMPSCI	CC4002 - Information Systems (YEAR)	24	3	85.7%	55.7	22	86	16.7	82	5	88.3%	54.2	8	86	17.4
CMPSCI	UDCMPSCI	CS4001 - Programming (YEAR)	23	2	100%	67.6	41	94	13.2	86	6	93.8%	60.6	12	94	16.3
CMPSCI	UDCMPSCI	CT4005 - Computer Hardware and Software Architectures (YEAR)	22	2	95%	59.2	15	88	16.6	82	4	91%	53.4	2	88	17.5
CMPSCI	UDCMPSCI	MA4005 - Logic and Mathematical Techniques (YEAR)	26	2	83.3%	58.5	10	96	20.8	49	4	77.6%	58.8	9	96	24.8

Progression							
Registered	Pass Progress	Conditional Progress	Completed Course	Withdrawn	Remain at Level	Failed	Outcome Pending
31	16 (51.6%)	4 (12.9%)	0 (0%)	6 (19.4%)	5 (16.1%)	0 (0%)	0 (0%)

**Fig 1.** BSc (Hons) Computer Science 2016/17 Autumn semester results.

**BSc (Hons) Computing UDCMPTNG**

Level 4

Route Code	Course Code	Module Results	All Students													
			Reg*	Not Attempted	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev	Reg	NA	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev
CMPTNG	UDCMPTNG	CC4002 - Information Systems (TERM2)	6	1	80%	49.4	33	62	10.1	6	1	80%	49.4	33	62	10.1
CMPTNG	UDCMPTNG	CS4001 - Programming (TERM2)	4	1	66.7%	38	9	60	21.4	4	1	66.7%	38	9	60	21.4
CMPTNG	UDCMPTNG	CT4005 - Computer Hardware and Software Architectures (TERM2)	5	1	100%	68.3	54	93	15.8	5	1	100%	68.3	54	93	15.8
CMPTNG	UDCMPTNG	MA4001 - Logic and Problem Solving (TERM2)	5	1	100%	74	64	83	7.4	5	1	100%	74	64	83	7.4
CMPTNG	UDCMPTNG	CC4002 - Information Systems (YEAR)	11	0	90.9%	52.6	17	80	16.9	82	5	88.3%	54.2	8	86	17.4
CMPTNG	UDCMPTNG	CS4001 - Programming (YEAR)	10	0	100%	58.1	40	81	14.3	86	6	93.8%	60.6	12	94	16.3
CMPTNG	UDCMPTNG	CT4005 - Computer Hardware and Software Architectures (YEAR)	10	0	100%	50.9	43	66	7.3	82	4	91%	53.4	2	88	17.5
CMPTNG	UDCMPTNG	MA4001 - Logic and Problem Solving (YEAR)	11	1	90%	44.9	24	54	8.8	41	3	71.1%	44.2	5	89	19.2

Progression							
Registered	Pass Progress	Conditional Progress	Completed Course	Withdrawn	Remain at Level	Failed	Outcome Pending
21	9 (42.9%)	3 (14.3%)	0 (0%)	6 (28.6%)	3 (14.3%)	0 (0%)	0 (0%)

**Fig 2.** BSc (Hons) Computer Science 2016/17 Spring Semester results.

In the academic year of 2017 and 2018 as shown in Fig. 3 and Fig. 4, 32 students enrolled for the first year BSc (Hons) Computer Science course with 22 in the September intake and 12 in the January intake. From the September intake 3 students (13%) withdrew from the course and no student (0%) withdrew from the January intake making it 9% dropout for the year.

Academic Year	2017/18	Today's Date	Apr 30, 2021
Last Data Refresh:	Apr 30, 2021 at 04:10 PM		

### BSc (Hons) Computer Science UDCMPSCI

#### Level 4

Route Code	Course Code	Module Results									All Students						
			Reg*	Not Attempted	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev.	Reg	NA	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev.	
CMPSCI	UDCMPSCI	CC4002 - Information Systems (YEAR)	21	0	95.2%	55.7	9	87	16.2	85	4	85.2%	55.2	9	88	18.6	
CMPSCI	UDCMPSCI	CS4001 - Programming (YEAR)	19	0	89.5%	56.9	15	82	16.5	91	9	89%	58.6	9	91	18.9	
CMPSCI	UDCMPSCI	CT4005 - Computer Hardware and Software Architectures (YEAR)	19	0	100%	62.5	45	84	12	77	3	95.9%	65.3	7	89	15.7	
CMPSCI	UDCMPSCI	MA4005 - Logic and Mathematical Techniques (YEAR)	19	0	84.2%	63.9	6	96	26.8	41	1	82.5%	66	6	100	27.3	

Progression							
Registered	Pass Progress	Conditional Progress	Completed Course	Withdrawn	Remain at Level	Failed	Outcome Pending
22	16 (72.7%)	2 (9.1%)	0 (0%)	3 (13.6%)	1 (4.6%)	0 (0%)	0 (0%)

Fig. 3. BSc (Hons) Computer Science 2017/18 Autumn semester results.

Academic Year	2017/18	Today's Date	Apr 30, 2021
Last Data Refresh:	Apr 30, 2021 at 04:10 PM		

### BSc (Hons) Computing UDCMPTNG

#### Level 4

Route Code	Course Code	Module Results									All Students						
			Reg*	Not Attempted	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev.	Reg	NA	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev.	
CMPMTNG	UDCMPTNG	CC4002 - Information Systems (YEAR)	13	1	75%	47.8	16	88	21.9	85	4	85.2%	55.2	9	88	18.6	
CMPMTNG	UDCMPTNG	CS4001 - Programming (YEAR)	11	2	88.9%	52.6	9	85	22	91	9	89%	58.6	9	91	18.9	
CMPMTNG	UDCMPTNG	CT4005 - Computer Hardware and Software Architectures (YEAR)	9	0	77.8%	54.1	7	81	21.9	77	3	95.9%	65.3	7	89	15.7	
CMPMTNG	UDCMPTNG	MA4001 - Logic and Problem Solving (YEAR)	10	1	100%	58.2	40	80	14.3	37	4	84.8%	58.1	15	82	17	

Progression							
Registered	Pass Progress	Conditional Progress	Completed Course	Withdrawn	Remain at Level	Failed	Outcome Pending
12	9 (75%)	0 (0%)	2 (16.7%)	0 (0%)	1 (8.3%)	0 (0%)	0 (0%)

Fig 4. BSc (Hons) Computer Science 2017/18 Spring semester results.

In the academic year of 2018 and 2019 as shown in Fig. 5 and Fig. 6, 46 students enrolled for the first year BSc (Hons) Computer Science course with 29 in the September intake and 17 in the January intake. 8 students (28%) from the September intake withdrew from the course and 2 students (12%) withdrew from the January intake making it 22% dropout for the year.

Academic Year	2018/19	Today's Date	Apr 30, 2021
Last Data Refresh:	Apr 30, 2021 at 04:12 PM		

### BSc (Hons) Computer Science UDCMPSCI

#### Level 4

Route Code	Course Code	Module Results									All Students						
			Reg*	Not Attempted	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev.	Reg	NA	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev.	
CMPSCI	UDCMPSCI	CC4057 - Introduction to Information Systems (SEM1)	21	2	78.9%	52.7	11	91	22.3	81	3	80.8%	56.9	7	95	23.6	
CMPSCI	UDCMPSCI	CS4051 - Fundamentals of Computing (SEM2)	21	5	81.3%	50.9	17	85	18.5	82	16	87.9%	54.5	11	89	18.8	
CMPSCI	UDCMPSCI	CS4001 - Programming (YEAR)	21	3	83.3%	52.8	11	82	19.9	79	8	83.1%	54.8	11	91	20	
CMPSCI	UDCMPSCI	CT4005 - Computer Hardware and Software Architectures (YEAR)	21	2	84.2%	52.4	3	80	23.1	76	10	90.9%	60.2	3	92	17.4	
CMPSCI	UDCMPSCI	MA4005 - Logic and Mathematical Techniques (YEAR)	22	5	82.4%	59.5	27	94	21.1	55	7	81.3%	59	3	96	24	

Progression							
Registered	Pass Progress	Conditional Progress	Completed Course	Withdrawn	Remain at Level	Failed	Outcome Pending
29	11 (37.9%)	3 (10.3%)	0 (0%)	8 (27.6%)	1 (3.5%)	4 (13.8%)	2 (6.9%)

**Fig 5.** BSc (Hons) Computer Science 2018/19 Autumn semester results.

Academic Year	2018/19	Today's Date	Apr 30, 2021
Last Data Refresh:	Apr 30, 2021 at 04:12 PM		

### BSc (Hons) Computing UDCMPTNG

#### Level 4

Route Code	Course Code	Module Results	All Students													
			Reg*	Not Attempted	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev	Reg	NA	Pass Rate	Avg. Mark	Min Mark	Max Mark	Std. Dev
CMPYNG	UDCMPTNG	CC4057 - Introduction to Information Systems (SEM1)	14	0	85.7%	58.3	11	88	23	81	3	80.8%	56.9	7	95	23.6
CMPYNG	UDCMPTNG	CS4051 - Fundamentals of Computing (SEM2)	15	2	92.3%	54.8	12	85	17.5	82	16	87.9%	54.5	11	89	18.8
CMPYNG	UDCMPTNG	OEL001 - English Language Advanced (YEAR)	1	0	100%	63	63	63	0	11	0	100%	58.2	40	78	9.4
CMPYNG	UDCMPTNG	CS4001 - Programming (YEAR)	15	2	84.6%	58.6	22	91	20	79	8	83.1%	54.8	11	91	20
CMPYNG	UDCMPTNG	CT4005 - Computer Hardware and Software Architectures (YEAR)	13	1	100%	66.9	53	81	8.6	76	10	90.9%	60.2	3	92	17.4
CMPYNG	UDCMPTNG	MA4005 - Logic and Mathematical Techniques (YEAR)	13	0	84.6%	60.2	4	92	22.8	55	7	81.3%	59	3	96	24

Progression							
Registered	Pass Progress	Conditional Progress	Completed Course	Withdrawn	Remain at Level	Failed	Outcome Pending
17	9 (52.9%)	1 (5.9%)	0 (0%)	2 (11.8%)	2 (11.8%)	2 (11.8%)	1 (5.9%)

**Fig 6.** BSc (Hons) Computer Science 2018/19 Spring semester results.

The School of Computing and Digital Media witnessed their highest dropout rate in the 2016 to 2017 academic year at 23% but the following year had a contrasting dropout rate of 9%. However, the dropout rate for the academic year 2018 to 2019 increased to 22%. There are several factors contributing to the dropout of students from computing-based courses. They are explained in the following section.

## 2.4 Reasons for Dropping Out

One of the major challenges is caused by the prior experience and perception of the subject based on academic experience from schools and colleges or personal experience. This incongruity is perhaps the greatest challenge facing both computing as an academic subject and the IT industry.

According to research conducted by University of Roehampton, the percentage of students who took up GCSE Computer Science witnessed a slight increase from 12.1% to 12.4% between 2017 and 2018 among all GCSE students [22]. This might be due to the increase in the number of GCSE Computer Science providers in the country. However, 8% of the schools that offered GCSE Computer Science in 2017 ceased to offer in 2018. The teaching hours for computing and ICT in the secondary schools in England has dropped by 36% during the six-year period from 2012 and 2017. The two years known as year 10 and 11 which includes GCSEs and other exams are termed Key Stage 4 (KS4). The research found that there was a 47% decrease in the teaching hours focused on computing and ICT per week. For students who did not take up GCSE in Computer Science, they are unlikely to get any sort of computing education in the schools beyond the age of 14. The GCSE IT was removed from the curriculum in 2018 and reduced the total number of hours spent on teaching computing even more. Kemp, Berry and Wong feel that the dominance of computer science over computing and ICT would limit access to computing education for young people [22].

The national computing curriculum for England, which was revised in 2014, had faced criticism from many as the curriculum is much involved with coding. The vice president of programmes for Salesforce.org Charlotte Finn suggests that there must be a change in the curriculum as it emphasizes coding and not the other computing skills, and if it prolongs, then there are risks of many students being left behind [28]. Paul Clarke, Chief Technology Officer (CTO) at Ocado suggests that school curriculum should include technology concepts that are more relevant in the current market. Analysing and Interpreting data to develop models, automation, artificial intelligence, and machine learning would make the children more digital literate. He feels that true digital literacy is more than teaching the students to code. This can be achieved only by updating the curriculum [29].

Finally, for many computing students at the pre-entry and transition to higher education stage there is a significant obstacle created by not possessing the requisite academic skills or experience and qualifications in important



subjects such as mathematics and English or not having the resources and time while at university to acquire them quickly enough. While certainly not restricted to students who have entered higher education on a vocational route this is an issue which is more likely to prove challenging for them. Lack of mathematical knowledge and skills; lack of familiarity with extended writing tasks; oral presentational skills; research skills can prove overwhelming and can inform decisions by students to disengage and withdraw from higher education [34].

Based on the literature review, it is suggested that retention of students can be increased by improving the optimism levels of a student. An optimistic student would be able to handle a tough situation or challenge faced during the time of study in a positive manner and not become disillusioned. Students intend to engage and participate more in their studies when they feel a sense of belonging with the university. This might help develop a positive relationship between the university and the students.

The increase in the number of universities post 1992, as well as their admissions, has also resulted in a rise in dropout rates especially in the courses that involve computing. This may be due to the changes in the curriculum in GCSE levels shifting the learning of computing more into coding away from other areas of computing. The entry requirements for gaining admission to computing based undergraduate courses has made it easier for students to enrol on the computing courses. However, the ability to face the challenges of the course in terms of academic knowledge is affected because of the learning quality and methods in the lower academic levels such as GCSE or A levels.

The dropout rate has been high among the students from black ethnic groups compared to other ethnicities. This is one area that would require more extensive and in-depth research on the improvement of retention rates among the students from black ethnic groups. This is further addressed in Section 8.

The university studied has recorded a decreasing number of entrants into the undergraduate courses between 2014 and 2018, however the dropout rate has been increasing despite the decreasing admission rates. This research identifies the issues causing low retention rates through the optimism levels of the School of Computing and Digital Media students. The methods involved in this research and the structure of the survey are discussed in the following section.

### **3 Research Methodology**

The data collected for this research is used to identify the optimism levels in the students and analyse it against factors such as age, gender, ethnicity, qualification, and nationality. A survey is conducted for the foundation and first year students in the School of Computing and Digital Media. The data collected is statistically analysed using R programming language. An exploratory data investigation is performed to summarize characteristics in the dataset. The Regression tree model is also used to build a statistical model for the data in this research. The data collection method employed in this research is a questionnaire in the form of a survey [2,3]. The data collected through the survey was then explored to discover and summarize the characteristics of the data [8]. The data collection method is explained in detail in Section 4. The following sections explain the process followed in detail.

**Exploratory Investigation.** The exploratory investigation or exploratory analysis is conducted to summarise the characteristics in a dataset. It involves data visualization and graphical analysis to explain the data. The exploratory investigation can be used to explore the data and formulate the hypotheses leading to new data collection and research. According to Tukey, the exploratory investigation fulfils the objective of suggesting hypotheses for the causes of observed phenomena, assessing assumptions based on which statistical inferences, identifying appropriate statistical tools and methodology and providing a basis for further data collection [5]. Few of the many graphical techniques that are used in exploratory Investigation are box plot, histogram, scatter plot, run chart, frequency plot. In this research the frequency plot is used to visualize the data. A frequency distribution plot is created in this research to identify the frequency of variables against optimism scores. The outcomes of the frequency distribution plot are used in selecting the appropriate modelling technique for the data.

**Regression Tree Model.** Regression Techniques consist of a single output or target variable which is numerical and one or more input or explanatory variables. The Regression Analysis can predict the value of continuous output variables against independent, continuous, and categorical input variables based on their latent relationship from data.

The implementation of tree-based models is an exploratory method to discover structure in the dataset and it is an alternative to linear and additive models for regression problems and to linear logistic and additive logistic models for classification problems. The tree-based models originated as an alternative to classical statistical methods like linear regression that are highly unstable when there is a correlation between the variables [25].

Regression Tree Models are developed as a two-step procedure. A recursive binary partitioning is implemented to produce a tree structure and then the insignificant leaves are pruned. The process has the possibility of assigning multivariate functions to terminal leaves for better generalisation. This allows a novel methodology of node partitioning, especially in a single optimisation model simultaneously performing the two tasks of identifying the breakpoint of binary split and assignment of multivariate functions to either leaf. This leads to an efficient regression tree model [42]. The regression decision tree has low misclassification rate and deviance compared to other models. The output presented from a decision tree is spontaneous, assists in decision making and is easy to interpret. The path of the tree leads to identifying interesting subsets of modules along with their characteristics [18, 19, 20, 21].

The quantitative approach involving survey questionnaires as the data collection method, exploratory data investigation and regression tree analysis model is used in this research to identify student retention in foundation and first year computing students using learned optimism as a lens.

#### **4 Data Collection**

The Data Collection is the process of collecting data that is required for the research to perform the statistical analysis. The data collection was undertaken using a questionnaire through a survey among the foundation and first year students from the School of Computing and Digital Media from the 18th of April 2021 to 18th of May 2021. The questionnaire is adapted from 'The Learned Optimism' by Seligman [35]. The questionnaire contains 30 questions with each having different scenarios asking the person what they would tell themselves. The recipients are asked to choose between two options. Every option is marked in either one of the alphabets between A to L. The recipient would need to mark their answer with an X next to the provided options. The answers corresponding to the question number and the alphabet are marked on the scoring sheet and then the total number of answers for the alphabets are calculated based on the sum of the answers. The results in the test scoring sheet are then interpreted based on the Optimism Survey Interpretation Guide as shown in Fig. 7. The Interpretation Guide helps to classify whether a student is an optimist or pessimist, or average based on the total optimism score.

The Pessimism score is calculated by the sum of the points in Columns I, D, and F. The score can describe the person's attitude reacting to when a bad thing occurs. If the scores are between

- 0-6, then the person is optimistic when bad things happen
- 7, then the person is average
- 8-14, the person is pessimistic when bad things happen

The Optimism score is calculated by the sum of the points in Columns H, E, and B. The score can describe the person's attitude reacting to when a good thing occurs. If the scores are between

- 10-15, then the person is optimistic when good things happen
- 8-9, then the person is average
- 0-7, the person is pessimistic when good things happen

To identify the total optimism score, the pessimism score is subtracted from the optimism score. If the scores are,

- 4 and above then the person is an optimist
- 2-3, then the person is average
- 1 or below, then the person is a pessimist

---

Total up the points in Columns I, D, and F.

This is your pessimism score when **bad events** happen. box 1

If you scored    0-6    you are optimistic when bad things happen  
                       7        you are average  
                       8-14    you are pessimistic when bad things happen

---

Total up the points in Columns H, E, and B.

This is your optimism score when **good events** happen. box 2

If you scored    10-15    you are optimistic when good things happen  
                       8-9        you are average  
                       0-7        you are pessimistic when good things happen

---

Subtract Box One from Box Two:     box 2    minus     box 1    equals   

This is your **total optimism score**

If you scored    4 and above    you are optimistic across the board  
                       2-3                you are average  
                       1 or below        you are pessimistic across the board

---

**Fig. 7.** Optimism Survey Interpretation Guide [35]

The primary objective of the survey is to identify how the optimism levels are among the students in the School of Computing and Digital Media. There are several factors that contribute to a student being optimistic or pessimistic or average. The survey collects information about the student’s age, ethnicity, age, gender, level of study, mode of attendance, and disability. The information about the student’s qualification and work experience was mapped from the school’s enrolment database. The purpose of this stage is to investigate how the optimism score depends on the explanatory variables.

The variables that are used in the analysis for this research are

- Qualification - (Foreign qualifications, BTECH, Higher Education Diploma, A Level, GCSE, Other, N/A)
- Work Experience – (Yes or No)
- Disabled – (Yes or No)
- Ethnicity - (White, Black, Asian, Other, Not Known)
- Age – (In years)
- Gender – (Female, Male)
- British – (Yes or No)
- Mode of Attendance – (Full time or Part time)
  
- Level of Study – (Foundation or First year)

**Table 3.** Optimism Survey Data

	Total	Male	Female	British	Non-British	First Year Undergraduate	Foundation Year
Optimist	38	31	7	10	28	15	23
Average	54	36	18	22	32	22	32
Pessimist	109	76	33	33	76	49	60

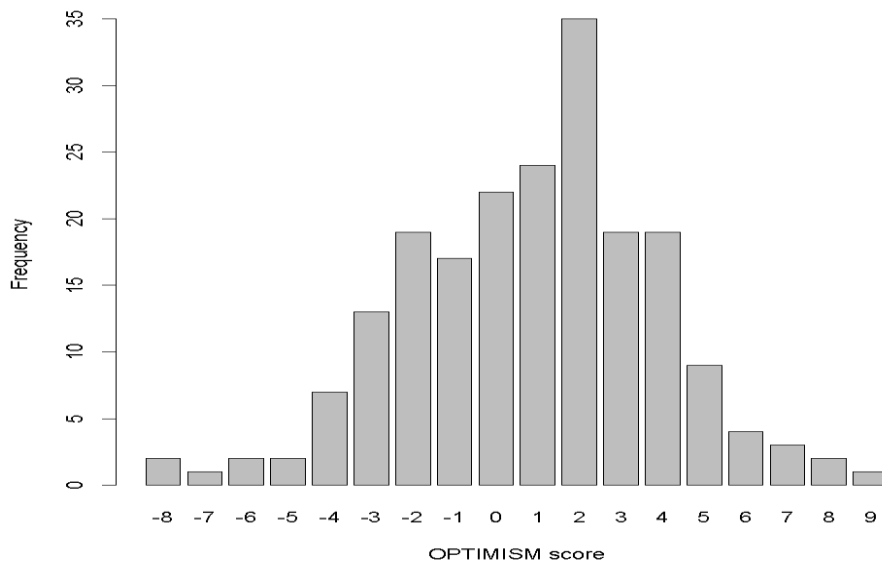
From the 201 students who took part in the survey, an initial review classified them based on their optimism levels as Optimist or Average or Pessimist corresponding to gender, nationality and course levels as shown in Table 3. All personal information such as name, student ID email address was anonymised due to data confidentiality. A statistical analysis was then performed to identify how total optimism scores are based on the explanatory variables mentioned previously using R Programming Language. This is explained in detail in the following section.

## **5 Data Analysis**

Data Analysis is defined as the systematic process of applying statistical, logical techniques such as cleaning, transforming, and modelling to describe, illustrate and evaluate data. According to Shamoo and Resnik there are various analytic procedures to develop inductive inferences from data and distinguish the phenomenon of interest from the statistical fluctuations present in the data [37]. The statistical analysis is carried out using the R programming language on R studio. The data collected from the survey is analysed statistically and a model is developed to identify the relationship between the explanatory variables and the target variable. The data is loaded in the R studio to follow the objectives set in the research. The analysis begins with an exploratory investigation to identify the levels of impact the variables have on the target and then a model is developed for the data using a regression decision tree model.

### **5.1 Exploratory investigation**

In an initial exploratory investigation, the frequencies of each category of the variables were obtained, as well as, the corresponding proportions for each category of each of the variables. Specifically, the foreign qualification was the most common (27% of students), 18% of students had work experience, 10% were disabled, 57% were white ethnicity and 20% black ethnicity, 71% were male, only 32% were British, 2% were part-time students, and 57% were at foundation year level of study while 43% were at first year of undergraduate degree level of study. A frequency plot of the optimism scores was obtained below (see Fig. 8).



**Fig. 8.** Frequency Plot

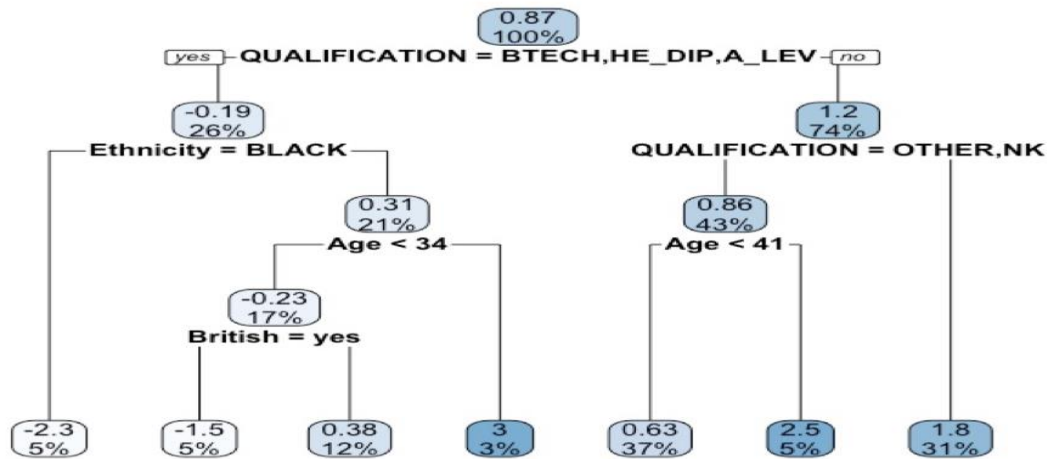
The following were observed from the exploratory investigation

- The minimum optimism score was -8 and the maximum was +9.
- The distribution of the optimism score was approximately normal.
- The optimism score was then plotted against each of the explanatory variables.
- This showed that the main variable affecting the optimism score was the qualification. Students with either foreign qualifications or GCSEs had the highest median optimism scores.

The frequency plot obtained by plotting the explanatory variables against the optimism score reveals that the most optimistic score was 9 and the least optimistic score was -8. From the plot, the highest frequency was observed for the students with an optimism score of 2 followed by a score of 1. Based on these results, the statistical model is developed using a regression decision tree model.

## 5.2 Model for the optimism score

The optimism score was then modelled using the explanatory variables in a regression decision tree. The figure below (see Fig. 9) displays the resulting fitted tree model. The decision tree is built by successive binary splits of the data. Nodes of the tree are in blue, with the 7 nodes at the bottom level of the tree called leaves. At the top of the tree the node contains all the 201 cases (i.e., 100% of the data) and has a mean (or average) optimism score of 0.87. Note that the average optimism score of all the 201 students falls under the category of pessimistic character, indicating on average students are more pessimistic than optimistic based on the score interpretation guide. At the second level from the top of the tree, the students are then divided into two groups (two branches of the tree leading to two nodes) based on the variable `QUALIFICATION`, as shown on the second level from the top of the tree. On the left are students with `QUALIFICATION = BTECH, HE_DIP OR A_LEV`, comprising 26% of the students with an average optimism score of -0.19, while on the right are the other students with `QUALIFICATION = FOREIGN, GCSE, OTHER or NK (not known)`, comprising 74% of students with an average optimism score of 1.2. Each of these two nodes are then split further. The bottom level of the tree has 7 leaves, and this partitions the students into 7 groups with similar values of optimism.



**Fig. 9.** Regression Decision tree

From left to right on the bottom level, the 7 groups are as follows:

- 1) Students with QUALIFICATION = BTECH, HE\_DIP OR A\_LEV and ETHNICITY = BLACK, comprising 5% of the students, with an average optimism score of -2.3.
- 2) Students with QUALIFICATION = BTECH, HE\_DIP OR A\_LEV and ETHNICITY = not BLACK, Age<34 who are British, comprising 5% of the students, with an average optimism score of -1.5.
- 3) Students with QUALIFICATION = BTECH, HE\_DIP OR A\_LEV and ETHNICITY = not BLACK, Age<34 who are not British, comprising 12% of the students, with an average optimism score of 0.38.
- 4) Students with QUALIFICATION = BTECH, HE\_DIP OR A\_LEV and ETHNICITY = not BLACK, Age>=34, comprising 3% of the students, with an average optimism score of 3.
- 5) Students with QUALIFICATION = OTHER or NK and Age<41, comprising 37% of the students, with an average optimism score of 0.63.
- 6) Students with QUALIFICATION = OTHER or NK and Age>=41, comprising 5% of the students, with an average optimism score of 2.5.
- 7) Students with QUALIFICATION = FOREIGN, GCSE, comprising 31% of the students, with an average optimism score of 1.8.

### 5.3 Summary of Data Analysis

This section presents the findings and the conclusion from the Regression Tree Decision Model used in the analysis for the optimism score against the independent variables such as qualification, ethnicity, age, and nationality. The results are categorized into Optimists, Average and Pessimists. The categorisation is completed based on the optimism score and the explanatory variables. Specifically:

#### Optimists

- Mature students are more optimistic compared to the younger students as explained by the following two findings in the analysis. Students aged 34 and above are classified as mature students in this research.
- Students aged 34 and above with a BTECH, Higher Education Diplomas or A level qualification, who are not black ethnicity (comprising 3% of the students) have an average optimism score of 3.
- Students aged 41 and above with other or not known qualifications (comprising 5% of the students) have an average optimism score of 2.5.

#### Average

- Students with a foreign or GCSE qualification (comprising 31% of the students) are averagely optimistic with an average optimism score of 1.8.

#### Pessimists

- Students who are aged below 34 and not from a black ethnic background with any of the qualifications from BTECH, Higher Education Diploma and A Levels are generally pessimistic.
- Students with any of the qualifications from BTECH, Higher Education Diploma and A Levels belonging to the black ethnic background (comprising 5% of the students) are found to be the most pessimistic with a score of -2.3.
- Students with any of the qualifications from BTECH, Higher Education Diploma and A Levels from all ethnic backgrounds other than the black ethnicity and aged below 34 and British (comprising 5% of the students) were found to be the second most pessimistic group with an average optimism score of -1.5.

The overall conclusion is that students with a foreign qualification are optimistic (comprising 31% of the students with an average optimism score of 1.8), while students with other or not known qualification are mildly pessimistic (comprising 43% of the students with an average optimism score of 0.86). Furthermore, students with a BTECH, Higher Education diploma or A level qualification are generally more pessimistic (comprising 26% of the students and with an average optimism score of -0.19), especially if they are also black ethnicity (comprising 5% of the students with an average optimism score of - 2.3), or are also not black ethnicity, aged under 34 and British (comprising 5% of the students with an average optimism score of -1.5).

## 6 Implications

The Higher Education Statistics Agency's Non-continuation: UK Performance Indicators report that the student drop-out rates for computing-based courses has been high compared to the other undergraduate studies between 2014 and 2019 [7]. The increasing student drop-out from computing courses in the UK and specifically from the School of Computing and Digital Media of the university studied has been the focus of this study. The purpose of this study is to identify the optimism levels of the students in foundation and first year of undergraduate computing courses and how it would support student retention. The conclusions from the analysis conducted in Section 5.3 imply the following steps require to be undertaken:

- A focussed study on the reason behind higher number of pessimistic students who had the qualification of BTECH, Higher Education Diploma and A Levels.
- Implement steps to improve the optimism levels for the students belonging to black ethnic groups.
- Identify the cause for the pessimism among students under 34 years of age and the qualifications mentioned in the first point
- The study has found that 109 (54%) of the 201 students who took part in the survey are classified under the pessimistic category and 54 (27%) of the students are in the average category. This means that only 38 (19%) of the students are optimistic.

The large number of pessimistic students as observed in the results of the analysis might also be due to the following reasons:

- Covid-19 Pandemic
- Job losses
- Mental health

The three reasons listed above seem to have affected many students in the higher education institutions in the United Kingdom. The academic year for the students started in September 2020 just a few weeks after the second wave of the Covid-19 virus affected the UK. The second wave affected the UK more than the first wave as the virus mutated into what was described as the 'Delta variant'. The highest number of cases recorded in a single day during the second wave was approximately 81,500 on the 29<sup>th</sup> of December compared to the first wave when the highest number of Covid-19 cases recorded on a single day was around 5,500 on the 22<sup>nd</sup> of April. The average cases in the first wave between the 1<sup>st</sup> of March 2020 to 04<sup>th</sup> of July was around 2,200 and the average cases during the second wave between 1<sup>st</sup> of August 2020 to 24<sup>th</sup> of April 2021 was around 15,300 (Cases in United Kingdom, 2021).

The second wave of the virus forced the government to impose a stricter lockdown for a longer period than the first wave. The universities followed the guidelines issued by the government and changed to online teaching mode. This allowed students who were not from London to get back to their home or country and continue their

studies through the facilities provided by the university by attending lectures online. The pandemic has produced several factors which reduce students' optimism levels through the form of job loss and mental health issues.

Based on the results of the analysis, the students who were aged below the age of 34 were in a pessimistic category. This may be because job losses during the pandemic affected the younger population more than the older population. Since all businesses other than essential services were ordered to be shut down during the lockdown, students are concerned about lack of part-time or casual work to support their studies and/or the prospect of getting a job when they complete their studies. According to research published by the London School of Economics in October 2020, more than 1 in 10 people between the age of 16 to 25 have lost their jobs since the pandemic began. Women, self-employed and economically weaker families were more prone to the job losses during the pandemic. The survey of 10,000 people conducted by the London School of Economics and Political Science (LSE) and Exeter University explains the younger population suffered substantial and sustained losses in employment and education (Elliot Major, Eyles, and Machin, 2020).

The data analysis has shown that only 19% of the participant students were found to be optimistic. An additional finding to the current research is that 54% of the respondents who took the survey were less optimistic which might be a sign of anxieties amongst this group, even of mental health issues. Similar research conducted by Wonkhe [41] agrees with this finding. Specifically, Wonkhe [41] conducted a survey in October 2020 to study the 'Loneliness' factor in students with the participation of 121 institutions from the United Kingdom. The results of that research showed that the majority of the 7273 respondents in the survey felt lonely with just 17% of the students who did not feel lonely [41]. Only 50% of the students felt that they were a part of the university community [13]. The Higher Education Policy Institute (HEPI) conducted a survey among 100 full time undergraduate students on how the pandemic caused by Covid-19 has affected their mental health. 58% of the respondents said that their mental health has become worse due to the pandemic, 14% said that they had better mental health and 28% said that they maintained the same mental health as before [17]. In addition, the job losses affecting young population and mental health issues caused due to the pandemic could be considered as the probable causes for 54% of the students to be pessimistic. In the following section, the authors discuss the limitations of the current study.

## **7 Limitations**

The current study involved regression analysis based on the data obtained through the survey as well as anonymised student data from the university's admission office. The findings in this study must be seen considering some limitations. The limitations faced in the study are as follows:

- The dataset was not provided directly but extrapolated based on the academic results provided by the university's admission office for each semester.
- The explanatory variables used in this study such as age, gender, qualification, and ethnic background information were not available in the data from the School of Computing and Digital Media.
- The survey results did not have the student qualification information, it was obtained by mapping the student qualifications based on the student ID from the enrolment data.

In future studies a higher number of participants could help us identify more retention-related factors in the foundation and first year computing students. In the following section, a detailed discussion explains our recommendations to further improve the current study by conducting more in-depth follow-up research.

## **8 Recommendations for further research**

The research conducted is a pilot study and will be repeated in the following years to monitor the actual dropout rate. The research has identified areas for further research related to the study undertaken in this article. These are as follows:

- a. Research focusing on the contrasting difference in optimistic levels between students having foreign qualifications and UK qualifications as the conclusion of the analysis highlights students with UK qualifications are more likely to be pessimistic.



- b. Identifying and exploring the factors causing students from black ethnicity to be less optimistic compared to the other ethnic backgrounds. Based on the results analysis and other sources mentioned in the previous sections, the students from the black ethnic background are more likely to be pessimistic. A separate study on how the ethnic backgrounds contribute to optimism levels among students and how the levels can be improved is also required.
- c. Repeating the same research in foundation and first year students of other courses as well as other UK universities. Such research would help discover other factors contributing towards optimism levels and in improving student retention as well as improving optimism levels among students in the UK.
- d. The recent results published in July 2021 from National Student Survey has shown that the School of Computing and Digital Media of the university studied has scored an overall of 80% for student satisfaction compared to the previous year score of 76%. The undergraduate courses from School of Computing and Digital Media, BEng Software Engineering is ranked 1st in the country with 100% student satisfaction and BSc Computer Science is ranked 3rd in the UK with 89% student satisfaction [24]. As mentioned in Section 2.2, the universities with low satisfaction scores in the National Student Survey have low retention rates. A potential interpretation is that the students were satisfied with the online teaching mode provided by the university during the pandemic. However, in the current study the participant students were found to be less optimistic, especially those with UK qualifications specifically, GCSE and A-Level. It is possible that the UK students' negative perception for maths and programming affects their optimism level while in foundation and/or first year computing courses [12, 40]. Therefore, low optimism level might be one of the major factors contributing to the low retention rates. However, the previous year's increased student satisfaction rates suggest a positive outlook of an increased retention rate for the current year as well. In a follow up research, student retention in the subject area of computing will be further investigated using a statistical modelling analysis to predict behavioural patterns. The same survey will be used to identify the optimism levels and compare it with the current research outcomes. This would allow the university to streamline the measures taken to increase the student optimism and develop a more efficient and effective retention method.

The recommendations suggested are based on the objective of increasing retention rates by conducting further research into identifying the level of differences in education levels between the UK and other countries. Determining the role of ethnic background in affecting optimism levels, doing wider research involving other schools of the university and other universities and the impact of student satisfaction scores in student retention are also proposed as directions for further research.

## 9 Conclusion

Sense of belonging and engagement during education is important for a student to gain knowledge and succeed in the course enrolled. It is also important for a university to develop this through the teaching and learning experiences. The objective of a student and a university would be to successfully graduate from the enrolled course. Optimism level in a student is a crucial factor in linking the student and the university to achieve the objective. The higher number of pessimistic students can also be the reason behind the higher number of dropout rates at the School of Computing and Digital Media of the university studied, indicating that there is a lack of sense of belonging and engagement between the students and the university.

Academic qualifications need to be assessed as there is a contrasting difference in optimism levels for students having UK and foreign qualifications. Based on the results of this pilot study it is observed that a high number of students being pessimistic is a matter of concern for the university but also for the students themselves as it affects their mental health in relation to the challenges ahead. The increase in the number of entrants into higher education is a sign that the solutions are to be implemented earlier to prevent the increasing dropout rates. The factors identified in the research affecting the optimism levels are native qualifications, ethnicity, and age.

The next phase of the research will aim to study how the optimism levels of the students change with the reintroduction of face-to-face teaching in the university after the pandemic period and will compare the results with the online teaching mode. The data collection method will also be extended to face to face interviews and focus groups to obtain more information for the research. Finally, the results obtained will be compared with results from the pilot study.

## 10 References

1. Andrews, J., Clark, R. and Thomas, L., 2012. Compendium of effective practice in higher education retention and success, [https://s3.eu-west-2.amazonaws.com/assets.creode.advancehe-document-manager/documents/hea/private/what\\_works\\_compendium\\_effective\\_practice\\_1568036670.pdf](https://s3.eu-west-2.amazonaws.com/assets.creode.advancehe-document-manager/documents/hea/private/what_works_compendium_effective_practice_1568036670.pdf), last accessed 2021/04/10.
2. Apuke, O.: Quantitative Research Methods: A Synopsis Approach. Kuwait Chapter of Arabian Journal of Business and Management Review, 6(11), 40-47 (2017).
3. McLaughlin, E.: What is data collection? - Definition from WhatIs.com. SearchCIO, <https://searchcio.techtarget.com/definition/data-collection>, last accessed 2021/07/28.
4. Armstrong, C.: *What is a University in the UK?*, <https://web.archive.org/web/20100513000141/http://www.jobs.ac.uk/careers/articles/1135/what-is-a-university-in-the-uk/>, last accessed 2021/07/20.
5. Behrens, J.: Principles and procedures of exploratory data analysis. Psychological Methods, 2(2), 131-160 (1997).
6. Bennett, R.: Unconditional offers blamed for increase in students dropping out of university, <https://www.thetimes.co.uk/article/unconditional-offers-blamed-for-increase-in-students-dropping-out-of-university-7zdmst86w>, last accessed 2021/06/20.
7. Bermingham, J.: Non-continuation: UK Performance Indicators. HESA, <https://www.hesa.ac.uk/data-and-analysis/performance-indicators/non-continuation>, last accessed 2021/04/08.
8. Bhatia, M.: A Complete Guide to Quantitative Research Methods – Atlan. Humans of Data, <https://humansofdata.atlan.com/2018/06/quantitative-research-methods/>, last accessed 27 June 2021/06/27.
9. Boykin, R.B.: Integrating Positive Psychology Techniques into Rehabilitation Counselor Education, Rehabilitation Education, vol. 24, no. 1, 25-34 (2010).
10. Diversity Abroad, Partners, <https://www.diversityabroad.com/partners/london-metropolitan-university>>, last accessed 27 June 2021/06/27.
11. Elliot Major, L., Eyles, A. and Machin, S.: Generation COVID: Emerging work and education inequalities, <https://cep.lse.ac.uk/pubs/download/cepcovid-19-011.pdf>, last accessed 2021/07/20.
12. Davis, A. and Jarvis, S.: Why are UK students the most stressed over studying maths?, <https://patient.info/news-and-features/why-are-uk-students-the-most-stressed-over-studying-maths>, last accessed 2022/02/18.
13. Dickinson, J.: The costs of Covid restrictions on students are social, <https://wonkhe.com/blogs/anti-social-learning-the-costs-of-covid-restrictions-on-students/>, last accessed 2021/07/28.
14. Explore-education-statistics.service.gov.uk, *Participation measures in higher education*, <https://explore-education-statistics.service.gov.uk/find-statistics/participation-measures-in-higher-education/2018-19#releaseHeadlines-tables>, last accessed 2021/04/08.
15. Fazackerley, A.: UK universities predict record student dropout rate, <https://www.theguardian.com/education/2020/sep/19/uk-universities-predict-record-student-dropout-rate>, last accessed 2021/06/22.
16. Hesa.ac.uk, Definitions: Students HESA, <https://www.hesa.ac.uk/support/definitions/students#qualifications-obtained-population>, last accessed 2021/07/28.
17. Hewitt, R.: Students' views on the impact of Coronavirus on their higher education experience in 2020/21, <https://www.hepi.ac.uk/wp-content/uploads/2020/12/HEPI-Policy-Note-27-Students-views-on-the-impact-of-Coronavirus-on-their-higher-education-experience-in-2020-21-FINAL.pdf>, last accessed 2021/07/20.
18. Jovancic, N.: Data Collection Methods for Obtaining Quantitative and Qualitative Data., <https://www.leadquizzes.com/blog/data-collection-methods/>, last accessed 2021/07/26.
19. Farrell, S.: Open-Ended vs. Closed-Ended Questions in User Research, <https://www.nngroup.com/articles/open-ended-questions/>, last accessed 2021/07/27.
20. McLeod, S.: The Interview Research Method, <https://www.simplypsychology.org/interviews.html>, last accessed 2021/07/27.
21. Bryman, A., Liao, T. and Lewis-Beck, M.: The SAGE Encyclopedia of Social Science Research Methods. Thousand Oaks: SAGE Publications, Incorporated (2004).
22. Kemp, P., Berry, M. and Wong, B.: The Roehampton Annual Computing Education Report: Data from 2017. London: University of Roehampton: University of Roehampton (2018).

23. Khan, S.: Skills for Londoners. London: Greater London Authority, [https://www.london.gov.uk/sites/default/files/sfl\\_strategy\\_final\\_june\\_20186.pdf](https://www.london.gov.uk/sites/default/files/sfl_strategy_final_june_20186.pdf), last accessed 2021/04/10.
24. Hunter, J.: National Student Survey 2021: overall satisfaction results show varied impact of Covid-19, <https://www.timeshighereducation.com/student/news/national-student-survey-2021-overall-satisfaction-results-show-varied-impact-covid-19>, last accessed 2022/01/04.
25. Clark, L. A., Pergibon, D.: Statistical Models in S, J. M. Chambers and T. J. Hastie, Eds., chapter Tree-Based Models, Chapman & Hall, New York, 377- 419 (1993).
26. Mantle, R.: Non-continuation: UK Performance Indicators 2017/18 HESA, <https://www.hesa.ac.uk/news/07-03-2019/non-continuation-tables>, last accessed 2021/06/16.
27. Marshall, P.: On course for success? Student retention at university, <https://www.smf.co.uk/wp-content/uploads/2017/07/UPP-final-report.pdf>, last accessed 2021/06/21.
28. McDonald, C.: Interview: Equality starts with education, says Salesforce.org, <https://www.computerweekly.com/news/450424453/Interview-Equality-starts-with-education-says-Salesforceorg-exec>, last accessed 2021/06/22.
29. McDonald, C.: Computing curriculum shake-up can't happen in a single five-year parliamentary term, says panel, <https://www.computerweekly.com/news/252441849/Computing-curriculum-shake-up-cant-happen-in-a-single-five-year-parliamentary-term-says-panel>, last accessed 2021/06/25.
30. nhs.uk, Overview - Cognitive behavioural therapy (CBT), <https://www.nhs.uk/mental-health/talking-therapies-medicine-treatments/talking-therapies-and-counselling/cognitive-behavioural-therapy-cbt/overview/>, last accessed 2021/04/12.
31. Peterson, C.: The Future of Optimism. American Psychologist, 55, 44-55 (2000).
32. Petrie, K. and Keohane, N.: On course for success? Student retention at university, <https://www.smf.co.uk/publications/course-success-student-retention-university>, last accessed 2021/04/08.
33. Petrie, K. and Keohane, N.: Building on success, <https://www.smf.co.uk/wp-content/uploads/2019/04/Building-on-Success.pdf>, last accessed 2021/06/15.
34. Richards, K. and Pilcher, N.: Study Skills: neoliberalism's perfect Tinkerbell. Teaching in Higher Education, 1-17 (2020).
35. Seligman, M.: Learned optimism. Penguin Random House Australia (1998).
36. Seligman, M.: Authentic Happiness. New York: Free Press (2002).
37. Shamoo, A.E., Resnik, B.R. (2003). Responsible Conduct of Research. Oxford University Press.
38. Study-UK British Council, A higher standard of education, <https://study-uk.britishcouncil.org/why-study/higher-standard-education>, last accessed 2021/06/21.
39. Times Higher Education, <https://www.timeshighereducation.com/world-university-rankings/2021/world-ranking#>, last accessed 2021/04/08.
40. Weale, S.: Maths anxiety' causing fear and despair in children as young as six, <https://www.theguardian.com/education/2019/mar/14/maths-anxiety-causing-fear-and-despair-in-children-as-young-as-six>, last accessed 2022/02/18.
41. Wonkhe, Non-continuation research, <https://wonkhe.com/wp-content/wonkhe-uploads/2020/11/Non-continuation-research-November-2020.pdf>, last accessed 2021/07/20.
42. Yang, L., Liu, S., Tsoka, S., Papageorgiou, L. G.: A regression tree approach using mathematical programming. Expert Systems with Applications, vol. 78, 347-357. Science Direct, (2017).