A mixed methods approach to understanding the relationship between computing students’ approaches to learning and academic performance for different entry pathways

By

Kim Ying Lim

A dissertation submitted to the University of Bristol in accordance with the requirements for award of the degree of Doctor of Education in the Faculty of Social Sciences and Law

School of Education

December 2019

This copy of the dissertation has been supplied on condition that anyone who consults it is understood to recognise that its copyright rests with the author and that no quotation from the dissertation, nor any information derived therefrom, may be published without the author’s prior, written consent.
ABSTRACT

The current study was developed to research the learning approaches (deep versus surface) used by two diverse entry pathways’ (diploma versus A-Level) students studying computing degree programmes, and to examine the relationship between their academic performance and approaches to learning within the context of a private education institution (PEI) in Singapore.

In this study, the epistemological and methodological position was grounded in the pragmatic paradigm of mixed methods which combines both quantitative and qualitative methods. A theoretical model based on Biggs, Kember, and Leung’s (2001) 3P (presage-process-product) model of teaching and learning was used to investigate the interrelationships among entry pathways (presage), approaches to learning (process), and academic performance (product). This study applied an embedded design, whereby the qualitative study was embedded within a larger quantitative sample. The group qualitative interview data complemented the quantitative results by providing rich insights into the quantitative results obtained. Both data sets were subsequently merged to examine the research questions (RQs). The Biggs et al.’s (2001) Revised Two Factor Study Process Questionnaire (R-SPQ-2F) was used to collect data from 415 students. Data analysis was performed through the use of descriptive and inferential statistics using Statistical Package for the Social Sciences (SPSS) version 24.

The mixed methods results of the study showed that (1) the entry pathway and gender do not have significant effects on the learning approaches adopted by
the students; (2) there was an association between age and students’ approaches to learning (SAL) in terms of the deep approach (DA) scores and deep motive (DM) scores; (3) there were significant differences in SAL in terms of the scales and subscales of R-SPQ-2F between different years of study; (4) SAL did not predict their academic performance; and (5) DA to learning is the more dominant learning approach regardless of student characteristics.

Finally, the interaction effects of entry pathway and learning approaches adopted by computing undergraduates were not significant, therefore, indicating that the effect of learning approaches on academic performance did not depend on the entry pathway. However, the findings of the study indicated a statistically significant relationship between entry pathway and academic performance, where students with A-Level entry pathway performed better compared to the students with the polytechnic entry pathway. The study recommended that further investigation could be done using a longitudinal study. Such a study should examine whether the approaches to learning of computing students change over time as they go through their tertiary education.
ACKNOWLEDGEMENTS

I would like to express my gratitude to several individuals and institutions for their help and supports rendered throughout my study.

I would first like to thank my supervisor Professor William Browne for his support and fantastic supervision. Thank you for always being there, ready to listen and provide constructive feedback for improvements. I would also like to thank Dr Jocelyn Wishart, who had led me through the first stages of my research work when I had no experience at all.

I am also very appreciative of the higher education institution I work in for providing me with the opportunity to pursue this study and access to the students and information necessary for me to complete my research.

I would also like to express my sincere gratitude towards my family, colleagues, and friends who have taken the time to assist and guide me throughout this study. Most importantly, the research would not have been completed without the great participation and collaboration of the wonderful students.

Finally, I would like to thank my parents for their support and unconditional love throughout this journey. To my children, Jonathan and Emily, thank you for your understanding and just being there for ‘mama’. Finally, my deepest thanks and appreciation go to my husband, Kwet. Without his support, his encouragement, and his understanding, this thesis would not have happened.
DECLARATION

I declare that the work in this dissertation was carried out in accordance with the requirements of the University's Regulations and Code of Practice for Research Degree Programmes and that it has not been submitted for any other academic award. Except where indicated by specific reference in the text, the work is the candidate's own work. Work done in collaboration with, or with the assistance of, others, is indicated as such. Any views expressed in the dissertation are those of the author.

SIGNED: ___________________________ DATE: 05 December 2019
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>ABSTRACT</th>
<th>...............................................................</th>
<th>i</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>...............................................................................</td>
<td>iii</td>
</tr>
<tr>
<td>DECLARATION</td>
<td>...............................................................................</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>...............................................................................</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>...............................................................................</td>
<td>vii</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>...............................................................................</td>
<td>xi</td>
</tr>
<tr>
<td><strong>CHAPTER 1 INTRODUCTION</strong></td>
<td>...............................................................................</td>
<td>1</td>
</tr>
<tr>
<td>1.1 Background to the study</td>
<td>...............................................................................</td>
<td>1</td>
</tr>
<tr>
<td>1.2 Education system in Singapore</td>
<td>...............................................................................</td>
<td>4</td>
</tr>
<tr>
<td>1.3 Trends in computing education in Singapore</td>
<td>...............................................................................</td>
<td>11</td>
</tr>
<tr>
<td>1.4 Transition and retention</td>
<td>...............................................................................</td>
<td>12</td>
</tr>
<tr>
<td>1.5 Purpose and research questions</td>
<td>...............................................................................</td>
<td>14</td>
</tr>
<tr>
<td>1.6 Structure of the thesis</td>
<td>...............................................................................</td>
<td>16</td>
</tr>
<tr>
<td><strong>CHAPTER 2 REVIEW OF RELATED LITERATURE</strong></td>
<td>...............................................................................</td>
<td>17</td>
</tr>
<tr>
<td>2.1 Introduction</td>
<td>...............................................................................</td>
<td>17</td>
</tr>
<tr>
<td>2.2 Literature search strategy</td>
<td>...............................................................................</td>
<td>17</td>
</tr>
<tr>
<td>2.3 Students’ approaches to learning (SAL)</td>
<td>...............................................................................</td>
<td>18</td>
</tr>
<tr>
<td>2.3.1 The surface approach (SA) to learning</td>
<td>...............................................................................</td>
<td>25</td>
</tr>
<tr>
<td>2.3.2 The deep approach (DA) to learning</td>
<td>...............................................................................</td>
<td>27</td>
</tr>
<tr>
<td>2.3.3 The strategic approach to learning</td>
<td>...............................................................................</td>
<td>29</td>
</tr>
<tr>
<td>2.3.4 Students’ approaches to learning and academic performance</td>
<td>...............................................................................</td>
<td>31</td>
</tr>
<tr>
<td>2.3.5 Learning approaches among computing students</td>
<td>...............................................................................</td>
<td>39</td>
</tr>
<tr>
<td>2.4 Factors influence students’ approaches to learning</td>
<td>...............................................................................</td>
<td>41</td>
</tr>
<tr>
<td>2.4.1 Entry pathways and approaches to learning of students</td>
<td>...............................................................................</td>
<td>45</td>
</tr>
<tr>
<td>2.5 Theoretical framework</td>
<td>...............................................................................</td>
<td>47</td>
</tr>
<tr>
<td>2.5.1 The presage factors</td>
<td>...............................................................................</td>
<td>49</td>
</tr>
<tr>
<td>2.5.2 The process factors</td>
<td>...............................................................................</td>
<td>49</td>
</tr>
<tr>
<td>2.5.3 The product factors</td>
<td>...............................................................................</td>
<td>51</td>
</tr>
<tr>
<td>2.6 Summary</td>
<td>...............................................................................</td>
<td>52</td>
</tr>
<tr>
<td><strong>CHAPTER 3 RESEARCH METHODOLOGY</strong></td>
<td>...............................................................................</td>
<td>53</td>
</tr>
<tr>
<td>3.1 Introduction</td>
<td>...............................................................................</td>
<td>53</td>
</tr>
<tr>
<td>3.2 Theoretical perspective</td>
<td>...............................................................................</td>
<td>54</td>
</tr>
</tbody>
</table>
3.2.1 The positivism paradigm (and the quantitative approach) ... 54
3.2.2 The interpretivism or constructivism paradigm (and the qualitative approach) ........................................ 55
3.2.3 The pragmatism paradigm (and the mixed methods approach) ................................................................. 57
3.3 Participants .................................................................................................................................................. 62
3.4 Instrumentation ....................................................................................................................................... 65
  3.4.1 Measuring approach to learning using the R-SPQ-2F questionnaire ..................................................... 68
  3.4.2 Why the R-SPQ-2F? ............................................................................................................................... 72
  3.4.3 Validity and reliability of the R-SPQ-2F ............................................................................................... 73
3.5 Pilot study .................................................................................................................................................. 75
  3.5.1 Pilot for the quantitative study ............................................................................................................ 75
  3.5.2 Pilot for the qualitative study ............................................................................................................. 76
3.6 Quantitative approach ............................................................................................................................. 76
  3.6.1 Main quantitative study ....................................................................................................................... 77
3.7 Qualitative approach ................................................................................................................................ 85
  3.7.1 Main qualitative study ........................................................................................................................ 85
3.8 Ethical considerations ................................................................................................................................ 89
3.9 Conclusion ................................................................................................................................................ 91

CHAPTER 4 RESULTS .................................................................................................................................. 93
4.1 Introduction ................................................................................................................................................ 93
4.2 Validity and reliability of the R-SPQ-2F instrument ................................................................................... 93
4.3 Quantitative analysis ................................................................................................................................ 100
  4.3.1 Participant response rate ...................................................................................................................... 100
  4.3.2 Demographic overview ....................................................................................................................... 102
  4.3.3 Survey data of R-SPQ-2F ................................................................................................................ 104
  4.3.4 Student approaches to learning scores ............................................................................................. 108
  4.3.5 Entry pathway and student approaches to learning .......................................................................... 114
  4.3.6 Gender and student approaches to learning .................................................................................... 115
  4.3.7 Age and student approaches to learning ........................................................................................... 115
  4.3.8 The year of study and student approaches to learning ..................................................................... 117
  4.3.9 Academic performance, entry pathway and student approaches to learning ................................ 119
4.4 Qualitative analysis ................................................................................................................................... 126
  4.4.1 Theme 1: Presage factors ................................................................................................................... 129
  4.4.2 Theme 2 and 3: Process and product factors .................................................................................... 147
4.5 Conclusions .................................................................................. 153

CHAPTER 5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS
........................................................................................................ 159

5.1 Introduction .................................................................................. 159
5.2 Summary of research ...................................................................... 160
5.3 Summary of results ......................................................................... 160
   5.3.1 The R-SPQ-2F ...................................................................... 160
   5.3.2 Research question no. 1 ......................................................... 162
   5.3.3 Research question no. 2 ......................................................... 169
   5.3.4 Research question no. 3 ......................................................... 172
5.4 Limitations of the study ................................................................. 177
5.5 Implications of the study ............................................................... 179
5.6 Recommendations for future studies ........................................... 181
5.7 Conclusions .................................................................................. 183

REFERENCES ....................................................................................... 186

APPENDIX A: Revised Two Factor Study Process Questionnaire (R-SPQ-2F) ................................................................. 234
APPENDIX B: Draft focus group interview’s questions ...................... 237
APPENDIX C: Ethical approval from study institution ......................... 238
APPENDIX D: Ethical approval from the University’s Ethics Committee
............................................................................................................. 240
APPENDIX E: Briefing slides ............................................................... 241
APPENDIX F: Informed Consent Form ............................................... 242
APPENDIX G: Summary of Lecturer Effectiveness Rating for First-Year Courses ........................................................................ 243
APPENDIX H: Summary of Publications ............................................ 244
# LIST OF TABLES

Table 1-1: Number of dropouts by cohort .............................................................. 14
Table 2-1: Summary of studies on the relationship between university students’ academic performance and their learning approaches ........................................................................ 36
Table 3-1: Summary of four major types of mixed methods designs .... 60
Table 3-2: Meaning of the subscales in the R-SPQ-2F instrument ........ 68
Table 3-3: Summaries of research studies using the R-SPQ-2F ........ 73
Table 3-4: Comparison of Cronbach alpha values obtained from different studies ................................................................................................................................. 74
Table 4-1: KMO and Bartlett’s Test of Sphericity ............................................ 94
Table 4-2: p-value in Bartlett’s Test ................................................................. 94
Table 4-3: Principal component extraction ..................................................... 95
Table 4-4: Parallel analysis .................................................................................. 96
Table 4-5: Factor loading .................................................................................... 98
Table 4-6: Cronbach’s alpha values reported by studies using R-SPQ-2F ................................................................................................................................. 99
Table 4-7: Cronbach’s alpha values comparison .......................................... 100
Table 4-8: Distribution of valid cases from different years of study .... 102
Table 4-9: Participants demographic overview ............................................ 103
Table 4-10: Participants demographic data split by the entry pathway .... 104
Table 4-11: Descriptive statistics of the 20 items of R-SPQ-2F .............. 105
Table 4-12: Skewness and kurtosis test ........................................................... 107
Table 4-13: SAL scales’ scores segregated by demographic components ................................................................................................................................. 109
Table 4-14: SAL subscales’ scores segregated by demographic components ................................................................................................................................. 111
Table 4-15: t-test results for the relationship between entry pathway and SAL ................................................................................................................................. 115
Table 4-16: t-test results for the relationship between gender and SAL 115
Table 4-17: One-way ANOVA results for age comparison of scales and subscales’ scores ................................................................................................................................. 117
Table 4-18: Results of pairwise comparisons using Tukey’s HSD .... 117
Table 4-19: One-way ANOVA results for the year of study comparison of scales and subscales’ scores ........................................119
Table 4-20: Results of pairwise comparisons using Tukey’s HSD ....... 119
Table 4-21: Tests of between-subjects effects .................................. 123
Table 4-22: Test of between-subjects effects .................................... 123
Table 4-23: Parameter estimates .................................................... 123
Table 4-24: Test of between-subjects effects .................................... 125
Table 4-25: Test of between-subjects effects .................................... 126
Table 4-26: Parameter estimates .................................................... 126
Table 4-27: Participants information .............................................. 127
Table 4-28: Sample of identified themes, subthemes, codes and verbatim quotation used in qualitative analysis ................. 128
LIST OF FIGURES

Figure 1-1: The Singapore Education Journey by Ministry of Education ............................................. 5
Figure 2-1: The 3P model of teaching and learning .......................................................... 48
Figure 4-1: Scree plot .................................................................................................................. 96
Figure 4-2: Histograms representing all the variables of the R-SPQ-2F
.................................................................................................................................................. 106
Figure 4-3: The trend of DA and SA in undergraduate computing students
.................................................................................................................................................. 111
Figure 4-4: Scatter graph illustrates DA and SA scores for each participant
and designated by the year of study ................................................................................ 113
LIST OF ABBREVIATIONS

3P  Presage-Process-Product
A-Level  Singapore-Cambridge General Certification in Education  Advanced-Level
DA  Deep Approach
DM  Deep Motive
DS  Deep Strategy
JC  Junior College
R-SPQ-2F  Revised Two Factor Study Process Questionnaire
SA  Surface Approach
SAL  Students’ Approaches to Learning
SM  Surface Motive
SS  Surface Strategy
CHAPTER 1 INTRODUCTION

1.1 Background to the study

The waves of globalisation coupled with rapid changes in Southeast Asia’s economic landscape, mean that the island nation of Singapore is facing some of the challenges over the past five decades of independence which is caused by stiff competition at the global, regional and national levels. While a country is as small as Singapore with scarce skills, resources, and goods and services, thus, this small nation does not have much to rely upon for survival other than the services and skills of its people (Bhaskaran, 2018).

The recent census conducted in 2018 showed that the overall population of Singapore stands at 5.6 million, with 4.0 million being natives and permanent residents (DOS Singapore, 2019). With such a small populace contrasted to contending economies within Southeast Asia countries, it was evident that the development of human capital through training and education is essential within the country. Indeed, Singapore might have been the first developed economy to estimate the direct relationship between production and education (Bowles & Gintis, 1976). This association of production with education has defined the landscape of education for the past 54 years, affecting even the intakes for different programmes provided within post-secondary institutions and universities based on the skills needed for economic growth. It was on this premise that the state coordinated labour and capital inputs to make sure that the entire economy moved towards the attainment of political goals (Ashton & Sung, 1999).
A critical contributor to the economic success of Singapore has been aligning information and communication technologies (ICT) deployment to the society and economy needs, and coordinated attempts arising from national ICT plans. Singapore witnessed the potential of ICT as the primary empowering agent in facilitating its financial development as early as the late 1970s (Lee & Koh, 2008). From the 1980s, Singapore has developed and operationalised national ICT master plans, which have culminated in business and populace literacy, enhanced ICT awareness, and ICT workforce development (Lee & Koh, 2008).

Thus, the increasing adoption of ICT in almost every industry sector has allowed the ICT industry to grow and be vibrant. In Singapore, this goes hand in hand with infocomm infrastructure establishment that was envisioned in the report ‘Intelligent Nation 2015 of Singapore’ (PMO Singapore, 2014). According to the Singapore Infocomm Media Development Authority’s (IMDA) published facts and figures, there were about 210,100 infocomm media professionals who were employed in the year 2017. Apart from the 14,700 job vacancies relating to infocomm media, the infocomm media professional demand in 2017 was 224,800. This number is projected to increase by about 35,800 between 2018 and 2020 (IMDA Singapore, 2018). Demand for such jobs has increased even faster, however, there are only a few information technology (IT) experts to satisfy rapidly increasing demands.

Singaporean autonomous universities have resorted to offering more computing places in a bid to overcome the increasing ICT workforce demand (Teng, 2018; Wong, 2018). When not studying for this Doctorate in Education (EdD), the researcher works at a private education institution¹ (PEI), and here

¹ PEI provide transnational education leading to various external degrees from foreign universities.
there is also a surge in interest in computing-related courses, with the cohort sizes growing significantly in recent years. According to Irons and Alexander (2004), students who are interested in studying computing may be intrinsically motivated but

“... it is often the case that students choose computing as a 'meal ticket' to well-paid jobs rather than from personal interest or motivation, and without sound understanding of what the course entails” (p. 8)

since a primary contributor to the Singaporean economy is ICT. As such, universities should play a proactive role in recruiting and retaining those who pursue ICT as a major. One of the essential predictors for university dropout is said to be 'academic performance' (Araque, Roldán & Salguero, 2009; Jia & Maloney, 2015; Paura & Arhipova, 2014).

Several studies have been carried out on the academic success of the students joining universities such Hall and Marchant (2000), McKenzie, Gow, and Schweitzer (2004), and Zeegers (2004). A study conducted on the first-year undergraduates’ academic achievement in a South African university has revealed that one in every three of the students drops out of the higher education learning institution within their first year of study (Wadesango, Mabovula, Makura, & Toni, 2017). Besides, the studies conducted in the U.S. of students taking computer science shows that the many dropouts take place during the first and second year of their university education (Giannakos, Pappas, Jaccheri, & Sampson, 2017). It has been found that about 40% of students in a computer science course typically drop the course and quit with no degree. This figure, however, varies between 30% to 60% based on the institution (Ohland et al. 2008).
From a pragmatist view, students gifted with hands-on problem-solving capabilities requires a practical teaching approach from which experiments and projects are used in solving and understanding concepts. From this aspect, pragmatists argue that it is, therefore, not important to pass down segmented organised chunks of knowledge to new students but rather students should apply their already pre-existed knowledge in solving the real-world problems in their daily lives, careers and citizenship (Plowright, 2011). There are other factors as well that have influenced the students’ success at the universities besides effective teaching.

One of the factors that has been studied in influencing the students’ success at the universities is the students’ ability to adopt desirable learning approaches (Duff & McKinstry, 2007; Malie & Akir, 2012). There has been lots of criticism from researchers concerning approaches that students should adopt in learning to improve their performance in academic study (Biggs, 1987). Most of the studies have indicated that students commonly apply different learning approaches and strategies which have fundamentally impacted on their academic achievement. For that reason, the ability of students to appropriately use ‘learning approaches’ influences their academic performance (Biggs, 1987; Diseth, 2003; Hasnor, Ahmad & Nordin, 2013; Malie & Akir, 2012).

1.2 Education system in Singapore

The Ministry of Education (MOE) in Singapore seeks to help students identify their talents, to utilise such talents effectively and achieve their maximum potential, and to nurture passionate learning that lasts throughout life. Among
the main strengths of the education system in Singapore are the bilingual policy, stress on ICT integration, high educator quality, and holistic broad-based education to complement learning (MOE Singapore, 2018a). Figure 1-1 below shows the five stages within the education system of Singapore.

![The Singapore Education Journey by Ministry of Education](https://www.moe.gov.sg/education/landscape/)

**Figure 1-1: The Singapore Education Journey by Ministry of Education**

(Source: Retrieved April 23, 2019, from https://www.moe.gov.sg/education/landscape/)

Pre-school education (four to six years old) constitutes the initial stage, which offers children opportunities for developing learning dispositions, learning social skills, and building self-confidence. Primary education (seven to twelve years old) constitutes the second phase, which helps to set a strong foundation among students, with the mother tongue, mathematics, and English language accounting for a substantial portion of the curriculum. Singapore uses an English-oriented bilingual education system. Students are taught subject-matter curricula with English as the instruction media, while the official mother tongue of every student - Tamil for ethnically Tamil Indians, Malay for Malays, and Mandarin Chinese for Chinese - is taught as a second language. All the primary school students will have to sit for a nation-wide assessment, namely the Primary School Leaving Examination (PSLE).
Secondary education constitutes the third stage. Students might decide to continue in schools, which provide a seamless six-year Integrated Programme (IP) leading up to the General Certificate in Education (GCE) Advanced-Level (A-Level) examination or the International Baccalaureate (IB) diploma qualification without having to sit for the GCE Ordinary-Level (O-Level) examination (MOE Singapore, 2018c). The programme integrates both secondary and Junior College (JC) education, which cater to intellectually and academically keen students to benefit from a broader learning experience in the academic and non-academic curriculum.

Besides the IP, students entering secondary one are streamed into the four years (i.e. Express) or five years (i.e. Normal Academic) of secondary school or choose ‘Normal Technical’ (NT) training on particular skills based on their PSLE results. The ‘Normal Academic’ stream students culminate with the GCE N(A)-Level (Normal (Academic) Level) examinations, while the ‘Express’ pathway students would sit for the GCE O-Level examinations. The diverse curricula are intended to match their interests and learning abilities and to help in building the students’ strengths. The GCE O-Level and A-Level examinations are Singapore’s qualifications that were decoupled from the U.K. equivalent examinations since 2002 and 2006 respectively (SEAB, 2018a, 2018b).

Singapore’s education structure offers many educational pathways for students. The fourth phase in post-secondary education is a good example. Three pathways exist within the fourth phase, namely polytechnics, Institutes of Technical Education (ITEs), and JCs. A pre-university programme resulting in the Singapore-Cambridge GCE A-Level examination prepares students within the initial JC pathway for further education by equipping them with
relevant knowledge and skills needed for tertiary education. The ITE education within the second pathway seeks to equip learners with technical knowledge and skills for meeting the needs of employees of different sectors of the industry (MOE Singapore, 2018c).

Polytechnic education constitutes the third pathway. The ages of students in polytechnics range between 17 and 21 years, and they mainly take three years to complete polytechnic education. The primary role of polytechnic education involves providing quality practice-driven training and generating a suitably trained workforce to complement changes with industrial development in Singapore. The polytechnics play a pivotal role in training the middle-level experts and technologists required for the new and developing industries. After this phase, students have the option of going to either a Singapore publicly-funded autonomous university or privately-funded university or even secure employment (MOE Singapore, 2018b).

University education constitutes the fifth stage of the education system in Singapore and is characterised by programmes for equipping students to attain their maximum potential and contribution towards society. There are currently six local universities in Singapore, and these Singaporean universities mainly recruit students from polytechnics and JCs. An estimated 34% of polytechnic diploma holders will be admitted into one of six universities for a degree, with approximately 70% of GCE A-Level holders going to university (Teng, 2016a).

The Council of Private Education (CPE) is a statutory organisation established in 2009 and mandated to regulate education in the private sectors. It indicated that in Singapore, about 1,000 private institutions were providing a wide array of higher education programmes. The programmes were offered to both local
and international students. In Singapore, by 2008, the enrolled students in private institutions were over 150,000. Out of this number, the international students were 45,000. The private schools are commonly involved in offering certificate, diploma, and graduate diploma levels. In Singapore, some private institutions additionally offer degrees, through partnering with other external international recognised institutions in Australia, U.S., and U.K. Foreign universities mainly confers the degrees and student certification, thereby enhancing acquisition of the sought-after education by the students who will be in Singapore’s affordable living environment (CPE Singapore, 2010). The overseas education systems have played an essential role in complementing the national education system in Singapore. It has added the value of international standards level of education appropriately in the academics’ landscape in Singapore. It is worth noting that in Singapore, working individuals are encouraged to attend upgrade courses in their various fields to remain relevant and updated in their employing organisations.

The education choices, as mentioned above, only denote the significant pathways that many Singaporean students will undertake. There are several other options, which could cater for people based on their distinctive educational needs and talents, for instance, students who are talented in arts or sports can opt to join the School of Arts (SOTA) or Singapore Sports School (MOE Singapore, 2018a).

Due to the education system in Singapore that subscribes to the principle of meritocracy (Mukhopadhaya, 2003), thus, students are stream based on academic results and extra-curricular achievements for every selected pathway. The competition begins at PSLE for options such as IP and JC pathways, which are considered more prestigious (Koh, 2014). An almost
perfect score within the examination is needed to join one of the best secondary schools or IP schools across the country. It is commonly thought that the academic careers of students are secured and their probability of transiting into one of the autonomous universities increases when students enrol into top secondary schools or IP schools. There are other alternatives for some students that may not have done as well as expected at the PSLE (Koh, 2014).

Some students who have achieved excellent results for the GCE O-Level examination are granted another chance to enrol in JC, or else, the O-Level graduates would be compelled to choose a polytechnic education. Even though polytechnic enrols about 45% of the secondary school leavers (Varaprasad, 2016), it is observed that the polytechnic path is usually considered the ‘second choice’. However, GCE O-Level graduates who apply specifically to polytechnic education because of interest in specific programmes only make up a small percentage of the cohort at the polytechnic (Ong & Cheung, 2016).

The demand for local higher education in Singapore is unprecedented and grows exponentially. According to the Hong Kong and Shanghai Banking Corporation (HSBC) review, an estimated 91% of parents in Singapore value higher education for their children. They view higher education as a way of enabling their children to achieve their lifetime goals. With this in mind, about 98% of Singaporean parents plan a regular financial contribution as a plan for university fees expecting their children to go to university (HSBC, 2015).

Thus, education is considered an essential key towards socio-economic mobility within Singapore and therefore, students, parents, and schools have much commitment towards pursuing it. The pressure of excelling in standard
national examinations, especially the PSLE, GCE O-Levels and A-Levels or IB has caused students to prioritise their education.

Parents in Singapore know that with education, a child is given access to the open world of opportunities. Regarding this, parents spend approximately $100,000 yearly on education. The amount paid by parents for their children’s education in Singapore is almost twice the global average amount (TODAYonline, 2017). The private education sector has also been growing exponentially, with the total expenditure on private tuition reaching $1.1 billion in 2016, which is almost twice the amount consumed in 2004 (Teng, 2016b). Such tuition programmes are often designed to help and sharpen students’ skills and constitute the most effective means of acquiring appropriate knowledge and skills to excel in examinations (Hio, 2014; Wai, 2018).

To help in the preparation of students for their main examinations, many teachers with vast experience at the primary and secondary schools have become professionals at drilling students to identify correct answers, spoon-feeding students using model answers and notes, and spotting right questions for respective examinations (Varma, 2016).

Therefore, it is unsurprising that after one decade in a very competitive education setting, most Singaporean students could be considered to have been transformed into ‘syllabus-boundness’ learners, that is they are not studying beyond the requirements of the syllabus (Smith, 2001), and ‘exam-smart’ at the time of leaving secondary or JC schooling (Davie, 2013).
1.3 Trends in computing education in Singapore

Computing presents a challenge to students and educates them to face problems in new and rigorous ways. If taught appropriately, computing programmes instil logical reasoning, critical thinking, and creativity. The subject’s core concepts are widely transferable, providing the students with the capacity of applying methods to several problems, enabling them to strive for multi-disciplinary pursuits, as well as enabling them to acquire information about their environment. Importantly, computing offers problem-solving and computational skills, which the workforce desperately needs. Computing helps students to be adaptable and competitive within the labour market, not just for jobs within computing, but for many occupations, which increasingly require domain expertise, soft skills, and in-depth technical skills (Looi, 2019).

Computing graduates in Singapore are in high demand nowadays - and this is helping to not only influence wages but also has led to an expansion of computing programmes in universities in Singapore. For instance, to match the rising demand for skilled graduates in computing, Nanyang Technological University (NTU) has set up mechanisms for increasing its enrolment for ten computing-related degree programmes to 675 places within the 2019 academic year. This translates to a 50% increase as compared to 2015, the year NTU’s intake for such programmes began rising steadily (Louis, 2019). Similarly, the Singapore Management University (SMU) had over 250 students graduate from its Information Systems School annually, between 2016 and 2018. According to SMU, the figure was expected to rise, and the intended intake in 2019 is 450 places. Regarding the National University of Singapore (NUS), its Computing School intake has nearly doubled from around 500 places in 2015 to 1000 places in 2018 (Ang, 2019). Additionally, the U.K., the U.S., and other
global universities are also experiencing an upsurge in computing-based programmes, with the size of cohorts increasing substantially in the past few years (McKenna, 2018).

1.4 Transition and retention

Integrating and transitioning post-secondary students into institutions of higher learning with diverse learning experiences presents several issues and challenges. Evidence exists from different studies that one crucial reason students are not progressing or performing academically during their initial year in higher education constitutes the “failure to adopt appropriate study skills” (Tait & Entwistle, 1996, p. 97-98). Therefore, this impacts on the academic performance of students (Bamber & Tett, 2001; McInnis, 2001; Zeegers & Martin, 2001).

This would show that the assessment and teaching regime that students experienced within their previous school has a likelihood of influencing the nature and processes involved in how students learn within the initial year of higher education. Ramsden (2003, p. 66) observed that “the approaches to examining students deployed at university are mainly influenced by their learning experiences at high schools”.

Given that there are two different graduate groups in Singapore namely the polytechnic graduates with diplomas and JC school-leavers who have A-Levels (as mentioned in Section 1.2) that form computing undergraduate entrants in this study, thus, addressing the preparedness for higher education in the student group is critical. But even more so focusing on the preparation of higher
education institutions to meet the needs of such students is paramount. In most cases, the entrant groups have undergone the ten years Singaporean school system (i.e. six years of primary education and four years of secondary education). However, A-Level and polytechnic graduates are believed to be different because of several entry requirements that should be obtained by students to be admitted for a higher academic programme as well as the schools attended.

The significance of students’ prior experience in determining their learning conceptions as well as their approach towards learning is emphasised by Prosser and Trigwell (1999). The authors identified the significance of the need for educators in university to assist students in understanding the effect of such prior experiences and helping them develop a more appropriate approach. Krank (2001) observed how several studies had presented evidence for the correlation between academic success and learning styles, but the typical academic setting does not support different styles of learning and asserted that any educational system, which does not consider the demands of different styles of learning via varied learning settings or varying teaching methodologies, at least, risks throwing away valuable human resource (Krank, 2001).

Therefore, the distinctive difference between the two groups of university entrants could make them adopt different learning approaches when they join higher education because of previous learning experience differences, which correlate with the entry pathways. Because of this, the formation of student approaches to learning would be affected when enrolling at the university (Hayes, King, & Richardson, 1997; Ramsden, 2003). Crawford, Gordon, Nicholas, and Prosser (1998), Duff and McKinstry (2007), and Ramsden (2003)
confirmed this, thus showing that prior experiences significantly impact the learning approaches of students. These studies looked at undergraduate students' approaches to studying accounting and mathematics courses.

It is, therefore, very important to carry out an extensive study on student approaches to learning due to their contribution to students' academic performance (Biggs & Tang, 2011). This is also essential as the private education institution (PEI) in this study (the researcher’s place of work) has experienced a high number of computing student dropouts after their first academic year (see Table 1-1).

<table>
<thead>
<tr>
<th>Table 1-1: Number of dropouts by cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cohort</strong></td>
</tr>
<tr>
<td>2014</td>
</tr>
<tr>
<td>2015</td>
</tr>
<tr>
<td>2016</td>
</tr>
</tbody>
</table>
(Source: Records from researcher)

This study's research problem was, therefore, to assess undergraduate computing students’ learning approaches for those who achieved admission to the university with very different entrance qualification ranges and types. As such, prior learning experiences imply that students may adopt varying learning approaches affecting their academic performance as higher education students.

1.5 Purpose and research questions

Students’ approaches to learning (SAL) are critical in not only signifying the intention of the learner but also how the student processes information (Baeten, Kyndt, Struyven, & Dochy, 2010; Biggs, Kember, & Leung, 2001). In essence, the type of approach that students employ is crucial because it has a significant
effect on the quality of learning as well as the overall academic performance of the learners (Duff, Boyle, Dunleavy, & Ferguson, 2004). Consequently, different learners utilise various approaches in their interpretation and analysis of information or processing of information to make it meaningful.

In this regard, approaches to learning do involve not only strategies but also motives. Biggs et al. (2001) argued that students who utilise a deep approach (DA) to learning have a better understanding of processed information than those who do not. Besides, they are intrinsically motivated as well as being capable of deploying strategies that allow them to process meaning from the material to be learned. On the other hand, students who employ a surface approach (SA) understand knowledge as knowledge reproduction in addition to being extrinsically motivated and use strategies that allow them to reproduce the material learned (Biggs et al., 2001).

Thus, this study was designed to investigate the different learning approaches, that is a deep learning approach versus a surface learning approach, possessed by diploma and A-Level entry pathways undertaking a computing degree programme. It was also designed to examine how students’ approaches to learning (SAL) are related to academic achievement in the Singapore private education institution (PEI) context.

The following research questions (RQs) are a guide to addressing the issues in the research statement and will be elaborated on in chapter three:

RQ1: What approaches to learning (deep versus surface) do computing undergraduates possess within the context of a Singapore transnational higher education institution?
RQ2: Are there any effects of different entry pathways (diploma versus A-Level) on students’ approaches to learning?

RQ3: Are there any relationships between students’ approaches to learning and academic achievement?

1.6 Structure of the thesis

This thesis contains five chapters, including this introduction in chapter one. This chapter has provided the framework for the context of the study. Chapter two will present the literature review associated with the research area of students’ approaches to learning (SAL). This review seeks to offer to understand the instruments and theoretical models available for examining learning approaches, as well as possible factors, which might determine such approaches. A theoretical framework would then be outlined to supports the current study using the review.

Chapter three presents the considerations and rationale for the selected methodology used in this study. The process of data analysis, design, instrument, and selection of samples will also be explored. The analysis and results of the study will be presented in chapter four. A discussion of the data and collation of data for purposes of answering the RQs presented in the study will be presented in chapter five. Finally, chapter five will recap the study, the key findings, as well as their limitations, will be outlined and discussed and end by drawing the final conclusions.
CHAPTER 2 REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter explores the findings of various literature investigating students’ approaches to learning (SAL) within institutions of higher learning or higher education. It will focus on the importance of SAL as well as its influence on student’s academic achievements. In addition, a review of computing SAL in higher education will also be examined. Besides examining the factors affecting SAL, this study will also explore the relationship between SAL and entry pathways as indicated by research findings. In this study, Biggs’s (1987) 3P theoretical framework will be relied upon, which refers to the presage-process-product model guiding teaching and learning processes (to be discussed in Section 2.5). A discussion on factors related to presage, process, and product will then follow. In addition to the research questions (RQs), the review of this literature is critical because it will help in the conceptualisation of the study, and how the study will be conducted. At the end of this chapter, a summary of the literature review will be given to conclude the major arguments of the chapter.

2.2 Literature search strategy

SAL have been the focus of several studies since the 1970s. These include those conducted by Biggs (1987), Entwistle and Ramsden (1983), and Marton and Säljö (1976a, 1976b, 1984). The relevant materials for this study from 1970 onwards were searched online by utilising the Web of Science, PsycInfo, ERIC, and ACM Digital Library databases. An extensive list of related keywords was used to search relevant literature on the topic.
This in-depth search enabled the study to retrieve 282 articles. However, through screening of titles and abstracts, 131 articles were found to be irrelevant for various reasons: some of the articles duplicated other articles, others were not published in the English language while others were not related to SAL, and thus were excluded. When the remaining 151 full texts articles were scanned, 19 articles were further excluded, and the remaining articles were downloaded to be used in the review. Besides, 13 more articles were found to be relevant based on a search of the reference lists of the 132 articles, and all 145 articles were used as references.

2.3 Students’ approaches to learning (SAL)

Learning proceeds by way of building new knowledge from the existing knowledge obtained through past experiences, training and acquisition of skills. As such, learning is an active process that allows learners to integrate new and existing knowledge (Cegielski, Hazen, & Rainer, 2011; Duff et al., 2004). The learning process is dependent on the characteristics of the student, teaching procedures and methods as well as the learning environment, workload, and assessment tasks (Biggs, 1989; Struyven, Dochy, & Janssens, 2005; Struyven, Dochy, Janssens, & Gielen, 2006). Moreover, other factors such as students’ approaches and attitudes to learning are also critical in influencing the learning process and learning outcomes (Biggs et al., 2001; Gijbels, Van de Watering, Dochy, & Van den Bossche, 2005). Connected to this, the phrase ‘approaches to learning’ is used to refer to the process in which students engage with the learning materials through utilising the most appropriate learning methodologies to achieve the desired learning outcomes in various academic
pursuits (Baeten et al., 2010; Bati, Gelderblom, & van Biljon, 2014; Biggs, 1987; Diseth & Martinsen, 2003).

SAL are dynamic due to the effects of changing prior experiences, perceptions of the learning tasks, learning environment, and expectations of learning outcomes (Byrne, Flood, & Willis, 2009; Ramsden, 2003; Struyven et al., 2006). This is a view supported by Marton and Säljö (1976a, 1976b) through their assertion that the learners’ different levels of academic performance, even after exposure to the same learning processes, can be effectively explicated by SAL. For this reason, SAL has attracted a significant amount of literature since 1970 (Biggs, 1993; Entwistle, 1981; Marton & Säljö, 1976a; Ramsden, 1987; Zeegers, 2001).

Marton and Säljö (1976a, 1976b) were the pioneers of the concept of SAL through their establishment of ‘deep approaches to learning’ and ‘surface approaches to learning’. In addition, Ramsden (1979) also developed a third approach of SAL called the ‘strategic approaches to learning’. In postulating the concept of SAL, Marton and Säljö (1976a) conducted a qualitative study applying a framework called the levels of processing theory which was developed by Craik and Lockhart (1972), and targeted investigating the quality of learning outcomes rather than the students’ quantity of knowledge based on their experiences and perspectives (Marton & Säljö, 1976a). In these studies, the students were given tasks such as reading of academic articles before asking them questions to assess ‘what’ they have learned from the reading tasks as well as ‘how’ the students tackled the tasks. From the findings of these studies, it was clear that students employed both the deep and surface level processing of information as key pillars of their learning processes as well as approaches to accomplishing the tasks before them. The deep level was
aimed at developing a critical understanding of the learning material’s structural complexity through finding the inter-relationship among the various concepts while the surface level was focused on memorising the learned information for later reproduction (Felder & Brent, 2005; Gijbels et al., 2005; Zeegers, 2001). Consequently, Marton and Säljö (1976a) surmised that

“there are qualitative differences in what is learned and that there are functional differences in the process of learning which give rise to the qualitative differences in outcome.” (p. 10)

The studies conducted by Eley (1992), Laurillard (1997), and Ramsden (2003) confirmed the findings of a study conducted by Marton and Säljö (1976b), which argued that the same student can apply a wide range of learning approaches to accomplish different learning tasks premised on the student’s ‘expectations’ on the demands of the task. This is a viewpoint supported by Ramsden (2003) in his argument that learning includes “general tendencies to adopt particular approaches related to the different demands of courses ...” (p. 51). Therefore, these interpretations of SAL are critical to this study as they contribute significantly to the view that SAL are dynamic and vary from one course context to the next as well as the demands, the contexts of the learning tasks and the attitude and learning goals of the student involved in the learning process (Biggs, 1987; Tait, Entwistle, & McCune, 1998). Later, Marton and Säljö (2005) further developed the concept of SAL as deep and surface approaches to learning (Marton & Säljö, 2005).

In order to assess SAL, Entwistle and Ramsden (1983) developed an inventory or a questionnaire titled the ‘Approaches to Studying Inventory’ (ASI) (Entwistle & McCune, 2004; Leung, Ginns, & Kember, 2008), which yielded four types of
learning approaches namely the deep, surface, strategic, and non-academic approaches. Entwistle and Ramsden’s (1983) deep and surface learning approaches are similar to those suggested by Biggs (1987) and Marton and Säljö (1976a, 1976b) in that a deep learning approach is defined as the process involving reading for understanding through active processing of information as well as making connections among the various learning materials and realigning the information learned with the existing knowledge. On the other hand, the surface learning approach includes leveraging on memorisation or rote learning to process information (Entwistle & Ramsden, 1983). According to Entwistle and Ramsden (1983), a student who employs a strategic learning approach seeks to score the highest possible grades through meticulous and conscientious studying as well as awareness of the demands of the learning tasks. Contrastingly, the non-academic learning approach is characterised by lack of interest, negative attitudes to learning as well as disorganised study methods (Entwistle & Tait, 1990).

A study by Biggs (1987), which was predicated on the SAL framework suggested by Marton and Säljö (1976a, 1976b) and on approaches premised on SAL theory by Entwistle and Ramsden (1983) developed three approaches to learning obtained from a designed questionnaire measuring the SAL. Biggs’s (1987) study developed the Study Process Questionnaire (SPQ) and the Learning Process Questionnaire (LPQ) that can be used to assess how students in both high school and higher institutions of learning accomplish their learning tasks (Kember & Leung, 1998). According to Biggs (1987), SPQ is important in examining the core components of SAL, including ‘motives’ and corresponding learning ‘strategies’. Through analysing these components, Biggs (1987) proposes three types of motives, namely the deep, surface, and achievements motives (Biggs, 1987; Biggs et al., 2001). It must be stated that
motives refer to the reasons or motivations that a student has for pursuing a specific task. On the other hand, strategies refer to the methods that are employed by a student to achieve specific goals or learning objectives (Biggs, 1987; Duff et al., 2004; Furnham, 2011). Therefore, one can argue that the motives of a student inform the strategies adopted, which can, in turn, influence the achievement of academic goals (Diseth, 2003).

Motives are therefore, critical drivers that affect the achievement of academic goals, and the deeper the motives that a student has the higher the intrinsic interest to learn as well as understand learning materials through employing deep learning strategies such as reading widely and effectively integrating new knowledge with existing knowledge (Biggs & Tang, 2011; Biggs et al., 2001). In comparison, the students embracing surface learning approaches do not have sustained interest in the subject matter and just utilise the surface learning strategies or rote method of learning to store information for future reproduction (no synthesis) and passing the course with minimal effort (Biggs, 1993; Zhang, 2000). Similarly, the students who utilise the achieving motive would adopt achieving strategies such as meticulous organisation in studying that can see them achieve the expected learning outcomes (Entwistle & McCune, 2004).

In higher education learning, a number of studies have arrived at the same conclusion that a deep learning approach produces better results or academic performance (Byrne, Flood, & Willis, 2002; Cano, 2007; Diseth, Pallesen, Hovland, & Larsen, 2006; Duff et al., 2004; Zeegers, 2001). However, age and gender factors do influence this relationship with several studies stating that female students have a weaker association (Byrne et al., 2002; Duff, 2002; Duff et al., 2004; Hassall & Joyce, 2001; Sadler-Smith, 1996), and older students seem to embrace the deep approach (DA) thus getting higher scores than
younger students who more often embrace a surface learning approach (Ayres & Guilfoyle, 2009; Gijbels et al., 2005; Sadler-Smith, 1996; Zeegers, 2001). Moreover, in general, older students are more intrinsically motivated as well as self-driven in their learning than younger students (Duff et al., 2004; Gijbels et al., 2005; McKenzie & Gow, 2004). It has also been noted that female students tend to prefer a surface approach (SA), and they are not committed and self-driven in their learning even in such academic disciplines as Science, Technology, Engineering, and Mathematics (STEM) subjects (Svedin & Bälter, 2016).

Several studies such as those conducted by Byrne et al. (2002), Duff et al. (2004), Eley (1992), and Reid, Wood, Smith, and Petocz (2005) have concluded that students who employ a SA to learning perform poorly as compared to those employing a deep learning approach. However, there also seem to be some studies which dispute a correlation between a deep learning approach and better academic performance (Campbell & Cabrera, 2014; Gijbels et al., 2005; Minbashian, Huon, & Bird, 2004). This is supported by the assessment system that rewards effective reproduction or conceptual display of knowledge, which a SA does effectively (Scouller, 1998; Segers, Nijhuis, & Gijselaers, 2006).

Generally, studies have concluded that learning approaches adopted by students have a significant impact on their academic performance across academic disciplines in higher education (Baeten et al., 2010; Biggs, 1987; Entwistle & Ramsden, 1983; Kek, Darmawan, & Chen, 2007; Kek & Huijser, 2011; Smith & Miller, 2005; Trigwell & Prosser, 1991b). This is a presupposition that is supported by Ramsden (2003) in his argument that a relationship exists between SAL and better grades and that
“surface approaches are usually more strongly linked to poor learning than deep ones are to effective learning, and the connections between grades and learning approaches are less marked than those between measures of learning quality and approaches.” (p. 59)

The student’s approach to learning is not characterised by inflexibility (Biggs, 1999) but rather by dynamism because students use various learning approaches in pursuing their academic goals (Ngidi, 2013; Struyven et al., 2006). The students’ learning approaches change significantly depending on the context, subject matter and the learning outcomes expected (Entwistle & McCune, 2004; Jackling, 2005; Zeegers, 2001). Moreover, the academic, social, and economic backgrounds as well as personality characteristics of students joining higher education are varied, further supporting the different preferences for specific learning approaches (Baeten et al., 2010; Diseth, 2007; Diseth & Martinsen, 2003; Duff et al., 2004; Gijbels et al., 2005; Zeegers, 2001; Zhang, 2000).

Though Biggs’s deep and surface approaches to learning model has indeed received criticisms (Howie & Bagnall, 2013), many studies defined the model as stimulating and suggestive (Howie & Bagnall, 2013). For example, Howie and Bagnall (2013) argued that the language used is considered ambiguous, while the model is found to be underdeveloped and circular, with a lack of definition of the structure (Haggis, 2003; Marshall & Case, 2005). Nevertheless, the next subsections explore the various approaches to learning in turn.
2.3.1 The surface approach (SA) to learning

Several studies have showed that students employing a SA to learning are extrinsically motivated (Chiou, Liang, & Tsai, 2012; Felder & Brent, 2005), and that they prefer memorising learning materials with the intention of reproducing them without failing examinations (i.e. their focus is not on understanding) (Entwistle & McCune, 2004; Weller et al., 2013; Yonker, 2011). As a result, a student employing this approach fails to actively engage with the learning material and tasks including reflecting, analysing facts or information as well as purposeful study because their intention is just completing learning tasks with little personal effort (Byrne et al., 2002; Emilia, Bloomfield, & Rotem, 2012; Reason, Cox, McIntosh, & Terenzini, 2010). Consequently, Ramsden (2003) views surface learning approaches as

“uniformly disastrous for learning... they may permit students to imitate authentic learning and to bamboozle their teachers into thinking that they have learned... the snag is that you may survive the exam but you will almost certainly forget everything you memorised for it after a few days.” (p. 45)

Therefore, studies have shown that the students embracing a surface learning approach tend to engage with the learning material superficially, with little effort to analyse them but with the end intention of just passing an examination. Through memorisation or rote technique, the students using a SA memorise the key points given by the instructor with the barest, of course, expectations (meeting the syllabus) and little effort and time, leading to a much more constrained learning process. This is an argument supported by Smith (2002) in his postulation that the current education systems across the world favour a SA to learning because of a number of factors:
“a lack of opportunity to pursue courses in depth, relatively high course contact hours, an excessive amount of course material, and a threatening and anxiety-provoking assessment system are the indirect consequences of changes intended to widen access and choice.” (p. 68)

In this regard, the reason why the students prefer a surface learning approach may be due to the burden of over-assessment or workload (Entwistle & Ramsden, 1983; Kember & Leung, 1998; Lizzio, Wilson, & Simons, 2002; Scully & Kerr, 2014); a view supported by Kember, Jamieson, Pomfret, and Wong (1995) who argued that

“the positive link between surface approach and perceived workload shows that it is those adopting a surface approach who feel that their workload is high.” (p. 352-353)

For Hughes and Peiris (2006), the use of surface learning approaches to learn to code programs by computer science students have been proven to produce worst performances. However, surface learning cannot be written off as inconsequential because it helps some students such as law students to remember specific legal elements needed in court cases as well as creating compelling arguments in a courtroom (deRaadt, Hamilton, Lister, & Tutty, 2005; Simon et al., 2006). It must be noted that learning programming is not a skill the can be learned through surface learning but a competency that can be honed through conscious learning (Chiou et al., 2012; Gijbels et al., 2005). Therefore, the students who employ surface learning approaches in computing rely on low-level metacognitive skills in their interaction with the learning materials (Yonker, 2011) using little effort and time. As a result, the SA to
learning is a cognitively passive study strategy that leads to poor understanding of the learning material (Byrne et al., 2002) as well as poor grades or failure to achieve expected learning outcomes (Diseth & Martinsen, 2003; Diseth et al., 2006). This has caused higher dropout rates among the students taking computing disciplines (Bälter et al., 2013; Davies & Elias, 2003; deRaadt et al., 2005).

2.3.2 The deep approach (DA) to learning

Unlike the students who embrace the surface learning approach, the students utilising the DA to learning are intrinsically motivated in their learning, and engage with the learning materials in a cognitively active and organised manner through employing critical thinking to process and analyse data at a higher-order level and higher intellectual curiosity without care for external rewards (extrinsic motivations) thus achieving the academic goals (Emilia et al., 2012; Felder & Brent, 2005). According to Felder and Brent (2005), a deep learning approach to learning is a concept that is explicated as referring to

“students who take a deep approach and do not simply rely on memorization of course material but focus instead on understanding it. They have an intrinsic motivation to learn, with intellectual curiosity rather than the possibility of external reward driving their efforts. They cast a critical eye on each statement or formula or analytical procedure they encounter in class or in the text and do whatever they think might help them understand it, such as restating text passages in their own words and trying to relate the new material to things they have previously learned or to everyday experience. Once the information makes sense, they try to fit it into a coherent body of knowledge.” (p. 63)
A more significant proportion of existing studies point out that students who utilise a DA to learning achieve better grades (Booth, Luckett, & Mladenovic, 1999; Byrne et al., 2002; Hall, Ramsay, & Raven, 2004; Mattick, Dennis, & Bligh, 2004; Sadlo & Richardson, 2003). In studies conducted by Eley (1992), and Watkins and Regmi (1990), utilising the SPQ instrument (Biggs, 1987), the findings showed that students of applied science, humanities and management prefer using the deep and strategic approaches to learning. On the other hand, Eley (1992) also found that students of chemistry, English and biochemistry students scored highest for using a DA as compared to accounting students. A study conducted by Byrne et al. (2002) further measured the learning approaches preferred by 95 first-year management accounting students in Dublin City University as well as how helpful they were in achieving the academic goals. This study also employed the Approaches and Study Skills Inventory for Students (ASSIST) (Tait & Entwistle, 1996) where the results indicated a significant positive correlation between deep and strategic approaches with better academic success while the SA to learning negatively correlated with high academic achievement.

According to the findings of studies conducted by Kumar and Sethuraman (2007), Shah et al. (2016), Siddiqui (2006), and Subasinghe and Wanniachchi (2009), the most preferred learning approach by medical students in their studies was the DA to learning. This finding was supported by the studies conducted by Cowman (1998), Mansouri et al. (2006), Pimparyon, Caleer, Pemba, and Roff (2000), and Tiwari et al. (2006) that a deep learning approach was also the most preferred learning approach used by nursing students. Contrastingly, dental students were found to prefer a SA to learning in a couple of studies (Haghparast, Ghorbani, & Rohlin, 2017; Jayawardena et al., 2013).
Primarily, differences between deep and surface learning exist, mainly due to how learners learn. Several studies have pointed out that students employing a DA to learning are more reflective, thoughtful, and focused, especially in understanding the context and subject matter, resulting in better academic performance (Diseth, 2003; Trigwell, Ashwin, & Millan, 2013; Watkins, 2001; Zeegers, 2001; Zhang, 2000). According to Ramsden (2003), learning outcomes and learning approaches adopted by a student have a strong relationship and, it is thus

“... evident that approaches are related to how much satisfaction students experience from their learning. Deep approaches are related to higher-quality outcomes and better grades. They are also more enjoyable. Surface approaches are dissatisfying; and they are associated with poorer outcomes.” (p. 53)

Consequently, students who utilise the DA to learning read widely, engage with others and learning materials, form critical analysis of ideas, thinks consistently about the learning tasks and integrate new and existing knowledge as well as personal experiences and environmental factors leading to satisfactory academic performance (Byrne et al., 2002; Weller et al., 2013; Zeegers, 2001). In light of the arguments mentioned above, it is clear that a DA to learning is the most critical learning approach that produces desired academic performance as well as life-long and worthwhile learning (Abraham, Kamath, Upadhya, & Ramnarayan, 2006; Byrne et al., 2002; Diseth & Martinsen, 2003).

2.3.3 The strategic approach to learning

The strategic learning approach, which is the third approach to learning, is an approach that involves a student learning with higher levels of self-motivation
and the desire to attain or achieve the highest grades as well as the satisfaction of achievement (Biggs, 1989; Richardson, 2009). In this approach, the goal of learning is to put consistent effort to learning through proper utilisation of time and directing a maximum effort to ensure that enhanced academic performance is achieved in all the assessments (Biggs et al., 2001, Entwistle, McCune, & Walker, 2001). Besides, students who embrace a strategic learning approach are driven by the need to understand the content to pass the assessment and course demands. For Felder and Brent (2005), the students who adopt a strategic learning approach

“do whatever it takes to get the top grade. They are well organized and efficient in their studying. They carefully assess the level of effort they need to exert to achieve their ambition, and if they can do it by staying superficial they will do so, but if the instructor’s assignments and tests demand a deep approach they will respond to the demand.” (p. 63)

Salder-Smith (1996), conducted an assessment on SAL using the Revised Approaches to Studying Inventory (RASI) (Entwistle & Tait, 1994) and concluded that students of business studies who employ a strategic approach scored higher grades than those students who take computing, accounting, and other related courses. However, the studies conducted by Furnham, Monsen, and Ahmetoglu (2009), and Shankar et al. (2006) found that students who use deep and strategic approaches to learning tend to perform better in academic subjects. This finding was corroborated by the studies conducted by Burton and Nelson (2006), Byrne et al. (2009), and Duff et al. (2004) who concluded that a strong correlation exists between adoption of a deep learning approach and better results and a weak correlation exists between a SA to learning and better performance.
Several studies have shown that the students utilising the strategic approach to learning are more flexible in their learning than those who are not (Abrahams et al., 2006). Therefore, students can switch from a DA to learning to a SA and vice versa thus maximising their chances of performing better in their academic study (Biggs et al., 2001; Felder & Brent, 2005; Weller et al., 2013). In this study, the strategic learning approach will not be explored in detail even though it can be clearly distinguished from the DA to learning. This is because the instrument utilised in this study, the Revised Two Factor Study Process Questionnaire (R-SPQ-2F) only generates a DA and a SA score (Biggs et al., 2001), and some studies found no differences when they included the strategic approach to learning (Nijhuis, Segers, & Gijselaers, 2005; Richardson, 2000).

In summary, the existing literature on SAL has suggested that a DA to learning produces more excellent academic performance than the SA, which also negatively correlates with positive learning outcomes. Consequently, the deep learning approach is crucial in the successful accomplishment of academic goals. It is, therefore, useful to look at connections between learning approaches and academic performance of students in more detail which is done in the next section.

### 2.3.4 Students’ approaches to learning and academic performance

Several studies have investigated the relationship between learning approaches and academic performance in students in higher education. These studies include those studies conducted by Byrne et al. (2002), Duff (2004), Gijbels et al. (2005), Lizzio et al. (2000), Watkins (2001), Zeegers (2001), and Zhang (2000) covering several academic disciplines and countries. In most of these studies, the conclusion arrived at supports the assertion that both the DA
and SA to learning are critical predictors of excellent academic performance, and students who employ a deep learning approach are more likely to perform much better in scores or grades than those who do not (Diseth, 2007; Watkins, 2001; Zeegers, 2001), while the SA to learning is associated with poor academic performance (Byrne et al., 2002; Salamonson et al., 2013).

In Zeegers's (2001) three-year longitudinal study, whether a correlation existed between learning approaches and academic performance was investigated in a group of 200 first-year science students. Guided by Biggs's (1987) SPQ, SAL was assessed, and academic performance was determined using the students' grade point average (GPA). Consistent with the other studies which have shown a positive correlation between a deep learning approach and good academic performance and a negative correlation between surface learning and the students' GPA, Zeegers's (2001) study corroborated these findings. Furthermore, studies conducted by Subasinghe and Wanniachchi (2009), support Zeegers's (2001) findings. Here through employing Biggs et al. (2001) R-SPQ-2F principles, the study indicated that students who embrace a deep learning approach perform better in academic pursuits than those who do not, and a significant correlation exists between learning approaches and better performance. Other studies, such as those conducted by Duff (2004) and Watkins (2001) corroborate this finding by arguing that deep learning approaches are associated with higher scores.

In order to explore the relationship between prior academic performances, the environmental effects on learning, learning approaches and academic achievement, Lizzio et al. (2002) studied 2,130 Australian undergraduates and found a significant positive correlation between the deep learning approach and GPA exists among commerce students. However, this relationship did not exist
among the humanities and science students. Moreover, Lizzio et al. (2002) further argued that the right learning environment is crucial in influencing the students' adoption of deep learning approaches as well as their academic performance.

In a study conducted by Zhang (2000), a relationship between the students’ characteristics and academic performance was examined using three samples of university students in the U.S. (n=67), mainland China (n=193) and Hong Kong (n=652). From the findings of this study, a strong correlation between a DA to learning and academic performance was identified in the U.S. and Mainland China, and a negative association was found between the surface learning approach and academic performance in Hong Kong university students. Among the Hong Kong and Mainland China students, parental education played a small role in the learning approaches while in the U.S., the students who employed deep learning approaches have significantly higher parental education levels.

Diseth and Martinsen's (2003) study (using 192 psychology students with mean age 21.7) investigated the relationship between deep, surface, and strategic learning approaches and academic performance and concluded that students (in their Norwegian university) responded differently to these learning approaches. The findings of this study further showed a positive but weak correlation between SA and academic performance. However, this study failed to corroborate the positive relationship between DA to learning and academic achievement. On further examination, it was realised that the course had a fixed curriculum and assessment criterion with little room for students to explore ideas and learning materials beyond the requirements of the curriculum. In addition, several students desired to pass their undergraduate assessment and
secure a place as graduate students. Consequently, surface and strategic approaches to learning were the most preferred because they yielded desired learning outcomes (Diseth & Martinsen, 2003).

In a study conducted by Booth et al. (1999), a weak association between DA to learning and academic achievement was found in a sample of medical undergraduates. This finding is supported by studies conducted by Diseth and Martinsen (2003), and Ramburuth and Mladenovic (2004) that deep learning approaches did not have a significant association with academic performance when compared with surface and strategic learning approaches which significantly contribute to academic excellence. In conclusion, it can be stated that the learning environment and perceived expectations of examinations have a significant influence on the students' learning approaches. In this regard, Ramsden (2003) argued that

“the approaches to studying students deploy at university are certainly influenced by their experiences of learning at secondary school.” (p. 66)

In contrast, Diseth, Pallesen, Brunborg, and Larsen (2010) asserted that it is "more important to discourage a surface approach than to encourage a deep approach if the goal is to improve performance" (p. 348) through using teaching practices and assessment methods that target improving the understanding of a concept by deep learning. Ramsden (1983) posited that it should be “clear that students’ approaches are linked to academic success” (p. 695) and it should be noted that a DA to learning has been identified by numerous studies as significantly producing higher score or grades (Byrne et al., 2002; Cano, 2007; Leung & Kember, 2003; Mattick et al., 2004; Pimparyon et al., 2000; Reid et al., 2005; Sadlo and Richardson, 2003; Stiernborg, Guy, & Tinker, 1997).
However, it must also be noted that several other studies show little or no correlation between learning approaches and academic achievement among undergraduate students. Therefore, the contradictory findings in these studies seem to suggest that no learning approach is better than the other in fostering the desired learning outcomes (Burton & Nelson, 2006; Cassidy & Eachus, 2000; Diseth & Martinsen, 2003; Duff, 2004; Rollnick et al., 2008).

The mixed findings seem to contradict the idea that students who adopt a SA to learning tend to end up with lower quality outcomes (Byrne et al., 2002; Diseth et al., 2010; Gijbels et al., 2005). Nonetheless, students often adopt a specific learning approach depending on the demands of particular subject areas and assessment requirements (Eley, 1992; Scouller, 1998). Additionally, Ballantine, Duff, and Larres (2008), Hayes et al. (1997), and Snelgrove (2004) stated that universities must focus on developing a DA to learning because of its benefits. However, it must be stated that surface learning is not written off as useless but helpful in obtaining fundamental knowledge prior to the interpretation associated with a deep learning approach. In this regard, this study aims to explore the role played by SAL in academic performance among computing students in a Singapore transnational higher education institution. The summary of studies examining the relationship between SAL and academic performance is presented in Table 2-1.
<table>
<thead>
<tr>
<th>University</th>
<th>Academic Performance</th>
<th>Learning Approaches</th>
<th>Correlation Coefficient</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>Examination choice and multiple-choice tests</td>
<td>Essay type</td>
<td>Students</td>
<td>Significant</td>
</tr>
<tr>
<td>University</td>
<td>Examination choice and multiple-choice tests</td>
<td>Essay type</td>
<td>Students</td>
<td>Significant</td>
</tr>
<tr>
<td>University</td>
<td>Examination choice and multiple-choice tests</td>
<td>Essay type</td>
<td>Students</td>
<td>Significant</td>
</tr>
</tbody>
</table>

**Table 2.1:** Summary of studies on the relationship between university students' academic performance and their learning approaches.

*Note: The table data is not transcribed in this text.*
<table>
<thead>
<tr>
<th>Course &amp; Year</th>
<th>Subject</th>
<th>Year Result</th>
<th>Overall First Year Medical</th>
<th>Undergraduate &amp; Medical</th>
<th>Overall</th>
<th>Medical</th>
<th>Overall</th>
<th>Undergraduate &amp; Medical</th>
<th>Medical</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd year</td>
<td>Medicine</td>
<td>Correlation</td>
<td>R-Spearman</td>
<td>0.09</td>
<td>0.18</td>
<td>1.00</td>
<td>0.71</td>
<td>0.32</td>
<td>0.06</td>
</tr>
<tr>
<td>2nd year</td>
<td>Chemistry</td>
<td>Correlation</td>
<td>R-Spearman</td>
<td>0.09</td>
<td>0.18</td>
<td>1.00</td>
<td>0.71</td>
<td>0.32</td>
<td>0.06</td>
</tr>
<tr>
<td>1st year</td>
<td>Physics</td>
<td>Correlation</td>
<td>R-Spearman</td>
<td>0.09</td>
<td>0.18</td>
<td>1.00</td>
<td>0.71</td>
<td>0.32</td>
<td>0.06</td>
</tr>
</tbody>
</table>

**Conclusions:**
- Deep surface performance is strongly associated with academic success.
- Instrument and analysis continue to support previous studies.
<table>
<thead>
<tr>
<th>Deep Surface</th>
<th>Performance</th>
<th>Instrument</th>
<th>Academic</th>
<th>Sample</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep</td>
<td>Instrument</td>
<td>Academic</td>
<td>Sample</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlation</td>
<td>Coefficient</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Deep Surface Performance Characteristics

- Sample size (N=120)
- Mean age (20 years)
- Gender distribution: 50% males, 50% females
- Performance scores:
  - ASL: 0.01 to 1.0
  - PDL: 0.02 to 1.2

Note: Low-performance students

Wang (2010)
2.3.5 Learning approaches among computing students

Several existing studies have indicated that students taking various disciplines employ different learning approaches to meet their academic goals (Biggs, 1987; Eley, 1992; Marton & Säljö, 1976a; Meyer, Parsons, & Dunne, 1990; Meyer & Watson, 1991). Moreover, depending on demands of various subjects or skills required to be acquired, undergraduate students adopt different learning approaches (Chan & Tang, 2006; Laird, Shoup, Kuh, & Schwarz, 2008; Salamonson et al., 2013).

For example, Bälter et al. (2013) investigated student course completion in two online preparatory courses in mathematics and computer programming, with 493 students that responded to the ASSIST (Tait & Entwistle, 1996). Results showed that students who successfully completed a mathematics course scored higher on subscales measuring DA to learning, while in the computer programming course, students who demonstrate a SA are less likely to complete the course. In this connection, Meyer and Eley (1999) posited that “…perceptions and experiences of learning contexts might be shaped also by the epistemology of a discipline and they might, therefore, vary considerably from one discipline to another” (p. 198).

Most of the existing studies have shown that the learning approaches are interdependent (Laird et al., 2008; McCune & Entwistle, 2011; Parpala et al., 2010; Smith & Miller, 2005) with students taking ‘soft’ courses in such fields as arts, social sciences and humanities utilising a DA to learning. Then again, the DA to learning is affected by several factors such as teaching quality, student support, course materials, and the learning environment within the institution (Entwistle & Tait, 1990). However, the surface learning approach is embraced by students majoring in ‘hard’ fields including engineering and computer
science (Entwistle & Tait, 1990) due to the fact that "science students are more likely to stress an over-concentration on techniques and procedural details, which promote a surface approach" (Lake, Boyd, & Boyd, 2015, p. 1739).

Even with the evidence that a deep learning approach is strongly correlated with better academic results, a number of other studies have shown that "engineering and the physical sciences (to) use (the) deep approach to learning less frequently than students from other fields" (Laird, Shoup, & Kuh, 2005, p. 17). Existing research has focussed on investigating the approaches used by the students taking subjects including accounting, economics, arts, education, social sciences, nursing, medicine, mathematics, and psychology (Booth et al., 1999; Eley, 1992; Phan & Deo, 2006; Skogsberg & Clump, 2003; Smith & Miller, 2005; Smith et al., 2007; Watkins & Regmi, 1990; Wilson, Smart, & Watson, 1996) but a few studies have explored the learning approaches used by computing students (Booth, 2001; de Raadt et al., 2005; Liang, Su, & Tsai, 2015; Simon et al., 2006).

In a study conducted by de Raadt et al. (2005), involving 177 introductory programming (CS1) students, and applying the R-SPQ-2F questionnaire developed by Biggs et al. (2001), the DA to learning was found to strongly correlate with higher scores and academic performance of students in CS1 grade. However, the study contrastingly found that the SA to learning has a negative correlation with better academic achievements. This is a finding supported by a study conducted by Simon et al. (2006) using the R-SPQ-2F, which found that the DA to learning has a positive relationship with higher scores or grades and students who dropped out were predominantly students with a SA to learning. Nonetheless, Simon et al. (2006) cautioned that although the DA may have a significant correlation with the academic performance, it
must be noted that the success of a learning method is dependent upon the interaction among content, environment, and personal traits.

As a matter of fact, most of the existing studies have attempted to examine the correlation between learning approaches and academic achievement of students, but, there is still only a little research evidence showing a significant correlation between learning approaches and academic performance in the computing discipline.

2.4 Factors influence students’ approaches to learning

Several existing studies have explored the factors that affect SAL in institutions of higher learning more generally (Byrne et al., 2002; Cano, 2007; Cetin, 2016; Duff, 2004; Gijbels et al., 2005; Zeegers, 2001). From these studies, the factors examined include academic disciplines (Ballantine et al., 2008; Entwistle & Ramsden, 1983; Kember, McKay, Sinclair, & Wong, 2008; Snelgrove, 2004), perceptions on workload and assessment (Kyndt, Dochy, Struyven, & Cascallar, 2010; Lizzio et al., 2002; Marton & Säljö, 1976a, 1976b; Struyven et al., 2006; Thomas & Bain, 1984; Varunki, Katajavuori, & Postareff, 2017), teaching and learning environment (Biggs et al., 2001; Duff, 2004; Kember et al., 2008; Snelgrove, 2004), age (Biggs, 1987; Richardson, 1995; Sadler-Smith, 1996; Zeegers, 2001), entry qualifications (Fuller & Chalmers, 1999; Mlambo, 2011; Zeegers, 2001) and gender (Duff, 1999; Redza, Ismail, Sarif, & Ismail, 2013; Wilson et al., 1996).

Some research has shown that female and male students study differently (Gurian & Stevens, 2004; Halpern et al., 2007). This view is however
contradicted by a number of studies such as those conducted by Byrne et al. (2002), Chiou et al. (2012), Kreber (2003), Richardson (1993), May, Chung, Elliott, and Fisher (2012), Wilson et al., (1996), and Zeegers (2001), who argued that gender differences have no impact on the choice of a student to either use a DA or a SA to learning. However, a study by Severiens and Ten Dam (1994) found that male students have a higher preferences for conceptualisation of abstract ideas than do females (Gallagher et al., 2000; Pajares, 1996) and that male students tend to aim at creating ‘meaning’ or ‘transformation’ in their academic pursuits whilst female students are interested in learning for learning’s sake. Moreover, several studies have indicated that male students prefer a DA to learning while females prefer surface learning (Duff, 1999, 2002; Sadler-Smith, 1996; Sadler-Smith & Tsang, 1998). However, this assertion is disputed by Hayes and Richardson (1995), who argue that the differences in SAL are attributed to context factors or learning environment and not gender. The current study’s populations are predominantly male students which concur with Alexander and Irons (2004), and McGettrick et al. (2005) that gender imbalance and low proportion of females in higher education are common among computing programmes. As the influence of gender has been inconsistent in research findings in determining the relationship between gender and students’ approaches to learning (SAL); thus Chiou et al. (2012) recommended further investigation of the relationship between SAL and gender, and the associated influence of the learning environment where this factor will be examined.

According to Zeegers (2001), age is a critical factor, especially for science students’ choice of SAL in that age affects both assessment and SAL scores. This is a finding supported by Richardson’s (1995) study that also identified age as affecting SAL score and assessment scores in students of the social
sciences. For Biggs et al. (2001), age influences SAL selection because, with increasing age, more prior experiences play an important role. However, a study conducted by Yonker (2011) found out that the selection of SAL by psychology students is dependent on age such that the older the student is, the more likely that student will adopt SA to learning, but no age-based differences were identified in connection to the selection of a deep learning approach. Conversely, the findings of Gijbels et al. (2005) differed in that older law students were found to embrace a deep learning approach when compared to younger students. Thus, in this study, the role played by age in the selection of learning approaches will be explored, while being cognisant of the fact that the participants in this study are mainly of the same age.

The selection of a learning approach has been known to be influenced by several factors such as teaching and learning environment, prior educational experience and perceptions on assessment and workload tasks (Ballantine et al., 2008; Duff, 2004; Kember et al., 2008; Richardson, 1995). A sample of 93 psychology and 155 business undergraduates studying in an Australian university responded to the Study Process Questionnaire (SPQ) investigating the impact of the discipline of study and assessment type on SAL (Smith & Miller, 2005). The findings indicated that content (discipline) has a significant influence on the selection of a learning approach, while the assessment type does not influence student learning.

As students differ in their academic environment preferences, Ramsden (1983) argued that students employ either DA or SA to learning depending on the demands of a course and the individual student’s perception about the course, and thus learning approaches can be used interdependently. In addition, Gow, Balla, Kember, and Hau (1996) demonstrates that learning approaches were
dynamically changing in order to deal with the ever-rising demands of the learning systems. The dynamism in instructional methods, teaching environments, types of tests and the inclusion of experimental skills learning systems is very essential. The modern educational requirements form why students need to adopt different SAL in order to learn for success. This contextual aspect of SAL is the reason that SAL is likely to vary across different disciplines (Abraham et al., 2006, Chiou et al., 2012; May et al., 2012). Although these factors appear important in the understanding of the adoption of suitable learning approaches, this study, therefore, will investigate such factors as different genders, entry qualifications, and age groups in affecting the selection of SAL among computing students.

This is because the study institution online system did not record prior achievement in a way that was suitable for the current study. The online system captured scanned copies of students’ official academic records, thus the information on prior achievement has to be manually extracted from scanned copies, which proved to be time consuming. Furthermore, to collect quantitative data such as socioeconomic status (SES) of students’ parents proved difficult with students being reluctant to share the information, as they are afraid disclosing such information will reveal their family income, parents’ occupational prestige, and parents’ education level. The current study did not attempt to investigate every factor since this would have been beyond its scope, but certain factors were considered (age, entry pathway, gender and year of study) that students were less embarrassed to share the information about.
2.4.1 Entry pathways and approaches to learning of students

The institution in this study offers full-time, three-year U.K. accredited undergraduate computing programmes in Singapore. The computing field provides students with employment opportunities in several areas such as system design and analysis, software engineering, database administration, the development of computerised systems, multimedia programming as well as application programming (NTUC Singapore, 2018). In order for a student to be admitted into computing programmes, U.K. institutions admit students with three GCE A-Level subjects and a certain level of mathematics, which may not be present when students join other disciplines (Boyle, Carter, & Clark, 2002). For the institution where the study takes place, the requirement includes passing two Singapore-Cambridge GCE A-Level subjects and a minimum of three passes in Singapore-Cambridge GCE O-Level subjects or polytechnic diploma or other equivalent international qualifications. English at GCE O-Level grade C and Mathematics at GCE O-Level grade B are also required (University of London, 2018a). Thus, degree programmes in computing at this study institution typically asked for mathematics O-Level grade B with A-Level mathematics being preferred but not compulsory.

In the selection of the learning approaches to be employed in learning a particular subject, prior experiences are critical in learning such a subject (Prosser & Trigwell, 1999). In some studies, it is clear that students who employ a SA to learning in their first year would most likely continue using it in their subsequent years (Prosser & Trigwell, 1999). This is a view supported by Shanahan and Meyer (2001) in their argument that the learning approach selected by students in their first year in institutions of higher learning is likely to be the preferred learning approach throughout all the learning years, which is also an assertion supported by Ramsden (2003) in his argument that
“it is abundantly clear that the same student uses different approaches on different occasions, it is also true that general tendencies to adopt particular approaches, related to the different demands of courses and previous educational experiences, do exist.” (p. 51)

From this assertion, it is evident that the learning approach selected by students when entering a learning environment is affected by their own personal and prior learning experiences (Hettich, 1997; Marton, Dall’Alba, & Beaty, 1993). Consequently, the deep and surface learning approaches of the student’s scores within a learning environment are significantly determined by the entry scores engendered by their use of a prior learning approach, and therefore, they are not likely to change that approach over the years of studying (Crawford et al., 1998; Gijbels et al., 2005; Wilson & Fowler; 2005). The students who are transitioning from polytechnics and Junior Colleges (JCs) to higher institutions with individual prior learning experiences, which may affect their SAL once they are in these institutions.

Essentially, the modes of teaching and subsequent assessment techniques in schools form the basis of the expertise and studying orientation that may not be conforming appropriately with the main methods of learning carried out in higher education system (Cook & Leckey, 1999). For instance, the students who come from a learning environment in which the learning and teaching approach is didactic and reproductive find it very difficult to transition into the self-driven learning environment presented by higher institutions of learning and maybe traumatising by them (Kember, 2001). In this regard, how students are prepared in school contributes to learning experiences in higher education, thus determining how they will learn (Clark & Ramsay, 1990). If their
expectations do not come true, their learning will be challenging, and effective transitioning will not occur. Moreover, this may make a student lose confidence in their learning capabilities, which will lead to a lack of motivation and willingness to engage in learning activities (Anderman & Midgley, 1998; Nichols & Miller, 1994). Learners who exhibit valid self-confidence and high levels of self-belief have been found to participate effectively in the learning process, as compared to those with poor self-belief and doubting their abilities (Lumsden, 1994).

Students entering higher education with a wide range of entrance qualifications are expected to show different learning approaches due to their prior experiences of varied learning environments and assessments (Crawford et al., 1998). However, there are very few research contributions showing that students entering higher education from different entry pathways, who supposedly differ in their prior learning experiences, as a result, show different learning approaches (Duff, 1999; Fuller & Chalmers, 1999). Therefore, more investigations should be conducted in this area in order to obtain insights into the role played by different entry pathways in the choice of SAL as well as the relationship with better academic performance.

2.5 Theoretical framework

In this study, Biggs et al.’s (2001) 3P (presage-process-product) learning model is employed to examine the existing relationship between the learning approaches and student characteristics and teaching methods in bringing better academic performance (Biggs et al., 2001). Figure 2-1 shows the 3P model of teaching and learning, which delineates the fact that learning
outcomes are influenced by several factors such as the selected approach to learning, student behaviour/characteristics and institutional factors (Biggs et al., 2001; Biggs & Tang, 2011). This model is appropriate to be adopted as the theoretical framework for the study because it indicates how students enrolled in the computing programmes from different entry pathways, and their different prior learning experiences relate to SAL, and how learning approaches determine their academic performance in higher education.

The 3P model developed by Biggs (1979) was adapted from Dunkin and Biddle (1974) and seeks to explain the correlations between student characteristics and context or learning environment (presage), SAL in a specific context (process), as well as learning outcomes (product) (Watkins, 2001). According to Biggs et al. (2001), the teaching context, the characteristics of the student, on-task approaches to learning and outcomes are all interdependent and dynamic. The 3P model conceptualises the learning process as an interacting system which is seen as a progression from presage through process to product, and each contains several variables.
2.5.1 The presage factors

The presage stage is a stage that exists before the time of learning and is made up of two main pillars, which include ‘student characteristics’ (prior knowledge, abilities, learning styles, motivation, stabilised learning approaches and personality), and ‘teaching context’ (curriculum content, learning environment, course structure and method of teaching and assessment) (Lizzio et al., 2002). The interaction of these two sets of presage factors leads towards the process stage which motivates a learner to adopt a particular approach to learning a task that may either directly or indirectly affect the student’s academic performance (Biggs, 1987, 1993; Biggs et al., 2001; Zhang & Bernardo, 2000).

2.5.2 The process factors

The process factors relate to the various approaches to learning selected by students in their pursuit of academic excellence (Biggs, 1987, 1993), which include deep, surface, and strategic learning approaches. As already noted the surface learning approach is known to facilitate memorisation and reproduction of what has been learned, while the DA relates to a thorough mastery of content, and the strategic approach relates to achieving the highest possible academic scores (Biggs, 1987). Each approach comprises of both a ‘motive’ describing why students choose to learn and a ‘strategy’ explaining how students go about their learning (Biggs, 1987).

Moreover, process factors also include all the learning activities that go on in class because the learning process begins from the interaction of student characteristics and learning environment. This interaction is key in predicting the students’ perceptions, which in turn will drive selected learning strategies and the outcome of the learning process. The 3P model of teaching and
learning, which has been supported by most researchers indicates that students can tell the difference between the approaches used in learning, based on their perception of the teaching. Thus, the perception of the student is critical in the selection of learning approaches. The learning approach adopted, which is either the DA or the SA to learning, will also be influenced by that student's perception of the teaching the student receives from the teacher as well as that student's prior learning experience and ability. Prosser and Trigwell (2006) argue that student-focused concept analysis techniques to teaching are tied to relevant DA to learning. However, the teacher-focused learning approach is only tied to somewhat shallow or surface learning. Studies have revealed that the best learning methods come from the student-focused approach, which considers the value of the DA technique. The DA to learning thus makes learning more worthwhile and exciting because it yields better academic results.

Deep learning approaches are related to students’ perceptions of good teaching, clear goals, appropriate workload and assessment, and freedom in how and what students learn (Diseth, 2007). The students’ previous perceptions and experiences of teaching and learning, whether positive or negative, impact on students’ perceptions of the learning context, and those perceptions, in turn, affect the students’ learning approaches. Hence, this model explains the value of an interactive system but is not describing a causal process. Different learning approaches, such as deep learning and/or surface learning and/or achieving learning, might be involved in these activities of learning.
2.5.3 The product factors

The product factors refer to the outcomes achieved by the students in their learning. With this concept, several studies have been conducted to explain the association between learning approaches and learning outcomes, especially academic performances such as higher GPA.

It must be stated that the 3P model of learning proposed by Biggs (2003) has been a constructive research theoretical framework in most studies examining SAL in various countries, academic disciplines, and contexts (Drew & Watkins, 1998; Lizzio et al., 2002; Zhang, 2000). In some studies, the focus is on how the presage factors linked to demographic factors can affect the adoption of learning approaches as well as academic achievement (Burton & Nelson, 2006; Burton, Taylor, Dowling, & Lawrence, 2009; Duff et al., 2004). Some other studies have focused on how teaching methods and learning environment can affect learning outcomes (Entwistle & Tait, 1990). Moreover, some other studies have explored the effect of personal effort on academic performance (Borg, Mason, & Shapiro, 1989; Kember et al., 1995; Krohn & O’Connor, 2005; Michaels & Miethe, 1989). However, the 3P model suggests such factors as teaching context and students’ characteristics as critical determiners of success in academic pursuits.

Several studies have shown that teaching context and students’ characteristics (presage factors) have an impact on selection of learning approaches (process factors), which in turn affect the learning outcomes (product factors) (Albaili, 1995; Biggs, 1988; Sadler-Smith & Tsang, 1998; Watkins, 1998; Zhang, 2000). In this study, the 3P model’s factors namely presage and process is especially relevant to take on. The present study focuses primarily on these student-based presage factors, or more precisely on the entry pathways and their
academic performance. The reason for this more limited focus is that student based-presage factors have not received sufficient attention in past studies as compared to the teaching and learning environments.

2.6 Summary

From the review of the existing literature, it can be concluded that students adopt certain learning approaches depending on several factors such as demands of a course, prior experiences and expected learning outcomes (Diseth, 2003). Moreover, the review of the literature in the field of SAL has clarified the issues surrounding the theoretical, methodological and analytical underpinnings associated with RQs as well as situated this study within this framework. The chapter provided an explanation for selecting entry pathways, approaches to learning and academic performance to be examined. In addition, this study will explore the relationship that exists between entry pathways and academic achievement. The next chapter explores the methodological framework utilised in this study.
CHAPTER 3 RESEARCH METHODOLOGY

3.1 Introduction

This study seeks to examine the correlation between the students' approaches to learning (SAL), academic performance, and different entry pathways for undergraduate computing majors within a transnational higher education institution in Singapore. It is hoped that the study findings will address the research questions (RQs) explored within the study:

RQ1: What approaches to learning (deep versus surface) do computing undergraduates possess within the context of a Singapore transnational higher education institution?

RQ2: Are there any effects of different entry pathways (diploma versus A-Level) on students’ approaches to learning?

RQ3: Are there any relationships between students’ approaches to learning and academic achievement?

This chapter begins with a discussion on the epistemological and methodological stance adopted in this study. Then the research methods used are described, detailing the data collection methods and data analysis techniques, introducing the choice of instrumentation, providing details about study participants and results of a pilot. The final section in the chapter discusses the ethical considerations.
3.2 Theoretical perspective

Researchers’ paradigms shape their theoretical viewpoints, which characterise research projects alongside their theoretical conclusion, which Patton (1990) has termed as ‘worldviews’ (p. 37). According to Patton (1990), it is imperative for researchers to identify their paradigm as it enables researchers to locate their role within the process of research, and identify the interpretation, analysis, and data collection methods. Therefore, a paradigm is a ‘worldview’ containing several assumptions and beliefs alongside their accompanying techniques (Denzin & Lincoln, 1994; Lincoln & Guba, 1985). In general, common research paradigms used within education studies include ‘positivism’, ‘constructivism’ or ‘interpretivism’, and ‘pragmatism’. The following section will debate different paradigms and approaches to research (quantitative, qualitative and mixed methods) before proceeding to examine the rationale of using the mixed methods approach that is used in this study.

3.2.1 The positivism paradigm (and the quantitative approach)

At the core of the positivism paradigm is the ontological and epistemological assumption that the world is external and there is one objective reality to human actions and phenomena; simply put, knowledge could be considered quantifiable and objective using characteristics that exist autonomously of the instruments and the investigator (Creswell, 2013; Crotty, 1998). Therefore, positivist researchers adopt scientific approaches and systematise the process of generating knowledge by locating a clear topic of research, developing relevant hypotheses as well as embracing an ideal research methodology. With regard to the positivism paradigm, it is imperative that researchers strive for objectivity as well as utilise quantifiable observations, which results in mathematical and statistical methods of uncovering the objective and single
reality that produces generalisations that replicate those that natural scientists produce. Because the focus of positivism research is on “uncovering truth and presenting it by empirical means” (Henning, van Rensburg & Smit, 2004, p. 17), consequently, the paradigm of positivism is usually linked to the quantitative method (Tashakkori & Teddlie, 2009).

Even though “quantitative research methods were originally developed in the natural sciences to study natural phenomena” (Myers, 1997, p. 241), Giddens (1975) suggested that the quantitative method for the natural sciences might be applied directly to the social sciences and the final product of studies by social scientists could be formulated based on methods used in the natural sciences. Because of this, the quantitative method has concurrently proven itself in social and natural sciences studies where quantitative methods are utilised for explaining the correlation between constructs through effect statistics, for instance, variations between averages, relative frequencies, and correlations between them (Punch, 2005). In summary, “quantitative researchers seek explanations and predictions that will generalise to other persons and places. The intent is to establish, confirm or validate relationships and to develop generalisations that contribute to theory” (Leedy & Ormrod, 2001, p. 102). Consequently, quantitative research involves the collection of data through questionnaires, surveys, and experiments, and analysis of data in the statistical form to support or refute “alternate knowledge claims” (Creswell, 2003, p. 153).

3.2.2 The interpretivism or constructivism paradigm (and the qualitative approach)
Interpretivism constitutes a paradigm mainly linked to qualitative research techniques (Creswell & Clark, 2007; Tashakkori & Teddlie, 2009). Researchers
that utilise the interpretive qualitative method hold the epistemological and ontological perception that reality is “socially constructed rather than objectively determined” (Carson, Gilmore, Perry, & Gronhaug, 2001, p. 5), thus they perceive the world through a “series of individual eyes” and choose participants who “have their own interpretations of reality” to “encompass the worldview” (McQueen, 2002, p. 16).

Interpretivist researchers ignore methods which provide accurate and objective information, rather they embrace flexible and personal research approaches such as observations and interviews, which enable them to gain deep insights into how human beings relate to their environments. Even though interpretivist researchers join the field with some previous understanding regarding the context of the study, they remain open to emerging knowledge in the entire study and allow it to grow with the assistance of respondents because of the unprecedented, multiple and sophisticated nature of what is considered reality (Hudson & Ozanne, 1988). In view of this, the interpretivist research goal involves comprehending and interpreting the meanings that characterise human behaviour instead of generalising and predicting effects and causes (Hudson & Ozanne, 1988; Neuman, 2014).

As Creswell (2009) states “qualitative study constitutes an avenue for comprehending and exploring the meaning groups or individuals ascribe towards a human or social problem” (p. 4), given this, qualitative studies seek to generate holistic comprehension of phenomena within context-specific environments. The qualitative approach involves obtaining empirical data regarding the world through unstructured interviews, diaries, documents, and observations that uncover deeply thought-provoking experiences, perceptions, and experiences of participants, which allow the researchers to communicate
a phenomenon’s intensity and richness in a manner that quantitative methods cannot (Creswell, 2009). In view of this, the key benefit of qualitative studies is the ability to present different textual descriptions regarding how respondents experience within the selected social phenomenon or context.

3.2.3 The pragmatism paradigm (and the mixed methods approach)

The importance of epistemology and the pragmatist ontologist is that worldview arises from the consequences of change and actions (Creswell, 2003). Blumer (1969) claims that “the essence of society lies in an ongoing process of action - not in a posited structure of relations. Without action, any structure of relations between people is meaningless. To be understood, a society must be seen and grasped in terms of the action that comprises it” (p. 71). Action refers to the means of changing existence, thus pragmatist researchers focus upon the main significance of the research question as well as the multi-method analysis and data collection to comprehend the issue rather than focus on techniques (Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2009). Pragmatism is mainly linked to mixed methods research (Creswell & Clark, 2007; Tashakkori & Teddlie, 2009).

The mixed-method approach embraces several philosophical paradigms and utilises several means of deriving knowledge through tackling multifaceted and sophisticated social science research issues dynamically (Greene, 2008; Howe, 1998). Additionally, the use of quantitative analysis and qualitative investigation permits the research to encompass a holistic and broader scope of study issues by inferring and concluding facets from conflicting and confluent outcomes (Teddlie & Tashakkori, 2010). Reflecting on the aim of this study in addition to the potential benefits that mixed-method approaches can offer, the quantitative research involves using self-reported questionnaires to examine
the learning methods that undergraduate students in computing school utilise, and to assess any variations within different learning approaches between respective groups within the study. Afterwards, the qualitative research then seeks to illuminate data interpretation and offer responses to questions, which numerical data failed to attain independently and was undertaken by using group interviews. It was expected that such a design would offer richer interpretation and greater depth of the questionnaire results concerning SAL, and as well help to achieve a good knowledge of the contextual and development factors that impacts the development of these learning approaches.

Curlette (2006) stated that "beliefs from the qualitative element of mixed-method study design could be integrated with data from quantitative research side to attain a belief statement regarding the presence of findings from qualitative studies" (p. 345). In Curlette’s (2006) perspective, data collected through qualitative methods could be utilised for supporting conclusions drawn by conducting quantitative data tests and vice-versa. In this regard, Frechtling, Sharp, and Westat (1997) stated that it is beneficial to the researcher to use a mixed-method study, which combines both methods to enhance the understanding of the research findings. Hanson et al. (2005) asserted that using the two types of data enables the researchers to generalise outcomes from the sample to the population concurrently, and to acquire an in-depth knowledge of the phenomena of interest. This means that researchers can generalise from the sampled population, which is one of the aspects of the quantitative research process. As shown in Table 3-1 are the Creswell and Clark’s (2007) classification that consist of the embedded, explanatory, exploratory, and triangulation types of design. Thus, an embedded design is
the best and most appropriate study design when qualitative study parameters were embedded into a larger body of quantitative research.
<table>
<thead>
<tr>
<th>Mixed Method</th>
<th>Description</th>
<th>Diagrammatic Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intervention-based</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Qualitative</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Quantitative</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Quantitative + Qualitative</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3-1: Summary of Four Major Types of Mixed Methods Designs
<table>
<thead>
<tr>
<th>Design</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploratory</td>
<td>The design is a reversed version of explanatory.</td>
</tr>
<tr>
<td>Mixed method</td>
<td>Uses the exploratory framework or theory. The design is typically used when there is no available or verifiable measure of construct and the design is exploratory.</td>
</tr>
</tbody>
</table>

*Source: Creswell & Clark (2007, p. 63-76)*
In conclusion, the epistemological and methodological stance adopted in this study will be grounded in the pragmatism paradigm of mixed methods design, comprising both quantitative and qualitative approaches. Johnson and Onwuegbuzie (2004) summarise the philosophical position of mixed-method researchers that they "agree with others in the mixed methods research movement that consideration and discussion of pragmatism by research methodologists and empirical researchers will be productive because it offers an immediate and useful middle position philosophically and methodologically; it offers a practical and outcome-orientated method of inquiry that is based on action and leads, iteratively, to further action and the elimination of doubt; and it offers a method for selecting methodological mixes that can help researchers better answer many of their research questions” (p. 17).

3.3 Participants

The study institution is a leading private education and life-long learning institution in Singapore. It establishes partnerships with international universities and institutions from the U.K., U.S. and Australia where students can choose from a wide range of high-quality overseas degree programmes. The study institution admits computing students into various computing/computer science/Information Technology (IT) programmes offered by the institution’s overseas partners. Thus, the participants that represented the undergraduates in this study were an opportunistic sample from one out of the 11-degree programmes offered by the two university partners in this study institution. Upon completion of the computing degree, the participants will gain a solid foundation in solving real-world problems with algorithms, creating the latest Augmented Reality (AR) games, developing software applications and
mastering the intricacies of cybersecurity. Particularly, the skills to think critically, solve problems and make good decisions are examples of skills that require the DA to learning.

The participants in the present study consist of undergraduate students pursuing degrees in computing programmes at a higher education institution where the researcher is an employee. The institution constitutes one of several private education institutions (PEIs) within Singapore that provides undergraduate courses across broad disciplines such as information technology (IT), social sciences, finance, management, and economics. The chosen institution has huge enrolments into the computing programmes, and many of the students constitute those that graduated from Junior Colleges (JCs) after acquiring their Singapore-Cambridge GCE A-Level qualifications or are diploma holders from any of the five polytechnics within Singapore. Those students admitted using other local or foreign qualifications only make up a small percentage of it. Students with polytechnic diploma qualifications might obtain some exemptions from the first-year and/or second-year courses in their first year of studies. In the year of university commencement, these students generally undertake up to four first-year courses or up to a combination of four first-year and second-year courses. Typically, the computing students in this study must be examined in (or exempted from) courses to a value of twelve full courses to be awarded the degree within the candidature period of three to eight years.

The undergraduate computing programme constitutes a three-year course with about 100-200 students within each year. The age range for computing programme students in the year of 2017 was 17 to 35 with an average age of 22 (standard deviation of 1.97). The ratio of male to female students is seven
to three (70% male and 30% female) in this context, where the current gender imbalance may be somewhat ‘common’ in students enrolling in computing and related degrees (Mason, Cooper, & Comber, 2011; Mbarika, Sankar, & Raju, 2003; Shillabeer & Jackson, 2013). Many students are Singaporeans and Permanent Residents\(^2\) children and have spent a large portion of their lives in the country and at least a decade within the educational system of Singapore. Less than 10% of the overall population of students constitute international students drawn mostly from Myanmar, Vietnam, Indonesia, India, China, and Malaysia. International students who wish to study in Singapore will be issued student visas.

A convenience sampling method was utilised within the study due to financial and time constraints. Convenience sampling constitutes a form of non-probability sampling method where the selection of samples is based on proximity to researchers and easy accessibility (Punch, 2005). The study utilises a homogenous population by confining the sample to undergraduate students in computing programmes. This procedure allowed for a comparison of findings between the two groups of different entry pathway students that are perceived to be different with GCE A-Level students geared towards the attainment of good grades. While polytechnic diploma students are subjected to more hands-on training to equip graduates with skills and knowledge as middle-level professionals. Additionally, the use of homogeneous samples might prevent potentially significant effects of age and gender between various academic disciplines. Furthermore, one single academic course of study may

\(^2\) The Permanent Residents (PRs) in Singapore are those individuals who have been allowed to stay in Singapore without restrictions, despite the fact that they are foreigners. They enjoy the privilege of working and free movement with no visa restrictions. The PRs also enjoys the privilege of studying in Singapore and still enjoys the government educational subsidies and as well enjoy the pension funds contributed by their employers.
have a diffusely homogenous sample and not allow significant generalisation to different educational disciplines, however, further analysing the data statistically can be done to compare the different entry pathways, focusing on their presage variables measured in the study. The size of the sample was 415 that comprised three undergraduate groups that are labelled as first-year (n=223), second-year (n=109), and third-year (n=83).

### 3.4 Instrumentation

Various instruments have been developed to evaluate SAL. These instruments range from the Approaches to Studying Inventory (ASI) (Ramsden & Entwistle, 1981), Revised Approaches to Studying Inventory (RASI) (Entwistle & Tait, 1994; Tait & Entwistle, 1996), Approaches and Study Skills Inventory for Students (ASSIST) (Entwistle, Tait, & McCune, 2000; Tait & Entwistle, 1996; Tait et al., 1998), Study Process Questionnaire (SPQ) (Biggs, 1987), and Revised Two Factor Study Process Questionnaire (R-SPQ-2F) (Biggs et al., 2001).

The ASI contains 64 items on 16 scales grouped into four dimensions reflecting deep (meaning), surface (reproducing), and strategic (achieving) approaches to learning, and study approaches associated with poor academic performance (non-academic orientation) (Entwistle & Ramsden, 1983). However, subsequent applied research indicated ASI scores have moderate validity and reliability (Entwistle & Ramsden, 1983; Watkins & Hattie, 1985), thus, the ASI was revised to form the RASI (Entwistle & Tait, 1994).
The RASI has 44 items, and 15 scales, grouped into six dimensions namely the ‘deep approach’, ‘surface approach’, ‘strategic approach’, ‘lack of direction’, ‘academic self-confidence’, and ‘metacognitive awareness of studying’ (Entwistle & Tait, 1994; Tait & Entwistle, 1996). Deep, surface and strategic approach dimensions are refinements of the meaning, reproducing and achieving scales of the ASI. Academic self-confidence shows the belief of a student in the ability of performing academically. Lack of direction constitutes a tightly-defined modification of the ASI’s non-academic orientation domain that included several scales such as being unable to focus, extrinsic motivation, negative attitudes and disorganised studying. Metacognitive awareness of studying is included to reflect; firstly, the knowledge, which the learner has regarding their recognition; and secondly, how they regulated it (Tait & Entwistle, 1996).

ASSIST constitutes the latest version for the RASI (Tait et al., 1998). ASSIST features 52 items, alongside 13 scales, classified into ‘deep’, ‘surface’, and ‘strategic’ approaches from RASI. The strategic approach was further modified to incorporate a scale called ‘monitoring effectiveness’ that reflects the ability of students to ensure their efforts attain the needed result (Tait & Entwistle, 1996).

The SPQ consists of a 42-item questionnaire that is proposed to be three-dimensional namely ‘surface’, ‘deep’, and ‘achieving’; each characterised by two subscales namely ‘motive’ and ‘strategy’ (Biggs, 1987). Even though used widely, the SPQ requires extensive administration within the classroom environment and not all constructs that the instrument measured were ideal for predicting the perceptions of students regarding their ‘deep approach’ and ‘surface approach’ (Biggs, 1987). Therefore, a shortened SPQ version, the R-
SPQ-2F, was designed, validated and submitted for publication by Biggs et al. (2001) to streamline the administration and interpretation of student responses in the measurement of SAL.

Although most of the inventories have been demonstrated to be a reliable measure of SAL across a range of academic disciplines, this study used the R-SPQ-2F instrument to gather data to measure students’ general disposition toward a specific approach to learning (Biggs et al., 2001). This study chose to use the R-SPQ-2F, firstly because the study wanted as high a response rate as possible and using the R-SPQ-2F with just 20 items would most likely only take 10-15 minutes to complete and can readily be applied in a classroom setting. As cautioned by Pettersen (2010) that “the longer the inventory, the less care students may take in completing it, and the less likely it is that staff will use it” (p. 239). Furthermore, the R-SPQ-2F instrument has been administered to higher education students across a range of different academic discipies in different countries, and Biggs et al. (2001) confirmed the reliability and consistency of using the R-SPQ-2F as a student approaches to learning measurement tool.

Though the SPQ and R-SPQ-2F have been used extensively in research to examine the relationship between SAL and academic performance (Fox et al., 2001; Gow & Kember, 1990; Zeegers, 2001). While SPQ is still a valid instrument, its usage has declined since the introduction of the R-SPQ-2F. One possible reason for the decline is the conciseness of the R-SPQ-2F, with only 20 Likert-like questions, thus administration of the R-SPQ-2F takes less than half the time to administer. The R-SPQ-2F is significantly shorter than the SPQ, and removed the contested “strategic” approach as a factor. As a researcher (and an educator) at the study institution, the straightforward implementation of
the R-SPQ-2F is an attractive feature, thus the study chose to use the R-SPQ-2F because the study wanted as high a response rate as possible using the R-SPQ-2F with just 20 items would most likely only take 10-15 minutes to complete and can readily be applied in a classroom setting. Thus, for the purposes of my research, the 42-item SPQ instrument was not feasible to distribute, given the scope of the study.

3.4.1 Measuring approach to learning using the R-SPQ-2F questionnaire

Biggs et al. (2001) designed the R-SPQ-2F to evaluate the learning approaches that the students adopted. As the R-SPQ-2F is designed based on Biggs’s 3P (Presage-Process-Product) theoretical framework, it can measure motives, strategies and learning approaches (Biggs et al., 2001; Kember & Leung, 1998). The R-SPQ-2F constitutes a short questionnaire, which features 20 items that measure two main scales, namely surface approach (SA) and deep approach (DA). The DA main scale has deep motive (DM) and deep strategy (DS) as subscales, while the SA main scale has surface motive (SM) and surface strategy (SS) as subscales. These four subscales represent the state of learning motivation of every individual student and their employment of learning strategy (Biggs, 1987). Each of the subscales (DM, DS, SM, and SS) contains five items. The meanings for the subscales, as mentioned above, are presented in Table 3-2.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Motive</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep</td>
<td>Deep motive is intrinsic; study to achieve interest and competence in particular academic subject</td>
<td>Deep strategy is meaningful; read widely, integrate with previous relevant knowledge</td>
</tr>
<tr>
<td>Surface</td>
<td>Surface motive is instrumental; main purpose is to meet requirements minimally; a balance between working too hard and falling behind</td>
<td>Surface strategy is reproductive; limit target to bare essentials and reproduce throughrote learning</td>
</tr>
</tbody>
</table>

(Source: Gow & Kember, 1990, p. 306)
The questionnaire includes six questions to capture the demographics of respondents, namely student name, student number, the programme of study, entry pathway to university, gender, and age (see Appendix A). Participants needed to show the answers to all items on a five-point Likert scale that ranged between 5 “this item is always or almost always true of me” and 1 “this item is never or only rarely true of me”. Each question relates to one of the four subscales and then the score of DA to learning is calculated by the sum of DM and DS score (Σ Deep Motive scores + Σ Deep Strategy scores) and the score of SA to learning is calculated by the sum of SM and SS score (Σ Surface Motive scores + Σ Surface Strategy scores).

The item scores, therefore, are added to obtain the DA and SA scores as follows:

Deep approach = Q1 + Q2 + Q5 + Q6 + Q9 + Q10 + Q13 + Q14 + Q17 + Q18; where Qn=question number n

Surface approach = Q3 + Q4 + Q7 + Q8 + Q11 + Q12 + Q15 + Q16 + Q19 + Q20; where Qn=question number n

The subscale scores can be calculated as follows:

Deep motive = Q1 + Q5 + Q9 + Q13 + Q17; where Qn=question number n

Deep strategy = Q2 + Q6 + Q10 + Q14 + Q18; where Qn=question number n

Surface motive = Q3 + Q7 + Q11 + Q15 + Q19; where Qn=question number n

Surface strategy = Q4 + Q8 + Q12 + Q16 + Q20; where Qn=question number n
Below are the items which correspond to each sub-dimension from the version of R-SPQ-2F used in the study (Biggs et al., 2001).

Items intended to indicate ‘deep motive’:

• 1. I find that at times studying gives me a feeling of deep personal satisfaction.
• 5. I feel that virtually any topic can be highly interesting once I get into it.
• 9. I find that studying academic topics can at times be as exciting as a good novel or movie.
• 13. I work hard at my studies because I find the material interesting.
• 17. I come to most classes with questions in mind that I want answering.

Items intended to indicate ‘deep strategy’:

• 2. I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied.
• 6. I find most new topics interesting and often spend extra time trying to obtain more information about them.
• 10. I test myself on important topics until I understand them completely.
• 14. I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.
• 18. I make a point of looking at most of the suggested readings that go with the lectures.
Items intended to indicate ‘surface motive’:

- 3. My aim is to pass the course while doing as little work as possible.
- 7. I do not find my course very interesting so I keep my work to the minimum.
- 11. I find I can get by in most assessments by memorizing key sections rather than trying to understand them.
- 15. I find it is not helpful to study topics in depth. It confuses and wastes time, when all you need is a passing acquaintance with topics.
- 19. I see no point in learning material which is not likely to be in the examination.

Items intended to indicate ‘surface strategy’:

- 4. I only study seriously what’s given out in class or in the course outlines.
- 8. I learn some things by rote, going over and over them until I know them by heart even if I do not understand them.
- 12. I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra.
- 16. I believe that lecturers shouldn’t expect students to spend significant amounts of time studying material everyone knows won’t be examined.
- 20. I find the best way to pass examinations is to try to remember answers to likely questions.

(Source: Bigg et al., 2001)
Prior studies have shown that the R-SPQ-2F with two factors, namely DA and SA best described the SAL (Gijbels et al., 2005; Zeegers, 2001). The R-SPQ-2F is designed to reflect SAL in their current teaching context (Biggs et al., 2001). English constitutes the instruction language in the institution; therefore, the questionnaires did not have to be translated.

### 3.4.2 Why the R-SPQ-2F?

The rationale behind the choice of the R-SPQ-2F was because it was a suitable tool for gauging the SAL in this study, as there have been a large number of studies which have used the R-SPQ-2F in both Western and Eastern contexts within the past few years. For example, Biggs et al. (2001) conducted a study consisting of responses to the R-SPQ-2F of undergraduate students from Australia (n=1146), and Hong Kong (n=1266) to examine the students learning approaches across different disciplines, level of study, and country. Leung et al.’s (2008) study, conducted in an Australian university, examined the relationship between learning approaches of health and science students (n=919) across five different disciplines and academic performance using the R-SPQ-2F.

Validation of the instrument was conducted in various countries. For instance, Stes, De Maeyer, and Van Petegem (2013) work culminated in the R-SPQ-2F Dutch version while the study by Justicia et al. (2008) yielded the R-SPQ-2F Spanish version. The studies, as mentioned earlier, showed that two factors effectively capture the R-SPQ-2F’s latent structure. The translation of the tool in various languages facilitated its use and validation across contexts.

In addition, Table 3-3 presents a summary of some of the research studies using the R-SPQ-2F.
Table 3-3: Summaries of research studies using the R-SPQ-2F

<table>
<thead>
<tr>
<th>Authors (and year)</th>
<th>Samples</th>
<th>Disciplines</th>
<th>Purposes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cetin (2016)</td>
<td>USA (n=166)</td>
<td>Early childhood education</td>
<td>Examine relationship between SAL, age, and GPA</td>
</tr>
<tr>
<td>Chan (2016)</td>
<td>Hong Kong (n=404)</td>
<td>Business</td>
<td>Examine relationship between SAL, extracurricular activities, and academic achievement</td>
</tr>
<tr>
<td>Everaert et al. (2017)</td>
<td>Central European (n=386)</td>
<td>Accounting</td>
<td>Examine relationship between SAL, motivation, time spend, and academic achievement</td>
</tr>
<tr>
<td>Howson (2013)</td>
<td>UK (n=53)</td>
<td>Social work</td>
<td>Examine SAL of different study mode and assess factors that contribute to different SAL</td>
</tr>
<tr>
<td>Jayawardena et al. (2013)</td>
<td>Sri Lanka (n=74)</td>
<td>Dental</td>
<td>Examine relationship between SAL and academic achievement</td>
</tr>
<tr>
<td>Kyndt et al. (2012)</td>
<td>Central European (n=108)</td>
<td>Educational sciences</td>
<td>Examine relationship between SAL, perceived workload, motivation, and working memory capacity (WMC)</td>
</tr>
<tr>
<td>Lake &amp; Boyd (2015)</td>
<td>Australia (n=504)</td>
<td>Not reported</td>
<td>Examine relationship between SAL, age, and gender</td>
</tr>
<tr>
<td>Salamonson et al. (2013)</td>
<td>Australia (n=919)</td>
<td>Health and science</td>
<td>Examine relationship between SAL and academic achievement across different disciplines</td>
</tr>
<tr>
<td>Shah et al. (2016)</td>
<td>Nepal (n=372)</td>
<td>Medical, dental and nursing</td>
<td>Examine relationship between SAL, age, gender, and disciplines</td>
</tr>
<tr>
<td>Xie &amp; Zhang (2015)</td>
<td>China (n=443)</td>
<td>Science and humanities</td>
<td>Examine relationship between SAL, demographics, personality, and ability</td>
</tr>
<tr>
<td>Yonker (2011)</td>
<td>USA (n=56)</td>
<td>Psychology</td>
<td>Examine relationship between SAL, age, and assessment methods</td>
</tr>
</tbody>
</table>

3.4.3 Validity and reliability of the R-SPQ-2F

Statistical analysis into the validity and reliability of the original English R-SPQ-2F has indicated acceptable levels along the primary dimension of deep versus surface approach (Biggs et al., 2001). For example, the developers of the R-SPQ-2F (Biggs et al., 2001) achieved a Cronbach alpha of 0.73 for DA and 0.64 for SA in their trial of the instrument with a sample that featured 495 undergraduate students from a variety of disciplines across each year of study from a Hong Kong university. Furthermore, a confirmatory factor analysis (CFA) supported the unidimensionality of the four subscales, with Cronbach’s alpha values of 0.62, 0.63, 0.72, and 0.57 for the DM factor, DS factor, SM factor, and SS factor, respectively (Biggs et al., 2001).
Gijbels et al. (2005) concluded that the R-SPQ-2F internal reliability results on the primary approach dimension (deep and surface) are sufficiently good to confirm the R-SPQ-2F as a useful instrument for research and for evaluating the learning processes of students in classrooms. Chan and Leung (2001) researched the psychometric properties and the implementation of the R-SPQ-2F in the Hong Kong Chinese context. The investigation results provided reasonable and reliable coefficients and goodness of fit for the two-factor model. The R-SPQ-2F Cronbach alpha values (Biggs et al., 2001; Gijbels et al., 2005) alongside those in the study by Chan and Leung (2001) are illustrated in Table 3-4.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep approach</td>
<td>0.73</td>
<td>0.76</td>
<td>0.73</td>
</tr>
<tr>
<td>Surface approach</td>
<td>0.64</td>
<td>0.78</td>
<td>0.75</td>
</tr>
<tr>
<td>Deep motive</td>
<td>0.62</td>
<td>0.61</td>
<td>0.60</td>
</tr>
<tr>
<td>Deep strategy</td>
<td>0.63</td>
<td>0.58</td>
<td>0.54</td>
</tr>
<tr>
<td>Surface motive</td>
<td>0.72</td>
<td>0.69</td>
<td>0.65</td>
</tr>
<tr>
<td>Surface strategy</td>
<td>0.57</td>
<td>0.48</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Justicia et al. (2008) suggested that the factor structure of the R-SPQ-2F should be used to measure the deep and surface approaches. However, it did not provide empirical support for the four-factor structure. These authors, thus, concluded that the latent structure of the R-SPQ-2F would be better represented by the two primary factors rather than the four sub-categories. The researcher anticipated based on past studies that the primary dimension would yield acceptably high alpha coefficients to allow the researcher to conduct further analysis and interpretation based on the questionnaire results. For this study, the SPSS software package was used to generate the Cronbach’s alpha coefficients from the survey data for each of the primary dimensions (deep and
surface) and the sub-dimensions (motivation and strategy). The results and their implications are discussed in Section 4.2.

3.5 Pilot study

Piloting the study allows the researcher the opportunity to assess the adequacy and effectiveness of research instruments, and also acquaints the researcher with the research process (Blaxter, Hughes, & Tight, 2001; Marczyk, DeMatteo, & Festinger, 2005). The pilot study in this research was conducted in two phases where the first phase of the pilot was undertaken to assess whether students experience difficulties in completing the questionnaire, and also the data from the pilot was then used to draft the focus group interview questions. The second phase of the pilot was conducted to appraise the suitability of proposed interview questions. The pilot study was conducted with a convenience sample featuring the third-year computing students as these students did not constitute the target for the primary survey as they were in their last year of a degree programme.

3.5.1 Pilot for the quantitative study

Before the main research, a pilot study was undertaken after classes with ten third-year students within week two of the academic year 2016-2017 using paper copies of the questionnaire to determine ambiguities as students might misinterpret certain contexts and terminology utilised within the statements for the items. Students received a brief regarding the use of findings and results, the questionnaire objectives, and the purpose of the pilot study and that anonymity would be maintained throughout the study. All students indicated they comprehended the questions and considered the survey user-friendly.
The pilot study was undertaken by the researcher and had a time frame where students took 15-20 minutes completing it. Feedback showed that changes were not necessary for the R-SPQ-2F questionnaire.

3.5.2 Pilot for the qualitative study

The data from the first phase of the pilot survey was used to draft a list of interview questions for collecting data on SAL and factors that influence the student’s learning approaches. In order to test and check the interview questions’ relevancy, a validity check on the questions was carried out with two professional colleagues, and feedback received that the questions were valid because they help in the determination of the variables under investigation. A suggestion to explain the meaning of ‘approach to learning’ was recommended as students might find it difficult to understand.

This was followed by a pilot group interview conducted with five third-year students from the 2016-2017 cohort to trial the questions and to determine if any changes should be made. Respondents were asked to provide feedback regarding the interview questions because the pilot interview is aimed at determining if students encounter challenges in responding to the questions. The feedback indicated that one interview question was not appropriate and needed to be rephrased or elaborated. Thus, the feedback was reviewed and the question was modified (see Appendix B for the interview questions).

3.6 Quantitative approach

The purpose of the quantitative data collection in the study was to elicit the learning approaches of computing students and helped to establish whether or
not the learning approaches of students indeed were a significant factor in determining the academic performance of students. It also allowed for a comparison of the learning approaches between the GCE A-Level graduate students and polytechnic diploma graduate students. The employment of a quantitative method within the study emerged as the ideal means of describing the correlations between computing students’ academic performance, entry pathways, and learning approaches in higher education institutions (Punch, 2005). The quantitative data were obtained from two sources namely student feedbacks from a validated survey instrument, and the demographic information of the entire computing student population as of the end of 2017 such as age, entry pathway, gender, the average mark of all attempted courses, and year of study.

### 3.6.1 Main quantitative study

Ethical approval for conducting the study was acquired from the institution being investigated (see Appendix C), as well as the Research Ethics Committee at the University of Bristol (see Appendix D) before collecting data. Data collection for the study consisted of one validated survey instrument that comprised of two sections: (1) the first section was used for the collection of demographic information on the student, and (2) the second section was used for the collection of learning approaches information on the student. The approval to utilise the R-SPQ-2F instrument was given in the Biggs et al. (2001) paper. The researcher designed the initial section in the questionnaire to obtain the demographic information on the students such as age and gender, entry pathway, the programme wherein the students are enrolled, the students’ registration number, and name of students. A colleague to the researcher proofread the instrument, and it was piloted among ten third-year computing students (see Section 3.5.1).
The current academic performance used in this study is measured by the average of the marks obtained by a student in all attempted courses in the institution. The average marks were changed into the ‘standard U.K. undergraduate degree classification system’ to facilitate analysis of data. ‘First’ class typically being awarded to those who attained 70% and above, ‘Upper Second’ class (2:1) to those who scored between 60% and 69%, ‘Lower Second’ class (2:2) awarded to those attaining 50% and 59%, and ‘Third’ class degrees awarded to students attaining between 40% and 49%. Several studies have employed Grade Point Averages (GPA) for measuring learning outcomes, particularly when examining the correlation between academic performance and SAL (Byrne et al., 2002; Sadler-Smith, 1996; Trigwell & Prosser, 1991b). Here the researcher decided to use the average mark to measure the students’ academic performance instead of GPA because the first- and second-year students do not have their year two and year three marks respectively.

The administration of the R-SPQ-2F was through a paper-based format during lectures to three student cohorts in first, second, and third years in week two of the 2017-2018 academic year. The researcher noted that although paper questionnaires can be resource-intensive in terms of both labour and financial investment, this format typically garners much higher participant response rates than online survey completion (Dommeyer, Baum, Chapman, & Hanna, 2002; Nulty, 2008). The researcher watched the self-administering of questionnaires to facilitate prompt feedback to respondent questions, and so that the researcher might also ensure consistent communication of instructions and study objectives (Cohen, Manion, & Morrison, 2011). The main disadvantage linked to this method is that the researcher’s presence might compel respondents to fill the entire questionnaire (Baruch & Holtom, 2008;
Cohen et al., 2011). Students were briefed on the purpose of the research and the original questionnaire was acknowledged as the intellectual property of Biggs et al. (2001) (see Appendix A and Appendix E). Taking part in the study was voluntary, thus the participants were urged to deliberate upon their general approach to learning but were not asked to link their R-SPQ-2F responses to particular courses, assessments, or teaching methods when responding to the questionnaire. Students were permitted a maximum of twenty minutes for completion of the R-SPQ-2F questionnaire and were allowed to complete the questionnaire anonymously or withdraw at any point of this study without having to provide any reasons. Participants did not receive any financial compensations or rewards for taking part in the study.

The researcher distributed 415 questionnaires to respondents (the total computing student population) that willingly chose to take part, and 76% (316) of the questionnaires were returned, with five of them being declared non-usable as they were not completely filled in, and thus were omitted in the results generation because of missing information. The requirement for each questionnaire to be processed was that all the 20 items had to be responded to. A further 28 respondents were excluded for the main analysis because they had other qualifications instead of diploma and GCE A-Level as the main entry qualification or had not specified their entry qualification. Therefore, data from 283 responses were used for further analysis. The participants comprised of 201 (71%) male students and 82 (29%) female students which are similar to the ratio in the whole cohort of 287 male (69.2%) and 128 female (30.8%). Failure to complete the survey tool was an indication that the respondent was unwilling to participate, whereas completing the survey meant consent.
All the responses were entered into Microsoft Excel spreadsheets and imported into SPSS version 24 for Windows (IBM Corp., Armonk) for analysis. Quality control procedures alongside standardised data entry were utilised including manual outlier reviews, consistency and range checks, and double entry.

The quantitative analyses below were conducted in this study.

**Construct validity and reliability**

As debated within Section 3.4.3, Biggs et al. (2001), Emilia et al. (2012), and Fryer, Ginns, Walker, and Nakao (2012) have previously tested the R-SPQ-2F instrument’s validity and reliability using different statistical methods including Cronbach’s alpha, exploratory or confirmatory factor analysis (EFA or CFA), and principal component analysis (PCA). Evaluating the R-SPQ-2F validity and reliability does not constitute the main reason for this research; however, the R-SPQ-2F structure of both factors (DA-SA) needed to be tested because the study participants were a different population of students compared to those within the samples of Biggs et al. (2001), Emilia et al. (2012), and Fryer et al. (2012). In view of this, the scales and subscales’ validity for the R-SPQ-2F instrument were confirmed using PCA, whereas measurement of internal consistency was achieved using Cronbach’s alpha coefficient.

*Construct validity.* The principal component analysis was used to explore the underlying dimensions of 20 items of the R-SPQ-2F (Pett, Lackey, & Sullivan, 2003). Before the PCA was performed, the samples’ number coupled with the correlation strength between constructs was evaluated to ascertain if the specific data set is ideal for factor analysis (Pallant, 2013). The Kaiser-Meyer-Olkin (KMO) statistic was used for testing the sampling adequacy (Kaiser, 1970, 1974), whereas Bartlett’s sphericity test was used for evaluating the
correlation strength among variables by verifying the null hypothesis, that the initial correlation matrix constitutes an identity matrix (Bartlett, 1954; Field, 2000; Pallant, 2013). Kaiser (1970, 1974) suggests that KMO should have a bare lowest value of 0.5 and gave higher values qualitative descriptors, with values of 0.5-0.7 being considered mediocre, values of 0.7-0.8 are considered good, and values of 0.8-0.9 are considered great, whereas values exceeding 0.9 are considered superb.

In order to determine the number of factors that should be retained, Kaiser's criterion, Cattell's scree plot, and parallel analysis were implemented (Pett et al., 2003; Tabachnick, Fidell, & Ullman, 2007). Kaiser's criterion stated that eigenvalues exceeding one should be regarded as ideal for choosing to incorporate a factor for analysis (Catell, 1996). Likewise, a scree plot exhibits the number of factors against corresponding eigenvalues, thus enabling the researcher to ascertain the number of variables to be retrieved by locating a region, where the sharp drop called an 'elbow' is made by the curve (Catell, 1996). Parallel analysis (Horn, 1965) was added as a third criterion for selecting the number of factors to be retained for the PCA.

The varimax rotation method (Abdi, 2003; Pett et al., 2003) was implemented in order to clarify the relationship among factors. The varimax rotation process involves adjusting the coordinates of data that result from a principal components analysis, with the intention of maximising the variance shared among items (Pett et al., 2003). Maximising the variance generally means to increase the squared correlation of items related to one factor, while decreasing the correlation on any other factor. Therefore, the varimax rotation can simplify the loadings of items and more specifically identify the factor upon which data load (Abdi, 2003; Pett et al., 2003).
Factor structure (items associated with each factor) was determined based on the rotated component matrix (Pett et al., 2003). Comrey and Lee (1992) suggested that the general rules (could also be based on researchers’ preferences) of the loadings over 0.71 are considered excellent; 0.63 loadings are very good; 0.55 loadings are good; 0.45 loadings are fair, and 0.32 loadings are poor. The researcher used the 0.40 value in this study to determine the items associated with each factor.

Internal consistency – Cronbach alpha coefficient. Cronbach’s alpha analysis was included to test the internal consistency of the data (Cronbach, 1951). The Cronbach alpha coefficient offers a reliability estimate, thus is ideal for multiple item scales, which feature non-dichotomous items, that is, items which could individually be scored along several values), as is the case in the current study. Measurement of Cronbach alpha values for internal consistency was achieved by computing the Cronbach alpha coefficients for the DA and SA scales, whereas the DM, DS, SM, and SS subscales were computed using the R-SPQ-2F results. Cohen et al. (2011) guidelines interpret that Cronbach’s alpha values of above 0.70 indicate that a questionnaire is reliable and internally consistent for a participant sample:

+ 0.90 Very high reliable
0.80 - 0.90 Highly reliable
0.70 - 0.79 Reliable
0.60 - 0.69 Marginally/minimally reliable
- 0.60 Unacceptably low reliability

Some researchers have considered Cronbach’s alpha values of 0.60 as the lowest acceptable score (Cohen et al., 2011).
Descriptive and inferential statistics

Frequency tables (for categorical variables) and descriptive statistics such as means and standard deviations (SDs) (for continuous variables) were used to summarise the demographic variables including age, academic performance, entry pathway, gender, and year of study, and the scales of R-SPQ-2F, including the DA and SA scales, and the two subscales of DA (i.e. DM and SM) and SA (i.e. SM and SS). Normality of age, academic performance, and the scales and the subscales of R-SPQ-2F was examined via skewness, kurtosis, and histogram plots. Although the data of the scales of R-SPQ-2F, including the DA and SA scales, and the two subscales of DA (i.e. DM and SM) and SA (i.e. SM and SS) seemed to be normally distributed, the data for academic performance and age were not normally distributed.

Chi-squared tests of independence and Mann-Whitney U tests (Field, 2013) were conducted to determine (1) if there was a relationship between entry pathway and, age, gender, degree classification, and year of study; (2) if there was a relationship between learning approach (DA versus SA), and age, entry pathway, gender, degree classification, and year of study; and (3) within each learning approach (DA versus SA), if there was an association between the subscales (i.e. DM versus DS, and SM versus SS), and age, entry pathway, gender, degree classification, and year of study.

Three paired t-tests were conducted to determine if there was a statistically significant difference between the scores of DA and SA at each level of the year of study.
Independent sample t-tests (Field, 2013) (for categorical variables with two levels, such as gender and entry pathway), and one-way ANOVAs (Field, 2013) (for categorical variables with more than two levels, such as age, degree classification, and year of study) were conducted to determine if there was a statistically significant difference in the score of the scales of R-SPQ-2F, including the DA and SA scales, and the two subscales of DA (i.e. DM and SM) and SA (i.e. SM and SS) according to each demographic factor. If there was an overall statistically significant difference for the ANOVA, pairwise comparisons controlling for the family-wise error rate using Tukey HSD (Honestly Significant Difference) tests (Field, 2013) were performed to determine where the differences occurred between groups.

Two general linear models (Field, 2013) were conducted to determine (1) if there was a relationship between academic performance and the score of the scales of R-SPQ-2F, including the DA and SA scales, after controlling for entry pathway; and (2) if there was a relationship between academic performance and the two subscales of DA (i.e. DM and SM) and SA (i.e. SM and SS), after controlling for entry pathway. In the models, interaction effects of entry pathway and the scales and subscales of R-SPQ-2F were included in order to determine if the effects of SAL on academic performance depended on the entry pathway. As the academic performance was not normally distributed, the transformed variable, square of academic performance, was used as the dependent variables in the general linear models.

For any analyses, without further specification, a $p$-value less than 0.05 indicates significance. All $p$-values were two-sided.
3.7 Qualitative approach

The purpose of the in-depth qualitative study, on the other hand, was to collect data that could contextualise the quantitative data collected by the R-SPQ-2F and to gain more detailed descriptions of student motivations and strategies towards learning. From a qualitative perspective, the analysis reviewed examination of the participants’ said belief patterns, outward intentions, and general strategic approaches in order to dissect their academic activities that were otherwise unrevealed by the questionnaire and quantitative measurements. Therefore, the researcher determined that a group interview approach was more suitable for this study, even though participants might consider the lecturer/interviewer, and researcher figures of authority within the study institution, but from a pragmatic perspective, group interview approaches are less costly and are convenient in regard to obtaining extensive information (Hedges, 1985). Additionally, group interviews allow examination of students’ individual opinions, feelings, and thoughts regarding learning approaches and offer opportunities for discussing their experiences amongst themselves (Denzin & Lincoln, 1998).

3.7.1 Main qualitative study

First-year, second-year as well as third-year students that had taken part within the R-SPQ-2F questionnaire received invitation emails. When selecting the participants for the group interviews, the researcher ensures that every group should have a good mixture of male and female students from various entry pathways, and/or they had high and contrasting scores in either the deep or surface dimension. The following interview groups were formed that is two groups for first-year students, one group for second-year students, and one group for third-year students. Each group consist of four to six participants. If a
cohort had less than four student responses, emails were used for recruiting others (see Section 4.4 Table 4-22 for demographics comparison).

The researcher did consider the purposive sampling method for qualitative data collection but did not adopt it as she worried that she might not find enough students to participate in the group interviews. This is because the researcher feels Southeast Asian students are not able, willing and comfortable to participate actively even when opportunities are given to them. Furthermore, when students knew that the researcher has selected them for her current study, they might choose to act in a way that allows her to reach the conclusions that she expects to see. Thus, the participants in purposive sampling can manipulate the data collected, and then this process will become a waste of time and resources.

Interviews were organised with students who agreed to attend the scheduled interview. Of the 23 students who responded positively, 20 students were selected and arranged into four group interviews. Before the interview was conducted, students received an email with a short paragraph detailing the function of the group interviews, information that explained the venue and time, as well as a respondent information sheet to enable students to understand the context. All the interviews were conducted in February 2018 at the study institution, and the researcher scheduled the interviews during participants’ break times or after classes.

The interviews were conducted with the researcher in English. All interviews were conducted by the researcher to prevent potential across-group differences, which could emerge if different interviewers conducted the interviews (Dillon, Madden, & Firtle, 1994; Welch, 1985). All participants signed
the consent form before commencing (see Appendix F). To decrease the necessity for the researcher to take detailed minutes, which might interrupt or slow down the discussion flow, the researcher sought the consent of the interviewees to utilise a digital audio recorder for recording the interviews with anonymity. Each session of the interview took 30 to 45 minutes. The researcher embraced a semi-structured method, using the interview guide, which was prepared by the researcher, to allow coverage of all important questions (see Appendix B). Respondents were issued with a pre-loaded Starbucks SGD$10 card for their participation within the interviews.

At the end of the sessions, the recorded interviews underwent transcription, coding, and analysis. The researcher adopted Braun and Clarke (2006) thematic analysis to analyse the group interview transcripts. Braun and Clarke (2006) define thematic analysis as “a method for identifying, analysing and reporting patterns within data” (p.79). The analysis method was selected due to its flexibility as well as its ease of use, particularly for novice qualitative investigators (Braun & Clarke, 2006). Additionally, it constitutes an ideal technique if resources and time are scarce, as is the case within the current study. The process of analysing themes features the steps below:

- Acquaintance with transcribed data;
- Produce initial codes;
- Identify and simplify codes into possible thematic concerns;
- Review themes as well as generating ‘thematic maps’; and
- Theme definition and naming (Braun & Clarke, 2006, p.79).

Creswell (2009) notes that while “the traditional approach in social sciences is to allow the codes to emerge during the data analysis”, it is often helpful to use
pre-defined codes “that address a larger theoretical perspective in the research” (p.187). Therefore, this study involved a thematic analysis based on the Biggs et al.’s (2001) 3P model of teaching and learning theoretical framework as deductive reasoning to examine and code the data from the group interviews. The deductive analysis is an “effective way to analyse the data as it is informed by an established conceptual framework and sensitising concepts, or based on the act of preliminary coding of a small portion of the data” (Yukhymenko et al., 2014, p. 96). It is important to note that this process of data analysis was a recursive process, where the researcher moved between the various phases of thematic analysis when required (Braun & Clarke, 2006). Analysis of themes in the study was conducted manually with yellow highlighting to fit the identified themes under the rubric of the 3P model with major headings of ‘presage’, ‘process’, and ‘product’ (Biggs et al., 2001).

The highlighted thematic concerns were compiled within a Microsoft Word document to organise, remove, or collapse particular thematic concerns. The final result was a three-column table consisting of identified themes/subthemes, codes, and text that illustrated the themes/subthemes and codes. Different codes, that although interesting, but which failed to fit into themes and subthemes, were put to one side and reviewed again. If after re-evaluation, the codes did not fit an identified theme, and no further categories could be established, the data were discarded as being redundant information. The themes, subthemes, selected illustrative quotations, and findings are discussed in Section 4.4.

A colleague of the researcher who has experience in the areas of qualitative research coded the transcript independently. The two sets of results were compared in the early stage of data analysis to increase reliability, and a master
list of codes that both of them agreed on was used in the analysis. Hence, triangulation will be established by using multiple data sources which included interviews with participants during the early stage of data analysis. A peer review of the interview transcripts and themes was completed by the same colleague of the researcher to ensure it was sensible and accurate. Overall, member checks enabled the participants to verify data, interpretations, as well as conclusions to help establish credibility. Member checks were achieved by emailing themes and transcripts to respondents to revise for precision and react to comments and transcripts. Because of this, checking for differences and similarities, finding patterns, and themes enabled the researcher to understand the problem being investigated, how participants view the issue being examined, as well as the type and nature of correlations involved. The data from respondents was accorded anonymity by allocating random numbers to all students. Thus, the report of the findings is in the form of group patterns rather than individuals.

3.8 Ethical considerations

The whole process of investigation was directed by ethical guidelines from the British Educational Research Association (BERA) (BERA, 2011) and the Personal Data Protection Act (PDPA) (PDPA, 2014). Within the study, the researcher took appropriate measures and precautions, which relate to ethical concerns in the collection of data and analysis; however, specific ethical concerns might probably arise. First, all participants were briefed on the reasons of the research, their participation, analysis and recording of their involvement as well as interactions in the study from the beginning, as advocated by PDPA (PDPA, 2014). Participants were given a ‘Participant
Consent Form’ (see Appendix F) and the opportunity to discuss the research verbally with the researcher. Concerns could be for disclosure from the institution of study and students, data use, privacy, and voluntary informed consent. Data collection was carried out in a classroom, due to the venue’s accessibility, familiarity and also being a less risky and tense environment for the participants. The interviews’ transcripts were anonymised and the respondents’ were allocated pseudonyms in any discussion of the interview data.

The data that the researcher collected was stored in manual files (for example hardcopies of transcripts), in the researcher’s office and home personal computer (PC) (for example softcopies of audio files). To ensure the highest level of data protection, physical movement of the data collected was limited to a minimum (for example researcher office and home PC). The hard copies of transcripts were stored in a lockable filing cabinet inside the researcher’s office. The researcher's office and home PC, and her back-up external hard disk were password-protected at the login and individual file level. The destruction of the collected data will be undertaken after the end of the study.

Secondly, the researcher was mindful about the possible vulnerability of the respondents and if they felt obligated to participate in the study. As this piece of research was conducted at the institution where the researcher was among the teaching faculty, it brought to certain points revolving around hierarchical relationships, and possible adverse experiences had by the students. Even though the researcher found it convenient to access readily available respondents within her place of work to undertake research, the researcher should note that the respondents do not experience pressure of taking part in the study, mainly because of the role she plays as the Head of Programme
(HOP), which may be considered a senior position within the institution. Therefore, the researcher informed the participants that they should participate voluntarily, and they could withdraw at any time for any reason, and without need for an explanation before, during, or after the research. Lastly, the researcher was also cautious of her role as the HOP-researcher that might have the potential for a conflict of interest on the part of the researcher, as her role within the study institution required her to provide academic advice to students, and also to adjunct lecturers. In a bid to handle research biasness, the researcher implemented a reflexive method and keeping in mind the impacts of bias in the entire research, especially during the analytical process and results interpretation and presentation.

There were no identified risks associated with participating in this study, however, if participants had concerns with the conduct of the research, the participants were able to contact the researcher reporting officer or her supervisor.

3.9 Conclusion

The epistemological and methodological position which was used in this study was grounded in the pragmatic paradigm of mixed methods design that featured both quantitative and qualitative approaches. The quantitative methods were employed to test and explain how the relationships between entry pathways (presage), approaches to learning (process), and academic performance (product) are related to each other. While the qualitative method provides data that give detailed descriptions on how the participants create strategies of solving their academic challenges determined by their motives.
The survey participants and procedures were introduced. The chapter mainly highlights the processes involved in developing instruments of data collection, which include survey guides and group interviews. Moreover, the chapter describes the different phases of collecting data and presents a description of the components used within the data analysis and techniques to ensure the study's validity and reliability. The ethical considerations, which underlie the whole process of the study were introduced. The processes of approving ethics alongside safeguards, which protect human participants’ rights, were discussed. The quantitative analysis of the questionnaire data, the introduction of the quantitative results, the data from the qualitative evaluations of the interviews and those results will comprise the following chapter.
CHAPTER 4 RESULTS

4.1 Introduction
The results for the quantitative data collected from the Revised Two Factor Study Process Questionnaire (R-SPQ-2F), including demographics, and students’ approaches to learning (SAL) are presented in this chapter. Moreover, it presents participants academic performance and offers the correlations with SAL and entry pathway, where measurement of academic performance in the study is based on average marks. Following this, the chapter provides the findings from the qualitative data derived from group interviews before ending with conclusions.

4.2 Validity and reliability of the R-SPQ-2F instrument
A total of 316 questionnaires were returned and out of these 1.6% (or five questionnaires) contained missing data at the level of the item. The researcher chose not to utilise incomplete questionnaires during the results generation process because non-completed questionnaires were an indication that the respondents did not wish to proceed in the study and the small percentage involved would have little impact on the results.

The scales and subscales’ validity for the R-SPQ-2F instrument were confirmed using principal component analysis (PCA). For the PCA, the Kaiser-Meyer-Olkin (KMO) statistic was used for testing the sampling adequacy (Kaiser, 1970, 1974), and Bartlett’s sphericity test was used for evaluating the correlation strength among variables (Bartlett, 1954). The KMO and Bartlett’s
sphericity test revealed that factor analysis was appropriate for the data of this study (KMO=0.839; $X^2(190)=1527.234$, $p<0.001$ for Bartlett’s test; see Tables 4-1 and 4-2).

<table>
<thead>
<tr>
<th>KMO and Bartlett’s Test of Sphericity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaiser-Meyer-Olkin Measure of Sampling Adequacy</td>
</tr>
<tr>
<td>Bartlett’s Test of Sphericity</td>
</tr>
<tr>
<td>Approx. Chi Square</td>
</tr>
<tr>
<td>Df</td>
</tr>
<tr>
<td>Sig.</td>
</tr>
</tbody>
</table>

**Table 4-1:**

<table>
<thead>
<tr>
<th>DA</th>
<th>Pearson Correlation</th>
<th>SA</th>
<th>DM</th>
<th>DS</th>
<th>SM</th>
<th>SS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.253**</td>
<td>0.913**</td>
<td>0.915**</td>
<td>-0.292**</td>
<td>-0.167**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td></td>
<td>311</td>
<td>311</td>
<td>311</td>
<td>311</td>
<td>311</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.251**</td>
<td>-0.211**</td>
<td>0.902**</td>
<td>0.907**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>311</td>
<td>311</td>
<td>311</td>
<td>311</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 4-2:**

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation</th>
<th>SA</th>
<th>DM</th>
<th>DS</th>
<th>SM</th>
<th>SS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.670**</td>
<td>-0.297**</td>
<td>-0.159**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>0.005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>311</td>
<td>311</td>
<td>311</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.237**</td>
<td>-0.146**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;0.001</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>311</td>
<td>311</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Pearson Correlation</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.637**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt;0.001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>311</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: ** Correlation is significant at the 0.01 level (2-tailed).

Before a factor analysis can be undertaken, the researcher needs to decide the number of factors that should be extracted. To determine the number of factors to be extracted in the PCA, the current study examined the results of Kaiser’s criterion, Cattell’s scree plot, and parallel analysis.

Based on the illustration in Table 4-3, the initial four eigenvalues of the data set had values 4.684, 2.688, 1.386, and 1.135, which is an indication that extraction of four factors is optimal because the value for the initial four factors are all greater than one. The approach of looking at eigenvalues can overestimate the number of components required, so an inspection of the scree plot was
undertaken to locate the point at which the last significant drop or break occurs
(see Figure 4-1).

The scree plot of eigenvalues versus the number of factors (see Figure 4-1)
indicates that the first three factors would be adequate to explain a significant
proportion of the variance because the elbow emerges following the third factor.
However, further analysis of the plot reported that only two variables were at
the point at which the curve becomes nearly parallel to the horizontal axis.

Table 4-3: Principal component extraction

<table>
<thead>
<tr>
<th>Comp.</th>
<th>Initial Eigenvalues</th>
<th>Extraction Sums of Squared Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Var.</td>
</tr>
<tr>
<td>1</td>
<td>4.684</td>
<td>23.418</td>
</tr>
<tr>
<td>2</td>
<td>2.688</td>
<td>13.438</td>
</tr>
<tr>
<td>3</td>
<td>1.386</td>
<td>6.928</td>
</tr>
<tr>
<td>4</td>
<td>1.135</td>
<td>5.675</td>
</tr>
<tr>
<td>5</td>
<td>0.977</td>
<td>4.887</td>
</tr>
<tr>
<td>6</td>
<td>0.906</td>
<td>4.528</td>
</tr>
<tr>
<td>7</td>
<td>0.848</td>
<td>4.239</td>
</tr>
<tr>
<td>8</td>
<td>0.827</td>
<td>4.135</td>
</tr>
<tr>
<td>9</td>
<td>0.762</td>
<td>3.810</td>
</tr>
<tr>
<td>10</td>
<td>0.698</td>
<td>3.489</td>
</tr>
<tr>
<td>11</td>
<td>0.663</td>
<td>3.314</td>
</tr>
<tr>
<td>12</td>
<td>0.635</td>
<td>3.174</td>
</tr>
<tr>
<td>13</td>
<td>0.597</td>
<td>2.986</td>
</tr>
<tr>
<td>14</td>
<td>0.558</td>
<td>2.768</td>
</tr>
<tr>
<td>15</td>
<td>0.523</td>
<td>2.615</td>
</tr>
<tr>
<td>16</td>
<td>0.484</td>
<td>2.319</td>
</tr>
<tr>
<td>17</td>
<td>0.439</td>
<td>2.190</td>
</tr>
<tr>
<td>18</td>
<td>0.421</td>
<td>2.104</td>
</tr>
<tr>
<td>19</td>
<td>0.407</td>
<td>2.036</td>
</tr>
<tr>
<td>20</td>
<td>0.384</td>
<td>1.920</td>
</tr>
</tbody>
</table>

Notes: Extraction Method = Principal Component Analysis.
The parallel analysis estimates of the upper 95\textsuperscript{th} percentile for the first four eigenvalues were 1.558, 1.450, 1.373, and 1.308 (see Table 4-4). Thus, the parallel analysis of 1000 random correlation matrices using O'Connor's (2000) program implied that only the first three observed eigenvalues exceeded their respective upper 95\textsuperscript{th} percentile and thus should be extracted.

Although parallel analysis suggested by Horn (1965) is another approach to determine the number of factors, but the researcher consented to use the structure of the two factors for the following reasons; (1) the researcher fitted the model into the four subscales and found that the subscales does not fit into the four factors; (2) other studies had tested the two factors and found them
ideal (Justicia et al., 2008; Immekus & Imbrie, 2010); and (3) as a motivation to the researcher for going for the simpler two factors solution.

Based on the information, a PCA containing the varimax rotation was conducted, forming two factors by allowing each question to correspond to a single factor loading of more than 0.4, forming similar question sets as those linked with deep approach (DA) and surface approach (SA) (see Table 4-5). Fixing both factors, the described overall variance of the instrument becomes 36.9% (i.e. the two factors explain roughly 37% of the variability in the 20 items). Factor One has ten items related to DA, including deep motive (DM) and deep strategy (DS) and is thus denoted ‘Deep Approach’. This factor explains 23.4% of the variability in the measures; Factor Two is composed of ten items, including surface motive (SM) and surface strategy (SS), and is thus denoted ‘Surface Approach’. This factor explains a further 13.4% of the variability.
In the current study, Cronbach’s alpha was used for assessing the reliability and internal consistency of the constructs. Reliable Cronbach’s alpha values of 0.73 for the DA and 0.64 for the SA scales were found within the tool (Biggs et al., 2001). Although the factor analysis was not able to identify the subscales due to finding only two factors we can still explore the subscales as found by Biggs et al. (2001) using the data in this study.

The Cronbach’s alpha reliability coefficient for each of the R-SPQ-2F subscales were DM at 0.62, DS at 0.63, SM at 0.72, and SS at 0.57 (Biggs et al., 2001, p.142). Results of the study by Biggs et al. (2001) showed that the R-SPQ-2F questionnaire had acceptable Cronbach alpha values for scale reliability. Additional Cronbach’s alpha values cited for past studies utilising the R-SPQ-2F are presented in Table 4-6.

<table>
<thead>
<tr>
<th>Table 4-5: Factor loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items</td>
</tr>
<tr>
<td>1. I find that at times studying gives me a feeling of deep personal satisfaction</td>
</tr>
<tr>
<td>2. I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied</td>
</tr>
<tr>
<td>3. My aim is to pass the course with doing as little work as possible</td>
</tr>
<tr>
<td>4. I only study seriously what’s given out in class or in the course outlines</td>
</tr>
<tr>
<td>5. I feel that virtually any topic can be highly interesting once I get into it</td>
</tr>
<tr>
<td>6. I find most new topics interesting and often spend extra time trying to obtain more information about them</td>
</tr>
<tr>
<td>7. I do not find my course very interesting so I keep my work to the minimum</td>
</tr>
<tr>
<td>8. I learn some things byrote,goingoverandoverthentillIknowthembyheartevenifIdonotunderstandthem</td>
</tr>
<tr>
<td>9. I find that studying academic topics can at times be as exciting as a good novel or movie</td>
</tr>
<tr>
<td>10. I test myself only on important topics until I understand them completely</td>
</tr>
<tr>
<td>11. I find I can get by in most assessments by memorising key sections rather than trying to understand them</td>
</tr>
<tr>
<td>12. I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra</td>
</tr>
<tr>
<td>13. I work hard at my studies because I find the material interesting</td>
</tr>
<tr>
<td>14. I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes</td>
</tr>
<tr>
<td>15. I find it is not helpful to study topics in depth as it confuses and wastes time when all you need is a passing acquaintance with topics</td>
</tr>
<tr>
<td>16. I believe that lectures shouldn’t expect students to spend significant amounts of time</td>
</tr>
<tr>
<td>17. I come to most classes with questions in mind that I want answering</td>
</tr>
<tr>
<td>18. I make a point of looking at most of the suggested readings that go with the lectures</td>
</tr>
<tr>
<td>19. I see no point in learning material which is not likely to be in the examination</td>
</tr>
<tr>
<td>20. I find the best way to pass examinations is to try to remember answers to likely questions</td>
</tr>
</tbody>
</table>
The Cronbach’s alpha reliability coefficient for the R-SPQ-2F two main scales alongside the four subscales of SAL scores for the current study are reported in Table 4-7. Other than comparing with the original Biggs et al. (2001) Cronbach’s alpha values, the study also compares the Cronbach’s alpha values from Shah et al.’s (2016) study because the sample size of the Shah et al. (2016) study is closest to this current study. The Cronbach’s alpha coefficients were 0.82 and 0.77 for DA and SA, respectively. The alpha values of the four subscales ranged between 0.62 (SS) and 0.70 (DS). The high Cronbach’s alpha values for DA and SA for this study replicated the findings of other studies, including Vanthournout, Coertjens, Gijbels, and Van Petegem (2008), Immekus and Imbrie (2010), and Mogre and Amalba (2014). According to Cohen et al. (2011), Cronbach’s alpha greater than or equal to 0.70 indicate that a questionnaire is reliable and internally consistent. However, researchers have also considered Cronbach’s alpha values of 0.60 as the lowest acceptable score (Cohen et al., 2011). As the Cronbach’s alpha values for the two scales and the four subscales of R-SPQ-2F were all greater than 0.60, it was concluded that the R-SPQ-2F has satisfactory internal consistency. Also, compared to other studies, the degree of internal consistency obtained in this study is higher, which means the scales and subscales are more coherent and consistent for further analysis or discussion.

Table 4-6: Cronbach’s alpha values reported by studies using R-SPQ-2F

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>DA</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everaert et al. (2017)</td>
<td>388</td>
<td>0.76</td>
<td>0.75</td>
</tr>
<tr>
<td>Henoch et al. (2014)</td>
<td>126</td>
<td>0.75</td>
<td>0.67</td>
</tr>
<tr>
<td>Immekus &amp; Imbrie (2010)</td>
<td>1480</td>
<td>0.81</td>
<td>0.80</td>
</tr>
<tr>
<td>Mogre &amp; Amalba (2014)</td>
<td>189</td>
<td>0.80</td>
<td>0.76</td>
</tr>
<tr>
<td>Shah et al. (2016)</td>
<td>372</td>
<td>0.71</td>
<td>0.72</td>
</tr>
<tr>
<td>Vanthournout et al. (2008)</td>
<td>100</td>
<td>0.81</td>
<td>0.69</td>
</tr>
<tr>
<td>Yonker (2011)</td>
<td>56</td>
<td>0.74</td>
<td>0.68</td>
</tr>
</tbody>
</table>
Table 4-7: Cronbach’s alpha values comparison

<table>
<thead>
<tr>
<th>Scales and subscales</th>
<th>No of items</th>
<th>Current study (N=311)</th>
<th>Biggs et al. (2001) (N=495)</th>
<th>Shah et al. (2016) (N=372)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA</td>
<td>10</td>
<td>0.82</td>
<td>0.73</td>
<td>0.71</td>
</tr>
<tr>
<td>SA</td>
<td>10</td>
<td>0.77</td>
<td>0.64</td>
<td>0.72</td>
</tr>
<tr>
<td>DM</td>
<td>5</td>
<td>0.69</td>
<td>0.62</td>
<td>0.56</td>
</tr>
<tr>
<td>DS</td>
<td>5</td>
<td>0.70</td>
<td>0.63</td>
<td>0.56</td>
</tr>
<tr>
<td>SM</td>
<td>5</td>
<td>0.64</td>
<td>0.72</td>
<td>0.62</td>
</tr>
<tr>
<td>SS</td>
<td>5</td>
<td>0.62</td>
<td>0.57</td>
<td>0.48</td>
</tr>
</tbody>
</table>

4.3 Quantitative analysis

The R-SPQ-2F was used as a survey instrument for gathering data to respond to the first research question (RQ): ‘What learning approaches (surface versus deep) do computing students’ have in the Singapore transnational higher education institution context?’. Moreover, the quantitative data gathered for this study was utilised for examining the correlations between the characteristics of students such as learning approaches, study year, gender, entry pathway, and age with specific reference to the second RQ: ‘Is there any impact of various entry pathways (diploma against A-Level) on students’ learning approaches?’. Afterwards, the results of the survey were used for exploring the correlation between academic performance and SAL to respond to the third RQ that is ‘Is there a correlation between academic attainment and students’ learning approaches?’.

Data analysis and graphical outputs of the study was carried out using Statistical Package for the Social Sciences version 24 (SPSS v24) and the Microsoft Excel 2016 software. To ensure the robustness of the results, significant associations were evaluated by using a probability level of $p<0.05$.

4.3.1 Participant response rate

316 undergraduate computing students volunteered to participate in this study, thus representing an overall participant response rate of 76% (316 out of 415 students). The response rate was 83% (186 out of 223 students), 82% (89 out
of 109 students) and 49% (41 out of 83 students) for years one, two, and three of the programme respectively. The researcher feels the lack of participation from year three students could be that they did not see ‘what is in it for them’ (i.e. they did not see any benefits in participating in the survey) since they were graduating soon. Students not participating in the study were either not interested in participating in the survey or absent from the class on the day of data collection. The researcher attempted to reduce bias by conducting a pilot survey (see Section 3.5.1), using paper questionnaires conducted during class time, and reassuring participants that the data collected will be kept confidential. Although considerable resources were spent on improving data collection procedures, so as to prevent non-response from occurring, the researcher felt that the use of incentives and follow-up with the non-respondents was not required since the participants were informed not to respond if they did not consent to take part in the survey.

Furthermore, the study has achieved an overall response rate of 76%, and according to Babbie (2007, p. 262) that “a response rate of 60 percent is good; a response rate of 70 percent is very good” for social sciences research. Five questionnaires were not completed, and 28 participants were omitted from the quantitative analysis because they had other qualifications instead of GCE A-Level or diploma as the key entry criteria or did not specify their entry qualifications. Therefore, within the data analysis, 283 feedbacks were utilised. The distribution of valid cases from different years of study is provided in Table 4-8.
<table>
<thead>
<tr>
<th>Year</th>
<th>Invited</th>
<th>Responses</th>
<th>Valid responses</th>
<th>Valid % (percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>223</td>
<td>186</td>
<td>172&lt;sup&gt;3&lt;/sup&gt;</td>
<td>77.0</td>
</tr>
<tr>
<td>Two</td>
<td>109</td>
<td>89</td>
<td>75&lt;sup&gt;4&lt;/sup&gt;</td>
<td>69.0</td>
</tr>
<tr>
<td>Three</td>
<td>83</td>
<td>41</td>
<td>36&lt;sup&gt;5&lt;/sup&gt;</td>
<td>43.0</td>
</tr>
<tr>
<td>Total</td>
<td>415</td>
<td>316</td>
<td>283</td>
<td>68.0</td>
</tr>
</tbody>
</table>

### 4.3.2 Demographic overview

Table 4-9 presents the demographics of the 283 participants of the study. Of the 283 undergraduate computing students, 111 (39.2%) were students with A-Level qualification and 172 (60.8%) students were Polytechnic graduates. The age of participants ranged from 17 to 35 with a median age of 22 (IQR=2). The majority of the sample were between the ages of 21 to 24 years old (73.5%) and male (71%). The higher male percentage is an indication that computing is still a male-dominated industry (Ballard, Scales, & Edwards, 2006). Over 40% of the participants (42.4%) were first class students. The median course mark for the students was 67 (IQR=17.5). Slightly over 60% of the participants (60.8%) were in their first year of study.

---

<sup>3</sup> Two incomplete questionnaires and 12 different entry qualifications  
<sup>4</sup> Three incomplete questionnaires and 11 different entry qualifications  
<sup>5</sup> Five different entry qualifications
Table 4-9: Participants demographic overview

<table>
<thead>
<tr>
<th>Variables</th>
<th>N=283</th>
</tr>
</thead>
<tbody>
<tr>
<td>% (N)</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>17 - 20</td>
<td>17.0% (48)</td>
</tr>
<tr>
<td>21 - 24</td>
<td>73.5% (206)</td>
</tr>
<tr>
<td>25 &amp; above</td>
<td>9.5% (27)</td>
</tr>
<tr>
<td>Overall age (Median (IQR))</td>
<td>22 (2)</td>
</tr>
<tr>
<td>Entry pathway</td>
<td></td>
</tr>
<tr>
<td>A-Level</td>
<td>39.2% (111)</td>
</tr>
<tr>
<td>Polytechnic</td>
<td>60.8% (172)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>29.0% (82)</td>
</tr>
<tr>
<td>Male</td>
<td>71.0% (201)</td>
</tr>
<tr>
<td>Degree classification</td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>42.4% (120)</td>
</tr>
<tr>
<td>2:1</td>
<td>28.6% (81)</td>
</tr>
<tr>
<td>2:2</td>
<td>19.1% (54)</td>
</tr>
<tr>
<td>Third</td>
<td>6.7% (19)</td>
</tr>
<tr>
<td>Ordinary</td>
<td>3.2% (9)</td>
</tr>
<tr>
<td>Overall course mark (Median (IQR))</td>
<td>67 (17.5)</td>
</tr>
<tr>
<td>Year of study</td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>60.8% (172)</td>
</tr>
<tr>
<td>Two</td>
<td>26.5% (75)</td>
</tr>
<tr>
<td>Three</td>
<td>12.7% (36)</td>
</tr>
</tbody>
</table>

Notes: Skewness for age and course mark=1.037 and 0.968, kurtosis for age and course mark=6.072 and 2.402, indicating non-normal distribution data (Leech, Barrett, & Morgan, 2014). As age and course mark may not be normally distributed, median and interquartile range (IQR) were reported, instead of mean and standard deviation.

Table 4-10 gives an overview of the demographic information of the student participants by their entry pathway. According to the results of chi-square tests and Mann-Whitney U tests, there was a statistically significant relationship between entry pathway and, age (U=14861.5, z=8.036, p<0.001) and gender ($X^2(1)=4.424$, $p=0.035$). In particular, students with A-Level entry-level (Median=21, IQR=2) were statistically significantly younger than students with polytechnic entry pathway (Median=23, IQR=1.8). Furthermore, males were statistically significantly more likely to have a polytechnic entry pathway than females (percent polytechnic entry pathway that is male=75.6% and percent A-level entry pathway that is male=64%). There was a statistically significant difference in course marks between the A-Level entry pathway students and polytechnic entry pathway students (U=7527, z=-3.004, p=0.003). In particular, students with A-Level entry-level (Median=70.75, IQR=19) had statistically significantly better grades than students with polytechnic entry pathway.
(Median=65.34, IQR=15.60). There was however no significant relationship between entry pathway and year of study ($X^2(2)=3.835, p=0.147$).

Table 4-10: Participants demographic data split by the entry pathway

<table>
<thead>
<tr>
<th>Variables</th>
<th>A-Level (N=111)</th>
<th>Polytechnic (N=172)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (N)</td>
<td>% (N)</td>
</tr>
<tr>
<td><strong>Age</strong> ($U = 14861.5, z = 8.036, p &lt; 0.001$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall age (Median (IQR))</td>
<td>21 (2)</td>
<td>23 (1.8)</td>
</tr>
<tr>
<td>17 - 20</td>
<td>36.0% (40)</td>
<td>4.7% (8)</td>
</tr>
<tr>
<td>21 - 24</td>
<td>59.5% (66)</td>
<td>82.6% (142)</td>
</tr>
<tr>
<td>25 &amp; above</td>
<td>4.5% (5)</td>
<td>12.8% (22)</td>
</tr>
<tr>
<td><strong>Gender</strong> ($X^2(1) = 4.424, p = 0.035$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>36.0% (40)</td>
<td>24.4% (42)</td>
</tr>
<tr>
<td>Male</td>
<td>64.0% (71)</td>
<td>75.6% (130)</td>
</tr>
<tr>
<td><strong>Degree classification</strong> ($U = 7527, z = -3.004, p = 0.003$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall course mark (Median (IQR))</td>
<td>70.75 (19)</td>
<td>65.34 (15.60)</td>
</tr>
<tr>
<td>First</td>
<td>54.1% (60)</td>
<td>34.9% (60)</td>
</tr>
<tr>
<td>2:1</td>
<td>23.4% (26)</td>
<td>32.0% (55)</td>
</tr>
<tr>
<td>2:2</td>
<td>13.5% (15)</td>
<td>22.7% (39)</td>
</tr>
<tr>
<td>Third</td>
<td>3.6% (4)</td>
<td>8.7% (15)</td>
</tr>
<tr>
<td>Ordinary</td>
<td>5.4% (6)</td>
<td>1.7% (3)</td>
</tr>
<tr>
<td><strong>Year of study</strong> ($X^2(2) = 3.835, p = 0.147$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>67.6% (75)</td>
<td>56.4% (97)</td>
</tr>
<tr>
<td>Two</td>
<td>20.7% (23)</td>
<td>30.2% (52)</td>
</tr>
<tr>
<td>Three</td>
<td>11.7% (13)</td>
<td>13.4% (23)</td>
</tr>
</tbody>
</table>

4.3.3 Survey data of R-SPQ-2F

Table 4-11 presents the descriptive statistics of the 20 items of R-SPQ-2F for the 283 participants. The computation of the R-SPQ-2F scale and subscale values was carried out as per Biggs et al. (2001, p. 149) recommendation of summing up the scores for each student for the questions corresponding to each scale in the R-SPQ-2F, with both scales containing subscales of motive and strategy.
Table 4-11: Descriptive statistics of the 20 items of R-SPQ-2F

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deep Approach</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I find that at times studying gives me a feeling of deep personal satisfaction</td>
<td>2.95</td>
<td>1.052</td>
</tr>
<tr>
<td>5. I feel that virtually any topic can be highly interesting once I get into it.</td>
<td>3.45</td>
<td>1.108</td>
</tr>
<tr>
<td>9. I find that studying academic topics can at times be as exciting as a good novel or movie.</td>
<td>2.50</td>
<td>1.029</td>
</tr>
<tr>
<td>13. I work hard at my studies because I find the material interesting.</td>
<td>3.09</td>
<td>1.012</td>
</tr>
<tr>
<td>17. I come to most classes with questions in mind that I want answering.</td>
<td>2.24</td>
<td>1.008</td>
</tr>
<tr>
<td><strong>Deep Motive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied.</td>
<td>3.68</td>
<td>0.926</td>
</tr>
<tr>
<td>6. I find most new topics interesting and often spend extra time trying to obtain more information about them.</td>
<td>3.09</td>
<td>1.001</td>
</tr>
<tr>
<td>10. I test myself on important topics until I understand them completely.</td>
<td>3.29</td>
<td>1.076</td>
</tr>
<tr>
<td>14. I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.</td>
<td>2.36</td>
<td>1.047</td>
</tr>
<tr>
<td>18. I make a point of looking at most of the suggested readings that go with the lectures.</td>
<td>2.87</td>
<td>1.147</td>
</tr>
<tr>
<td><strong>Surface Approach</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. My aim is to pass the course while doing as little work as possible.</td>
<td>2.95</td>
<td>1.296</td>
</tr>
<tr>
<td>7. I do not find my course very interesting so I keep my work to the minimum.</td>
<td>1.88</td>
<td>0.901</td>
</tr>
<tr>
<td>11. I find I can get by in most assessments by memorizing key sections rather than trying to understand them.</td>
<td>2.29</td>
<td>1.048</td>
</tr>
<tr>
<td>15. I find it is not helpful to study topics in depth. It confuses and wastes time, when all you need is a passing acquaintance with topics.</td>
<td>1.80</td>
<td>0.863</td>
</tr>
<tr>
<td>19. I see no point in learning material which is not likely to be in the examination.</td>
<td>2.39</td>
<td>1.132</td>
</tr>
<tr>
<td><strong>Surface Motive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.00</td>
<td>3.362</td>
<td></td>
</tr>
<tr>
<td>4. I only study seriously what's given out in class or in the course outlines.</td>
<td>3.24</td>
<td>1.047</td>
</tr>
<tr>
<td>8. I learn some things by rote, going over and over them until I know them by heart even if I do not understand them.</td>
<td>2.60</td>
<td>1.191</td>
</tr>
<tr>
<td>12. I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra.</td>
<td>2.52</td>
<td>1.029</td>
</tr>
<tr>
<td>16. I believe that lecturers shouldn't expect students to spend significant amounts of time studying material everyone knows won't be examined.</td>
<td>1.94</td>
<td>0.990</td>
</tr>
<tr>
<td>20. I find the best way to pass examinations is to try to remember answers to likely questions.</td>
<td>2.86</td>
<td>1.271</td>
</tr>
</tbody>
</table>

Data histograms for the two main scales, that is, DA, and SA, alongside their four subscales, namely DM, DS, SM, and SS for the R-SPQ-2F instrument are shown in Figure 4-2. The histograms indicate that nearly all the questionnaire constructs had almost normal distributions except for SM, which had a slight skew to the right.
Figure 4-2: Histograms representing all the variables of the R-SPQ-2F (A black line illustrating the normal curve of the histogram)

For the determination of normality, the researcher utilised skewness and kurtosis statistics to measure whether the data has a normal distribution (see Table 4-12). Skewness provides a description of distribution changes away from normal distributions. Negative skewness indicates that the mode shifts to
the right leading to a dominant left tail. Positive skewness indicates that the mode shifts to the left leading to a dominant right tail. Kurtosis accounts for the tails’ heaviness or lightness. Positive kurtosis results in an increase in the ‘pointiness’ for distributions having heavy (longer) tails whereas negative kurtosis denotes a much more flatter or uniform distribution with light (shorter) tails.

Table 4-12: Skewness and kurtosis test

<table>
<thead>
<tr>
<th></th>
<th>DA</th>
<th>SA</th>
<th>DM</th>
<th>DS</th>
<th>SM</th>
<th>SS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>283</td>
<td>283</td>
<td>283</td>
<td>283</td>
<td>283</td>
<td>283</td>
</tr>
<tr>
<td>Missing</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.069</td>
<td>0.462</td>
<td>0.064</td>
<td>-0.118</td>
<td>0.522</td>
<td>0.258</td>
</tr>
<tr>
<td>Std. Error of Skewness</td>
<td>0.145</td>
<td>0.145</td>
<td>0.145</td>
<td>0.145</td>
<td>0.145</td>
<td>0.145</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-0.110</td>
<td>0.041</td>
<td>-0.133</td>
<td>-0.179</td>
<td>-0.086</td>
<td>0.016</td>
</tr>
<tr>
<td>Std. Error of Kurtosis</td>
<td>0.289</td>
<td>0.289</td>
<td>0.289</td>
<td>0.289</td>
<td>0.289</td>
<td>0.289</td>
</tr>
</tbody>
</table>

Notably, the general rule of thumb asserts that in the event such skewness or kurtosis are not more than ±1.0, then the distribution skewness or kurtosis does not lie outside the normality range, thus the distribution could be regarded as normal (Leech, Barrett, & Morgan, 2014). In the event that the values surpass ±1.0, then the distribution’s skewness or kurtosis is beyond the normality range, thus the distribution might not be regarded as normal (Leech et al., 2014). It could be inferred that skewness or kurtosis values for all constructs in the questionnaire were small, showing a normal distribution assumption of all constructs was plausible. In view of this, an assumption was made that parametric tests (i.e. paired t-tests, independent sample t-tests, and ANOVAs) would produce robust analysis results.

Although one or two of the variables looked slightly skewed to the right and so the researcher also considered using logged versions of the variables in the analysis. The results the researcher found for the logged versions were similar
to those for the original scale, so the researcher reports the original scale here for ease of interpretation.

4.3.4 Student approaches to learning scores

Table 4-13 illustrates the distribution for cohorts of the main SAL scores segregated by demographic components. Groupings show the predominant approach to learning and participants were put into the DA or SA group on the basis of their higher SAL score. Eight students (four from year one, three from year two, and one from year three) with identical scores for the two approaches were put within the SA group as the researcher felt that the DA group had many more students. The students were then split further into four groups based on which of the subgroups they scored highest on as illustrated in Table 4-14.

According to the cross-tabulation results presented in Table 4-13, most of the computing undergraduate students applied the deep learning approach (67.8%) in their learning compared to the surface learning approach (32.2%). The median course mark for students who applied the deep learning approach (Median=68.58, IQR=17.70) was statistically significantly higher than the median course mark for students who applied the surface learning approach (Median=65.07, IQR=16.25) (U=7215.5, z=-2.365, p=0.018). There was also a statistically significant relationship between year of study and learning approach ($X^2(2)=16.607, p<0.001$). Students tended to apply the deep learning approach in the first year of study more often than in the third year of study (68.2% versus 45.1%).

Of the students who adopted the deep learning approach, over two-thirds (70.8%) were between 21-24 years old; whilst of the students who adopted the surface learning approach, nearly 80% (79.1%) were between 21-24 years old.
The average age of the students was 22.04 (SD=2.10) for students adopted the deep learning approach and 22.38 (SD=1.64) for students adopted the surface learning approach, and the difference was not statistically significant ($t(281)=-1.370$, $p=0.172$). Over half of the students that adopted the deep learning approach had polytechnic entry pathway (57.3%) with a greater (nearly 70) percentage of students that adopted the surface learning approach having polytechnic entry pathway (68.1%) though this difference was not statistically significant. For each learning approach, about 70% of the students were male (71.4% for DA and 70.3% for SA). There was no statistically significant relationship between learning approach, and age ($U=9578$, $z=1.331$, $p=0.183$), entry pathway ($X^2(1)=3.043$, $p=0.081$), or gender ($X^2(1)=0.031$, $p=0.859$).

Table 4-13: SAL scales’ scores segregated by demographic components

<table>
<thead>
<tr>
<th></th>
<th>DA (N=192)</th>
<th>SA (N=91)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (U = 9578, z = 1.331, $p = 0.183$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall age (Median (IQR))</td>
<td>22 (2)</td>
<td>22 (2)</td>
</tr>
<tr>
<td>17 - 20</td>
<td>20.3% (39)</td>
<td>9.9% (9)</td>
</tr>
<tr>
<td>21 - 24</td>
<td>70.8% (136)</td>
<td>79.1% (72)</td>
</tr>
<tr>
<td>25 &amp; above</td>
<td>8.9% (17)</td>
<td>11.0% (10)</td>
</tr>
<tr>
<td>Entry pathway ($X^2(1)=3.043$, $p=0.081$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-Level</td>
<td>42.7% (82)</td>
<td>31.9% (29)</td>
</tr>
<tr>
<td>Polytechnic</td>
<td>57.3% (110)</td>
<td>68.1% (62)</td>
</tr>
<tr>
<td>Gender ($X^2(1)=0.031$, $p=0.859$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>26.6% (55)</td>
<td>29.7% (27)</td>
</tr>
<tr>
<td>Male</td>
<td>71.4% (137)</td>
<td>70.3% (64)</td>
</tr>
<tr>
<td>Degree classification ($U = 7215.5$, $z = -2.365$, $p = 0.018$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall course mark (Median (IQR))</td>
<td>68.58 (17.70)</td>
<td>65.07 (16.25)</td>
</tr>
<tr>
<td>First</td>
<td>46.4% (89)</td>
<td>34.1% (31)</td>
</tr>
<tr>
<td>2.1</td>
<td>27.1% (52)</td>
<td>31.9% (29)</td>
</tr>
<tr>
<td>2.2</td>
<td>18.2% (35)</td>
<td>20.9% (19)</td>
</tr>
<tr>
<td>Third</td>
<td>5.7% (11)</td>
<td>8.8% (9)</td>
</tr>
<tr>
<td>Ordinary</td>
<td>2.6% (5)</td>
<td>4.4% (4)</td>
</tr>
<tr>
<td>Year of study ($X^2(2)=16.607$, $p &lt; 0.001$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>68.2% (131)</td>
<td>45.1% (41)</td>
</tr>
<tr>
<td>Two</td>
<td>23.4% (45)</td>
<td>33.0% (30)</td>
</tr>
<tr>
<td>Three</td>
<td>8.3% (16)</td>
<td>22.0% (20)</td>
</tr>
</tbody>
</table>
Table 4-14 further divided students in DA and SA into DM/DS and SM/SS. For students utilising DA who preferred DM, slightly over 60% students (62.6%) were male; for students utilising DA who preferred DS, almost 80% of students (79.2%) were male. There was a statistically significant relationship between the preference of DA or DM and gender ($X^2(1)=6.431$, $p=0.011$).

The median age was 22 (IQR=3) and 22 (IQR=2) for students preferring DM and students preferring DS, respectively. Nearly half of the students preferring DM (48.4%) were A-Level graduates, while only just over one-third of the students preferring DS (37.6%) were A-Level graduates. The median course mark was 68 (IQR=17.71) and 69.5 (IQR=17.96) for students preferring DM and students preferring DS, respectively. For both DM and DS, most students were in their first year of study (62.6% for DM versus 73.3% for DS). There was no statistically significant relationship between preference of DM/DS and, age ($U=5041$, $z=1.176$, $p=0.240$), entry pathway ($X^2(1)=2.252$, $p=0.133$), course mark ($U=4777$, $z=0.472$, $p=0.637$), and year of study ($X^2(1)=2.893$, $p=0.235$).

The median age was 22 (IQR=3) and 22 (IQR=2) for students preferring SM and students preferring SS, respectively. Nearly half of the students preferring SM (42.4%) were A-Level graduates, while about one-quarter of the students preferring SS (25.9%) were A-Level graduates. For both SM and SS, about one-third of the students (27.3% for SM and 31.0% for SS) were female. The median course mark was 66.75 (IQR=24.16) and 64.67 (IQR=16.64) for students preferring SM and students preferring SS, respectively. About half of the SM students were in their second year of study (48.5%), and half of the SS students were in their first year of study (50.0%). There was no statistically significant relationship between preference of SM/SS and, age ($U=930.5$, $z=-0.223$, $p=0.823$), entry pathway ($X^2(1)=2.657$, $p=0.103$), gender ($X^2(1)=0.143$, $p=0.707$).
\[ p = 0.706 \], course mark \( (U = 751.5, z = -1.697, p = 0.090) \), and year of study \( (X^2(1) = 5.748, p = 0.056) \).

Table 4-14: SAL subscales’ scores segregated by demographic components

<table>
<thead>
<tr>
<th></th>
<th>DA (N=192)</th>
<th>SA (N=191)</th>
<th>DM (N=91)</th>
<th>DS (N=101)</th>
<th>SM (N=33)</th>
<th>SS (N=58)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ( (U = 594.1, z = 1.176, p = 0.240 ) under DA; ( U = 630.5, z = -0.223, p = 0.823 ) under SA)</td>
<td>22 (3)</td>
<td>22 (2)</td>
<td>22 (3)</td>
<td>22 (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall age (Median [IQR])</td>
<td>27.5% (25)</td>
<td>13.9% (14)</td>
<td>12.1% (4)</td>
<td>8.8% (5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17-20</td>
<td>64.5% (62)</td>
<td>76.2% (77)</td>
<td>72.7% (24)</td>
<td>82.8% (48)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 &amp; above</td>
<td>7.7% (7)</td>
<td>9.9% (10)</td>
<td>15.2% (5)</td>
<td>8.8% (5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entry pathway ( X^2(1) = 2.252, p = 0.133 ) under DA; ( X^2(1) = 2.087, p = 0.187 ) under SA</td>
<td>A-Level</td>
<td>49.4% (44)</td>
<td>37.6% (38)</td>
<td>42.4% (14)</td>
<td>25.9% (15)</td>
<td></td>
</tr>
<tr>
<td>Polytechnic</td>
<td>51.8% (47)</td>
<td>62.4% (63)</td>
<td>57.6% (19)</td>
<td>74.1% (43)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender ( X^2(1) = 6.431, p = 0.011 ), under DA; ( X^2(1) = 0.143, p = 0.706 ) under SA</td>
<td>Female</td>
<td>37.4% (34)</td>
<td>20.8% (21)</td>
<td>27.3% (9)</td>
<td>31.0% (19)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>62.6% (57)</td>
<td>79.2% (80)</td>
<td>72.7% (24)</td>
<td>69.0% (40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree classification ( X^2(1) = 4777, z = 0.472, p = 0.637 ) under DA; ( U = 751.5, z = -1.897, p = 0.060 ) under SA</td>
<td>Overall course mark (Median [IQR])</td>
<td>68.0% (17.7)</td>
<td>69.50 (17.96)</td>
<td>66.75 (24.16)</td>
<td>64.67 (16.64)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>46.2% (42)</td>
<td>46.5% (47)</td>
<td>39.4% (13)</td>
<td>31.0% (18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>25.3% (23)</td>
<td>28.7% (29)</td>
<td>33.3% (11)</td>
<td>31.9% (19)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>25.0% (23)</td>
<td>17.6% (18)</td>
<td>18.2% (6)</td>
<td>22.4% (13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ordinary</td>
<td>5.5% (6)</td>
<td>5.9% (6)</td>
<td>9.1% (3)</td>
<td>8.8% (5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year of study ( X^2(1) = 2.893, p = 0.235 ), under DA; ( X^2(1) = 5.748, p = 0.056 ) under SA</td>
<td>One</td>
<td>62.8% (67)</td>
<td>73.3% (74)</td>
<td>36.4% (12)</td>
<td>50.0% (29)</td>
<td></td>
</tr>
<tr>
<td>Two</td>
<td>26.4% (24)</td>
<td>20.8% (21)</td>
<td>48.5% (16)</td>
<td>24.1% (14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three</td>
<td>11.0% (10)</td>
<td>5.9% (6)</td>
<td>15.2% (5)</td>
<td>23.9% (15)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We will now look at the actual scores themselves to examine which of the two scores (DA versus SA) was higher at each year of study.

Figure 4-3: The trend of DA and SA in undergraduate computing students
Figure 4-3 shows the average DA scores and SA scores of year one, year two, and year three undergraduate computing students. The horizontal axis represents the students' academic year, whereas the vertical axis represents the learning approaches' average score. The blue line in Figure 4-3 shows the DA trend, whereas the yellow line shows the SA learning approach trend. It is evident that there is a declining DA trend within undergraduate computing students from year one to year three. In contrast, the SA scores show a consistent increase from year one to year three. For year one students, the mean score of DA is slightly higher than 30 (M=30.58) and for SA is below 30 (M=22.83).

A paired t-test was conducted, and the results indicated that year one undergraduate computing students scored statistically significantly higher on DA (M=30.58, SD=6.29) than SA (M=22.83, SD=5.43) (t(171)=11.038, p<0.001). For year two students, the gap between DA and SA becomes much smaller, and both the mean score of DA and SA are below 30. A paired t-test was conducted, and the results indicated that year two undergraduate computing students still statistically significantly preferred DA (M=28.32, SD=6.64) over SA (M=24.31, SD=6.22) (t(74)=3.603, p=0.001). This distinct trend continues into their third year of study. However, according to the results of the paired t-test, there was no statistically significant difference between the DA and SA scores at year three (M=26.22, SD=4.56 for DA; M=27.75, SD=7.71 for SA, t(35)=-0.911, p=0.369). Thus, this shows that the year one students may have a specific learning approach when they first enrol into computing programmes but gradually lose their distinct learning approach when they progress into year two and year three of their studies. Even though here the data is cross-sectional with different students at each of the different years of study, one possible explanation could be that the students’ learning approach
was influenced by the curriculum design and teaching formats of the computing programmes.

A scatter diagram was utilised for gaining a deeper insight into the SAL in different academic years. Therefore, Figure 4-4 constitutes the graphical representation for DA and SA scores of participants plotted and designated by the year of study. There were no distinct patterns for the distributions of the DA and SA scores by year of study. The scatter diagram shows square A containing students that scored above the DA average and below the SA average. Within square B under the average in both DA and SA, square C above the average for both DA and SA and in square D above the average for SA and under the average for DA.

Figure 4-4: Scatter graph illustrates DA and SA scores for each participant and designated by the year of study
The students within square A indicate preferences for a deep learning approach, which is pursued by student-centred teachers. The square D within Figure 4-4 identifies the students that scored below average DA and above average SA, thus clearly indicating a preference for surface learning approach. Further the students in square B and square C indicate non-dominant or intermediate approach towards learning. Studies name them 'disintegrated', 'not yet established', 'non-academia orientation', or 'dissonant' (Entwistle, Meyer, & Tait, 1991; Lindblom-Ylänne & Lonka, 1998). Some research attributed this to a lack of metacognitive thinking within learning (Biggs, 1985).

Additionally, from this Figure 4-4, the first years (blue circles) and second years (green circles) students are seen in all the four squares. The third-year students (beige circles) data, presents a movement up and leftward showing the dominating SA scores. From this figure, a close data point to the centre presents little or no difference between the two models - deep and surface approaches.

4.3.5 Entry pathway and student approaches to learning

The sample consisted of 111 A-Level and 172 polytechnic entry pathway graduates. Six independent sample t-tests were performed to establish whether there was a statistically significant difference in the two scales (DA and SA) and four subscales (DM, DS, SM, and SS) of R-SPQ-2F between students taking the A-Level entry pathway and students with the polytechnic entry pathway. Table 4-15 summarised the results of the independent sample t-tests for comparison of scales and subscales’ scores by the entry pathway of participants. There was no statistically significant difference in any of the two scales (DA and SA) and four subscales (DM, DS, SM, and SS) of R-SPQ-2F.
between students with A-Level entry pathway and students with polytechnic entry pathway ($p>0.05$, see Table 4-15).

Table 4-15: t-test results for the relationship between entry pathway and SAL

<table>
<thead>
<tr>
<th>Scales and subscales</th>
<th>A-Level (N=111)</th>
<th>Polytechnic (N=172)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>DA</td>
<td>29.98</td>
<td>6.18</td>
<td>29.06</td>
<td>6.48</td>
</tr>
<tr>
<td>SA</td>
<td>23.39</td>
<td>6.08</td>
<td>24.14</td>
<td>6.23</td>
</tr>
<tr>
<td>DM</td>
<td>14.47</td>
<td>3.44</td>
<td>13.93</td>
<td>3.48</td>
</tr>
<tr>
<td>DS</td>
<td>15.51</td>
<td>3.40</td>
<td>15.13</td>
<td>3.58</td>
</tr>
<tr>
<td>SM</td>
<td>10.64</td>
<td>3.40</td>
<td>11.06</td>
<td>3.34</td>
</tr>
<tr>
<td>SS</td>
<td>12.75</td>
<td>3.50</td>
<td>13.08</td>
<td>3.47</td>
</tr>
</tbody>
</table>

Notes: $t = t$-statistic; $p = p$-value; degrees of freedom (df) for the t-test = 281.

4.3.6 Gender and student approaches to learning

The sample consisted of 82 females and 201 males. Table 4-16 presented the relationship between gender and learning approach variables as determined using independent sample t-tests. Means in Table 4.16 suggest that there is no difference between the approaches to learning of male and female students.

There was no statistically significant difference in any of the two scales (DA and SA) and four subscales (DM, DS, SM, and SS) of R-SPQ-2F between male and female students ($p>0.05$, see Table 4-16).

Table 4-16: t-test results for the relationship between gender and SAL

<table>
<thead>
<tr>
<th>Scales and subscales</th>
<th>Female (N=82)</th>
<th>Male (N=201)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>DA</td>
<td>29.55</td>
<td>6.73</td>
<td>29.37</td>
<td>6.23</td>
</tr>
<tr>
<td>SA</td>
<td>23.91</td>
<td>6.75</td>
<td>23.82</td>
<td>5.94</td>
</tr>
<tr>
<td>DM</td>
<td>14.34</td>
<td>3.67</td>
<td>14.06</td>
<td>3.39</td>
</tr>
<tr>
<td>DS</td>
<td>15.21</td>
<td>3.89</td>
<td>15.31</td>
<td>3.44</td>
</tr>
<tr>
<td>SM</td>
<td>10.63</td>
<td>3.86</td>
<td>11.00</td>
<td>3.24</td>
</tr>
<tr>
<td>SS</td>
<td>13.28</td>
<td>3.79</td>
<td>12.81</td>
<td>3.34</td>
</tr>
</tbody>
</table>

Notes: $t = t$-statistic; $p = p$-value; degrees of freedom (df) for the t-test = 281.

4.3.7 Age and student approaches to learning

Six one-way analysis of variiances (ANOVA) were fitted to determine if there was a statistically significant difference in any of the SAL scores (i.e. the two scales (DA and SA) and four subscales (DM, DS, SM, and SS) of R-SPQ-2F)
according to students' age category. Tables 4-17 and Table 4-18 summarised the one-way ANOVA results for comparison of scales and subscales' scores of R-SPQ-2F by the age of participants. There was a statistically significant difference in the DA scores among the three age groups (F(2, 280)=3.248, p=0.040; see Table 4-17). In particular, the results of pairwise comparisons (Table 4-18) suggested the DA scores for students between 17 to 20 years old (M=31.29, SD=5.52) were statistically significantly higher than the DA scores for students 25 years old or older (M=27.67, SD=5.61) (Mean difference=3.63, SE=1.52, p=0.047). However, there was no statistically significant difference in the DA scores between students 17-20 years old and students 21-24 years old (p=0.103) and between students 21-24 years old and students 25 years old or older (p=0.453).

There was also a statistically significant difference in the DM scores among the three age groups (F(2, 280)=4.264, p=0.015; see Table 4-17). In particular, the results of pairwise comparisons (see Table 4-18), again like for the DA scores, suggested the DM scores for students between 17 to 20 years old (M=15.31, SD=3.12) were statistically significantly higher than the DM scores for students 25 years old or older (M=13.07, SD=3.23) (Mean difference=2.24, SE=0.82, p=0.019) and in addition were statistically significantly higher than the DM scores for students 21-24 years old (M=14.01, SD=3.52) (Mean difference=1.30, SE=0.55, p=0.048). However, there was no statistically significant difference in the DM scores between students 21-24 years old and students 25 years old or older (p=0.377). There were no statistically significant differences in the remaining SAL scores among the three age groups (F(2, 280)=0.410, p=0.664 for SA; F(2, 280)=1.518, p=0.221 for DS; F(2, 280)=0.371, p=0.690 for SM; F(2, 280)=0.316, p=0.730 for SS; see Table 4-17).
Table 4-17: One-way ANOVA results for age comparison of scales and subscales’ scores

<table>
<thead>
<tr>
<th>Scales and subscales</th>
<th>17-20 (N=48)</th>
<th>21-24 (N=208)</th>
<th>25 &amp; above (N=27)</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA</td>
<td>Mean: 31.29</td>
<td>Mean: 29.22</td>
<td>Mean: 27.67</td>
<td>3.248</td>
<td>0.040</td>
</tr>
<tr>
<td>SA</td>
<td>Mean: 23.15</td>
<td>Mean: 24.03</td>
<td>Mean: 23.67</td>
<td>0.410</td>
<td>0.664</td>
</tr>
<tr>
<td>DM</td>
<td>Mean: 15.31</td>
<td>Mean: 14.01</td>
<td>Mean: 13.07</td>
<td>4.264</td>
<td>0.015</td>
</tr>
<tr>
<td>DS</td>
<td>Mean: 15.98</td>
<td>Mean: 15.21</td>
<td>Mean: 14.59</td>
<td>1.518</td>
<td>0.221</td>
</tr>
<tr>
<td>SM</td>
<td>Mean: 10.52</td>
<td>Mean: 10.96</td>
<td>Mean: 10.89</td>
<td>0.371</td>
<td>0.690</td>
</tr>
<tr>
<td>SS</td>
<td>Mean: 12.63</td>
<td>Mean: 13.04</td>
<td>Mean: 12.78</td>
<td>0.316</td>
<td>0.730</td>
</tr>
</tbody>
</table>

Table 4-18: Results of pairwise comparisons using Tukey’s HSD

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(l) age</th>
<th>(J) age</th>
<th>Mean Difference (l-J)</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA</td>
<td>17-20</td>
<td>21-24</td>
<td>2.07</td>
<td>1.01</td>
<td>0.103</td>
</tr>
<tr>
<td></td>
<td>17-20</td>
<td>25 and +</td>
<td>3.63</td>
<td>1.52</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>21-24</td>
<td>25 and +</td>
<td>1.55</td>
<td>1.29</td>
<td>0.453</td>
</tr>
<tr>
<td>DM</td>
<td>17-20</td>
<td>21-24</td>
<td>1.30</td>
<td>0.55</td>
<td>0.048</td>
</tr>
<tr>
<td></td>
<td>17-20</td>
<td>25 and +</td>
<td>2.24</td>
<td>0.82</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>21-24</td>
<td>25 and +</td>
<td>0.94</td>
<td>0.70</td>
<td>0.377</td>
</tr>
</tbody>
</table>

Notes: SE = standard error, p = p-value.

4.3.8 The year of study and student approaches to learning

Six one-way analysis of variances (ANOVA) models were fitted to determine if there was a statistically significant difference in any of the SAL scores (i.e. the two scales (DA and SA) and four subscales (DM, DS, SM, and SS) of R-SPQ-2F) according to students’ year of study.

Tables 4-19 and 4-20 summarised the one-way ANOVA results for comparison of scales and subscales’ scores of R-SPQ-2F by year of study. There was a statistically significant difference in all scales and subscales’ scores of R-SPQ-2F among the three groups in terms of year of study (F(2, 280)=8.967, p<0.001 for DA; F(2, 280)=10.423, p<0.001 for SA; F(2, 280)=7.115, p=0.001 for DM; F(2, 280)=7.755, p=0.001 for DS; F(2, 280)=8.304, p<0.001 for SM; F(2, 280)=8.496, p<0.001 for SS; see Table 4-19).

In particular, the results of pairwise comparisons (see Table 4-20) suggested the DA and DS scores for students in their first year of study (M=30.58,
SD=6.28 for DA; M=15.89, SD=3.45 for DS) were statistically significantly higher than the scores for students in their second year of study (M=28.32, SD=6.64, Mean difference=2.26, SE=0.86, p=0.024 for DA; M=14.64, SD=3.36, Mean difference=1.25, SE=0.47, p=0.024 for DS) and students in their third year of study (M=26.22, SD=4.56, Mean difference=4.35, SE=1.14, p<0.001 for DA; M=13.72, SD=2.75, Mean difference=2.17, SE=0.63, p=0.002 for DS).

The results of pairwise comparisons (see Table 4-20) also suggested the SA and SS scores for students in their third year of study (M=27.75, SD=7.71 for SA; M=15.00, SD=4.16 for SS) were statistically significantly higher than the scores for students in their first year of study (M=22.83, SD=5.43, Mean difference=4.92, SE=1.09, p<0.001 for SA; M=12.45, SD=3.11, Mean difference=2.55, SE=0.62, p<0.001 for SS) and students in their second year of study (M=24.31, SD=6.22, Mean difference=3.44, SE=1.21, p=0.013 for SA; M=13.09, SD=3.59, Mean difference=1.91, SE=0.69, p=0.016 for SS).

Finally, the results of pairwise comparisons (see Table 4-20) suggested the DM scores for students in their third year of study (M=12.50, SD=2.76) were statistically significantly lower than the scores for students in the first year of study (M=14.69, SD=3.51, Mean difference=-2.19, SE=0.62, p=0.001). However, the SM scores for students in their third year of study (M=12.75, SD=4.12) were statistically significantly higher than the scores for students in the first year of study (M=10.37, SD=2.97, Mean difference=2.38, SE=0.60, p<0.001). There was no statistically significant difference in the scores between students in any other two levels of the year of study (p>0.05).
### Table 4-19: One-way ANOVA results for the year of study comparison of scales and subscales’ scores

<table>
<thead>
<tr>
<th>Scales and subscales</th>
<th>Year One (N=172)</th>
<th>Year Two (N=75)</th>
<th>Year Three (N=36)</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>DA</td>
<td>30.58</td>
<td>6.28</td>
<td>28.32</td>
<td>6.54</td>
<td>26.22</td>
</tr>
<tr>
<td>SA</td>
<td>22.63</td>
<td>5.43</td>
<td>24.31</td>
<td>6.22</td>
<td>27.75</td>
</tr>
<tr>
<td>DM</td>
<td>14.69</td>
<td>3.51</td>
<td>13.68</td>
<td>3.40</td>
<td>12.50</td>
</tr>
<tr>
<td>DS</td>
<td>15.89</td>
<td>3.45</td>
<td>14.64</td>
<td>3.66</td>
<td>13.72</td>
</tr>
<tr>
<td>SM</td>
<td>10.37</td>
<td>2.97</td>
<td>11.21</td>
<td>3.50</td>
<td>12.75</td>
</tr>
<tr>
<td>SS</td>
<td>12.45</td>
<td>3.11</td>
<td>13.09</td>
<td>3.59</td>
<td>15.00</td>
</tr>
</tbody>
</table>

### Table 4-20: Results of pairwise comparisons using Tukey’s HSD

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(I) year of study</th>
<th>(J) year of study</th>
<th>Mean Difference (I-J)</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA</td>
<td>1.00</td>
<td>2.00</td>
<td>2.26</td>
<td>0.86</td>
<td>0.024</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>3.00</td>
<td>4.35</td>
<td>1.14</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>3.00</td>
<td>2.10</td>
<td>1.26</td>
<td>0.219</td>
</tr>
<tr>
<td>SA</td>
<td>1.00</td>
<td>2.00</td>
<td>-1.48</td>
<td>0.83</td>
<td>0.174</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>3.00</td>
<td>-4.92</td>
<td>1.09</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>3.00</td>
<td>-3.44</td>
<td>1.21</td>
<td>0.013</td>
</tr>
<tr>
<td>DM</td>
<td>1.00</td>
<td>2.00</td>
<td>1.01</td>
<td>0.47</td>
<td>0.083</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>3.00</td>
<td>2.19</td>
<td>0.62</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>3.00</td>
<td>1.18</td>
<td>0.69</td>
<td>0.020</td>
</tr>
<tr>
<td>DS</td>
<td>1.00</td>
<td>2.00</td>
<td>1.25</td>
<td>0.47</td>
<td>0.024</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>3.00</td>
<td>2.17</td>
<td>0.63</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>3.00</td>
<td>0.92</td>
<td>0.69</td>
<td>0.584</td>
</tr>
<tr>
<td>SM</td>
<td>1.00</td>
<td>2.00</td>
<td>-0.84</td>
<td>0.45</td>
<td>0.154</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>3.00</td>
<td>-2.38</td>
<td>0.60</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>3.00</td>
<td>-1.54</td>
<td>0.66</td>
<td>0.058</td>
</tr>
<tr>
<td>SS</td>
<td>1.00</td>
<td>2.00</td>
<td>-0.64</td>
<td>0.47</td>
<td>0.361</td>
</tr>
<tr>
<td></td>
<td>1.00</td>
<td>3.00</td>
<td>-2.55</td>
<td>0.62</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>3.00</td>
<td>-1.91</td>
<td>0.69</td>
<td>0.016</td>
</tr>
</tbody>
</table>

*Notes: SE = standard error; p = p-value.*

### 4.3.9 Academic performance, entry pathway and student approaches to learning

The study institution used the final degree classification system to measure students’ academic performance. The system is based on the use of an overall average of the weighted marks for level four, level five, and level six⁶ courses as the indicator of the degree classification (University of London, 2018b). The researcher decided to use the average mark to measure students’ academic performance instead of using the final degree classification because the year one and year two students do not have their level five and level six marks.

---

⁶ Level 4 courses come in the form of 1st year of a bachelors programme. Level 5 courses come in the form of 2nd year of a bachelors programmes and Level 6 courses are the final component in a bachelor’s degree (QAA, 2014).
respectively. To calculate the average mark, the researcher followed the following procedure:

- Add the marks obtained in all the courses of n years together;
- Add the total marks of all the courses. For example, if a student has attempted four courses and each course of 100 marks then total will be 400 marks; and
- Divide the marks obtained by total possible marks and multiplied to 100.

Note that in the linear models, the square of academic performance was the dependent variable as the academic performance scores themselves were not normally distributed (Table 4-9). The skewness and kurtosis of the square of academic performance were -0.085 and -0.409, respectively. As the skewness and kurtosis were not more than ±1.0, the distribution of the data (square of academic performance) could be regarded as normal (Leech et al., 2014).

To determine if there was a relationship between academic performance, and entry pathway and students’ approaches to learning (SAL), two general linear models were performed:

1. Model 1: dependent variable = square of academic performance, and independent variables = entry pathway and the two scales of R-SPQ-2F, DA and SA
For both models, interaction effects of entry pathway and the scales or subscales of R-SPQ-2F were modelled in order to determine if the effects of SAL depended on the entry pathway.

**Analysis results for Model 1**

Table 4-21 shows the results of the general linear models for Model 1, where dependent variable = square of academic performance, and independent variables = entry pathway, DA, and SA. Interaction effects of entry pathway and DA and SA were also included in the model. The $R^2=0.076$ (Adjusted $R^2=0.059$; see Table 4-21) indicated 7.6% of the total variation in the dependent variable, square of academic performance, can be explained by the independent variables, entry pathway, DA, and SA. The F-test of the overall significance of the model indicated that the independent variables statistically significantly predict the dependent variable ($F(5, 277)=4.529, p=0.001$; see Table 4-21).

The interaction effect of entry pathway and DA was not statistically significant ($F(1, 277)=0.465, p=0.496$; see Table 4-21), indicating the effect of DA on academic performance did not depend on entry pathway. Similarly, the interaction effect of entry pathway and SA was not statistically significant ($F(1, 277)=3.828, p=0.051$; see Table 4-21), indicating the effect of SA on academic performance did not depend on entry pathway.

As none of the interaction effects was statistically significant, a model with only the main effects of the entry pathway, DA, and SA was fitted. The analysis results are presented in Tables 4-21, 4-22, and 4-23. The $R^2=0.063$ (Adjusted $R^2=0.053$; see Table 4-22) indicated 6.3% of the total variation in the dependent variable, square of academic performance, can be explained by the independent variables, entry pathway, DA, and SA. It was found that the main
effect of DA on the square of academic performance was not statistically significant (F(1, 279)=3.149, p=0.077; see Table 4-22), indicating there was no statistically significant relationship between academic performance and DA.

However, the main effect of entry pathway on the square of academic performance was statistically significant (F(1, 279)=5.774, p=0.017; see Table 4-22), indicating there was a statistically significant relationship between academic performance and entry pathway. The parameter estimate for entry pathway was 465.919 (B=465.919 for entry pathway=0, see Table 4-23), indicating academic performance for students with A-Level entry pathway was 21.59 (=sqrt(465.919)) units higher than academic performance for students with polytechnic entry pathway.

Furthermore, the main effect of SA on the square of academic performance was statistically significant (F(1, 279)=5.502, p=0.020; see Table 4-22, indicating that there was a statistically significant relationship between academic performance and the scale of R-SPQ-2F, SA. The parameter estimate for SA was -37.161 (B=-37.161, see Table 4-23), suggesting that there was a statistically significant negative relationship between academic performance and SA. In particular, for one unit increase of the SA score, academic performance would decrease by 6.096 (=sqrt(37.161)) units.
Table 4-21: Tests of between-subjects effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>56657763.519</td>
<td>5</td>
<td>11331552.704</td>
<td>4.529</td>
<td>0.001</td>
<td>0.076</td>
</tr>
<tr>
<td>Intercept</td>
<td>112269312.103</td>
<td>1</td>
<td>112269312.103</td>
<td>44.873</td>
<td>&lt;0.001</td>
<td>0.139</td>
</tr>
<tr>
<td>Entry pathway</td>
<td>3623167.395</td>
<td>1</td>
<td>3623167.395</td>
<td>1.528</td>
<td>0.217</td>
<td>0.005</td>
</tr>
<tr>
<td>DA</td>
<td>8228554.397</td>
<td>1</td>
<td>8228554.397</td>
<td>3.289</td>
<td>0.071</td>
<td>0.012</td>
</tr>
<tr>
<td>DA</td>
<td>8769496.555</td>
<td>1</td>
<td>8769496.555</td>
<td>3.505</td>
<td>0.062</td>
<td>0.012</td>
</tr>
<tr>
<td>Entry pathway * DA</td>
<td>1164108.689</td>
<td>1</td>
<td>1164108.689</td>
<td>0.465</td>
<td>0.496</td>
<td>0.002</td>
</tr>
<tr>
<td>Entry pathway * SA</td>
<td>957761.196</td>
<td>1</td>
<td>957761.196</td>
<td>3.828</td>
<td>0.051</td>
<td>0.014</td>
</tr>
<tr>
<td>Error</td>
<td>69303472.182</td>
<td>277</td>
<td>2501930.412</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>672340269.633</td>
<td>283</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>749692487.701</td>
<td>282</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: $R^2 = 0.076$ (Adjusted $R^2 = 0.059$); df = degrees of freedom; F = F-statistic; p = p-value. Partial eta squared represents effect size.

Table 4-22: Test of between-subjects effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>46934874.634</td>
<td>3</td>
<td>15644958.278</td>
<td>6.211</td>
<td>&lt;0.001</td>
<td>0.063</td>
</tr>
<tr>
<td>Intercept</td>
<td>12769321.251</td>
<td>1</td>
<td>12769321.251</td>
<td>50.662</td>
<td>&lt;0.001</td>
<td>0.154</td>
</tr>
<tr>
<td>Entry pathway</td>
<td>14544626.343</td>
<td>1</td>
<td>14544626.343</td>
<td>5.774</td>
<td>0.017</td>
<td>0.020</td>
</tr>
<tr>
<td>DA</td>
<td>7931650.365</td>
<td>1</td>
<td>7931650.365</td>
<td>3.149</td>
<td>0.077</td>
<td>0.011</td>
</tr>
<tr>
<td>SA</td>
<td>13858357.955</td>
<td>1</td>
<td>13858357.955</td>
<td>5.502</td>
<td>0.020</td>
<td>0.019</td>
</tr>
<tr>
<td>Error</td>
<td>702757612.967</td>
<td>279</td>
<td>2518844.491</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>672340269.633</td>
<td>283</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>749692487.701</td>
<td>282</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: $R^2 = 0.048$ (Adjusted $R^2 = 0.036$); df = degrees of freedom; F = F-statistic; p = p-value. Partial eta squared represents effect size.

Table 4-23: Parameter estimates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>SE</th>
<th>t</th>
<th>p</th>
<th>95% Confidence Interval Lower Bound</th>
<th>95% Confidence Interval Upper Bound</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[entry pathway=$0$]</td>
<td>4495.895</td>
<td>667.001</td>
<td>6.740</td>
<td>&lt;0.001</td>
<td>3182.901</td>
<td>5808.890</td>
<td>0.140</td>
</tr>
<tr>
<td>[entry pathway=$1$]</td>
<td>465.919</td>
<td>193.892</td>
<td>2.403</td>
<td>0.017</td>
<td>84.242</td>
<td>847.596</td>
<td>0.020</td>
</tr>
<tr>
<td>DA</td>
<td>27.251</td>
<td>15.357</td>
<td>-1.775</td>
<td>0.077</td>
<td>-2.979</td>
<td>57.482</td>
<td>0.011</td>
</tr>
<tr>
<td>SA</td>
<td>-37.161</td>
<td>15.843</td>
<td>-2.346</td>
<td>0.020</td>
<td>-68.347</td>
<td>-5.974</td>
<td>0.019</td>
</tr>
</tbody>
</table>

Notes: For entry pathway, $0 = \text{A-Level}$ and $1 = \text{Polytechnic}; a = \text{This parameter is set to zero because it is redundant (as entry pathway} = 1 \text{was the reference group).} B = \text{parameter estimate}; SE = \text{standard error}; t = \text{t-statistic}; p = \text{p-value. Partial eta squared represents effect size.}

Analysis results for Model 2

Table 4-24 shows the results of the general linear models for Model 2, where dependent variable = square of academic performance, and independent variables = entry pathway, DM, DS, SM, and SS. Interaction effects of entry pathway and, DM, DS, SM, and SS were also included in the model.

The $R^2=0.085$ (Adjusted $R^2=0.055$; see Table 4-24) indicated 8.5% of the total variation in the dependent variable, academic performance, can be explained by the independent variables, entry pathway, DM, DS, SM, and SS. The F-test of the overall significance of the model indicated that the independent variables
statistically significantly predict the dependent variable \( (F(9, 273)=2.835, \ p=0.003; \) see Table 4-24).

The interaction effects of (1) entry pathway and DM \( (F(1, 273)=1.045, \ p=0.307; \) see Table 4-24), (2) entry pathway and DS \( (F(1, 273)=0.025, \ p=0.875; \) see Table 4-24), (3) entry pathway and SM \( (F(1, 273)=2.108, \ p=0.148; \) see Table 4-24), and (4) entry pathway and SS \( (F(1, 273)=0.100, \ p=0.752; \) see Table 4-24), were not statistically significant, indicating the effects of DM, DS, SM, and SS on academic performance did not depend on entry pathway.

As all interaction effects of entry pathway and, DM, DS, SM, and SS, were not significant, a model with only the main effects of entry pathway, DM, DS, SM, and SS was fitted. The analysis results are presented in Tables 4-25 and 4-26. The \( R^2=0.069 \) (Adjusted \( R^2=0.052; \) see Table 4-25) indicated 6.9% of the total variation in the dependent variable, square of academic performance, can be explained by the independent variables, entry pathway, DM, DS, SM, and SS.

It was found that (1) the main effect of DM on square of academic performance was not statistically significant \( (F(1, 277)=0.071, \ p=0.790; \) see Table 4-25), (2) the main effect of DS on square of academic performance was not statistically significant \( (F(1, 277)=1.928, \ p=0.166; \) see Table 4-25), and (3) the main effect of SM on square of academic performance was not statistically significant \( (F(1, 277)=0.006, \ p=0.939; \) see Table 4-25), and indicating there was no statistically significant relationship between academic performance and, DM, DS, and SM.

However, the main effect of entry pathway on academic performance was statistically significant \( (F(1, 277)=5.899, \ p=0.016; \) see Table 4-25), indicating there was a statistically significant relationship between academic performance and entry pathway. The parameter estimate for entry pathway was 471.195
(B=471.195 for entry pathway=0, see Table 4-26), indicating academic performance for students with A-Level entry pathway was 21.71 (=sqrt(471.195)) units higher than academic performance for students with polytechnic entry pathway. Consequently, Model 2 has a similar finding to Model 1, where students with A-Level entry pathway scored higher in their academic performance compared to the students with the polytechnic pathway. 

Furthermore, the main effect of SS on academic performance was statistically significant (F(1, 277)=3.397, p=0.034; see Table 4-25), indicating that there was a statistically significant relationship between academic performance and the subscale of R-SPQ-2F, SS. The parameter estimate for SS was -74.396 (B=-74.396, see Table 4-26), suggesting that there was a statistically significant negative relationship between academic performance and SS. In particular, for one unit increase of the SS score, academic performance would decrease by 8.625 (=sqrt(74.396)) units. Thus, this suggests that the significant SA effect in Model 1 is probably due to the SS subscale rather than the SM subscale.

Table 4-24: Test of between-subjects effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>64073223.425</td>
<td>9</td>
<td>7119247.047</td>
<td>2.835</td>
<td>0.003</td>
<td>0.085</td>
</tr>
<tr>
<td>Intercept</td>
<td>10256172.669</td>
<td>1</td>
<td>10256172.669</td>
<td>40.847</td>
<td>&lt;0.001</td>
<td>0.130</td>
</tr>
<tr>
<td>Entry pathway</td>
<td>5101405.606</td>
<td>1</td>
<td>5101405.606</td>
<td>2.031</td>
<td>0.155</td>
<td>0.007</td>
</tr>
<tr>
<td>DM</td>
<td>661823.497</td>
<td>1</td>
<td>661823.497</td>
<td>0.264</td>
<td>0.608</td>
<td>0.001</td>
</tr>
<tr>
<td>DS</td>
<td>4444860.484</td>
<td>1</td>
<td>4444860.484</td>
<td>1.770</td>
<td>0.185</td>
<td>0.006</td>
</tr>
<tr>
<td>SM</td>
<td>531342.557</td>
<td>1</td>
<td>531342.557</td>
<td>0.212</td>
<td>0.646</td>
<td>0.001</td>
</tr>
<tr>
<td>SS</td>
<td>10893800.076</td>
<td>1</td>
<td>10893800.076</td>
<td>4.338</td>
<td>0.038</td>
<td>0.016</td>
</tr>
<tr>
<td>Entry pathway * DM</td>
<td>2625390.651</td>
<td>1</td>
<td>2625390.651</td>
<td>1.045</td>
<td>0.307</td>
<td>0.004</td>
</tr>
<tr>
<td>Entry pathway * DS</td>
<td>6213222.24</td>
<td>1</td>
<td>6213222.24</td>
<td>0.025</td>
<td>0.875</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Entry pathway * SM</td>
<td>5292889.219</td>
<td>1</td>
<td>5292889.219</td>
<td>2.108</td>
<td>0.148</td>
<td>0.008</td>
</tr>
<tr>
<td>Entry pathway * SS</td>
<td>251233.223</td>
<td>1</td>
<td>251233.223</td>
<td>0.100</td>
<td>0.752</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Error</td>
<td>685619264.276</td>
<td>273</td>
<td>2511425.876</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6723405269.633</td>
<td>283</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>749692487.701</td>
<td>282</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: $R^2 = 0.085$ (Adjusted $R^2 = 0.055$). df = degrees of freedom; F = F-statistic; p = p-value; Partial eta squared represents effect size.
Table 4-25: Test of between-subjects effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>51735779.695</td>
<td>5</td>
<td>10347755.939</td>
<td>4.107</td>
<td>0.001</td>
<td>0.069</td>
</tr>
<tr>
<td>Intercept</td>
<td>123546135.649</td>
<td>1</td>
<td>123546135.649</td>
<td>49.032</td>
<td>&lt;0.001</td>
<td>0.150</td>
</tr>
<tr>
<td>Entry pathway</td>
<td>1486414.952</td>
<td>1</td>
<td>1486414.952</td>
<td>5.899</td>
<td>0.016</td>
<td>0.021</td>
</tr>
<tr>
<td>DM</td>
<td>178820.640</td>
<td>1</td>
<td>178820.640</td>
<td>0.711</td>
<td>0.396</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DS</td>
<td>4856943.109</td>
<td>1</td>
<td>4856943.109</td>
<td>1.228</td>
<td>0.270</td>
<td>0.007</td>
</tr>
<tr>
<td>SM</td>
<td>15020.515</td>
<td>1</td>
<td>15020.515</td>
<td>0.006</td>
<td>0.939</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SS</td>
<td>11405797.343</td>
<td>1</td>
<td>11405797.343</td>
<td>4.527</td>
<td>0.034</td>
<td>0.016</td>
</tr>
<tr>
<td>Error</td>
<td>697953708.005</td>
<td>277</td>
<td>2519888.477</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>6723405269.633</td>
<td>283</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: $R^2 = 0.069$ (Adjusted $R^2 = 0.052$). df = degrees of freedom; F = F-statistic; p = p-value; Partial eta squared represents effect size.

Table 4-26: Parameter estimates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>SE</th>
<th>t</th>
<th>p</th>
<th>95% Confidence Interval</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
<td>Upper Bound</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>4428.986</td>
<td>668.886</td>
<td>6.621</td>
<td>&lt;0.001</td>
<td>3112.240</td>
<td>5745.732</td>
</tr>
<tr>
<td>[entry pathway=0]</td>
<td>471.195</td>
<td>194.001</td>
<td>2.429</td>
<td>0.016</td>
<td>89.291</td>
<td>353.999</td>
</tr>
<tr>
<td>[entry pathway=1]</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>9.960</td>
<td>37.385</td>
<td>0.266</td>
<td>0.790</td>
<td>-63.638</td>
<td>83.555</td>
</tr>
<tr>
<td>DS</td>
<td>50.475</td>
<td>36.356</td>
<td>1.388</td>
<td>0.166</td>
<td>-21.093</td>
<td>122.044</td>
</tr>
<tr>
<td>SM</td>
<td>2.866</td>
<td>37.512</td>
<td>0.077</td>
<td>0.939</td>
<td>-70.949</td>
<td>76.742</td>
</tr>
<tr>
<td>SS</td>
<td>-74.396</td>
<td>34.967</td>
<td>-2.128</td>
<td>0.034</td>
<td>-143.231</td>
<td>-5.561</td>
</tr>
</tbody>
</table>

Notes: For entry pathway, 0 = A-Level and 1 = Polytechnic. a = This parameter is set to zero because it is redundant (as entry pathway = 1 was the reference group). B = parameter estimate’ SE = standard error; t = t-statistic; p = p-value. Partial eta squared represents effect size.

Section 4.3 of this chapter has examined the students’ scale and subscale scores of each learning approach (i.e. deep approach and surface approach) via their responses to Biggs et al.’s (2001) R-SPQ-2F and presented the quantitative findings of the study. In the following Section 4.4, the researcher aimed at bringing together, the results from the interviews in order to describe the understanding of student scale and subsequent subscale scores.

4.4 Qualitative analysis

Among the 316 respondents, 20 students were selected to participate in the group interviews, and Table 4-26 provides the participants' information. Chapter 3 Section 3.7.1 provides a detailed description on how the selection of interviewees and interviews were conducted.
A Microsoft Word document transcription process was carried out for the 20 records of interviews which were then analysed and read many times while searching for the research-based keyword code. The researcher sent a copy of the interview transcript to all participants for their review, but the participants did not respond to the researcher’s request. Furthermore, the researcher had also scheduled a follow-up session to have them review the transcripts, but the participants failed to turn up. The lack of response could very well be due to the busy schedule of preparing for their examinations. The researcher had therefore proceeded with the qualitative analysis using the peer review conducted. The identified codes corresponded to ‘presage’, ‘process’, and ‘product’ factors in Biggs et al.’s (2001) 3P model of teaching and learning. A total of 90 codes were formed after the deductive thematic analysis was completed, and the researcher sorted these codes into identified themes and subthemes and ensured that all the coded extracts of text fit within the identified themes (Braun & Clarke, 2006). At this stage, the researcher needed to review

<table>
<thead>
<tr>
<th>S/N</th>
<th>Student label</th>
<th>Age</th>
<th>Degree classification</th>
<th>Year of study</th>
<th>Entry pathway</th>
<th>Gender</th>
<th>Learning approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Y1S1AFD</td>
<td>19</td>
<td>First</td>
<td>One</td>
<td>A-Level</td>
<td>Female</td>
<td>Deep</td>
</tr>
<tr>
<td>2</td>
<td>Y1S2AMD</td>
<td>22</td>
<td>First</td>
<td>One</td>
<td>A-Level</td>
<td>Male</td>
<td>Deep</td>
</tr>
<tr>
<td>3</td>
<td>Y1S3PMO</td>
<td>23</td>
<td>2:2</td>
<td>One</td>
<td>Polytechnic</td>
<td>Male</td>
<td>Deep</td>
</tr>
<tr>
<td>4</td>
<td>Y1S4AOA</td>
<td>22</td>
<td>First</td>
<td>One</td>
<td>A-Level</td>
<td>Male</td>
<td>Deep</td>
</tr>
<tr>
<td>5</td>
<td>Y1S5PMO</td>
<td>23</td>
<td>2:1</td>
<td>One</td>
<td>Polytechnic</td>
<td>Male</td>
<td>Surface</td>
</tr>
<tr>
<td>6</td>
<td>Y1S6AFD</td>
<td>19</td>
<td>First</td>
<td>One</td>
<td>A-Level</td>
<td>Female</td>
<td>Deep</td>
</tr>
<tr>
<td>7</td>
<td>Y1S7PFS</td>
<td>20</td>
<td>2:1</td>
<td>One</td>
<td>Polytechnic</td>
<td>Female</td>
<td>Surface</td>
</tr>
<tr>
<td>8</td>
<td>Y1S8MOA</td>
<td>22</td>
<td>First</td>
<td>One</td>
<td>A-Level</td>
<td>Male</td>
<td>Surface</td>
</tr>
<tr>
<td>9</td>
<td>Y1S9MOA</td>
<td>20</td>
<td>Third</td>
<td>One</td>
<td>Polytechnic</td>
<td>Female</td>
<td>Deep</td>
</tr>
<tr>
<td>10</td>
<td>Y1S10PFS</td>
<td>20</td>
<td>2:2</td>
<td>One</td>
<td>Polytechnic</td>
<td>Female</td>
<td>Surface</td>
</tr>
<tr>
<td>11</td>
<td>Y1S11PMO</td>
<td>23</td>
<td>Ordinary</td>
<td>One</td>
<td>Polytechnic</td>
<td>Male</td>
<td>Deep</td>
</tr>
<tr>
<td>12</td>
<td>Y2S12PMS</td>
<td>24</td>
<td>2:1</td>
<td>Two</td>
<td>Polytechnic</td>
<td>Male</td>
<td>Surface</td>
</tr>
<tr>
<td>13</td>
<td>Y2S13MOA</td>
<td>23</td>
<td>2:2</td>
<td>Two</td>
<td>A-Level</td>
<td>Male</td>
<td>Deep</td>
</tr>
<tr>
<td>14</td>
<td>Y2S14MOA</td>
<td>21</td>
<td>2:1</td>
<td>Two</td>
<td>A-Level</td>
<td>Female</td>
<td>Deep</td>
</tr>
<tr>
<td>15</td>
<td>Y2S15PFS</td>
<td>22</td>
<td>First</td>
<td>Two</td>
<td>Polytechnic</td>
<td>Female</td>
<td>Surface</td>
</tr>
<tr>
<td>16</td>
<td>Y2S16AFD</td>
<td>21</td>
<td>First</td>
<td>Two</td>
<td>A-Level</td>
<td>Female</td>
<td>Surface</td>
</tr>
<tr>
<td>17</td>
<td>Y3S17AFD</td>
<td>22</td>
<td>First</td>
<td>Three</td>
<td>A-Level</td>
<td>Female</td>
<td>Deep</td>
</tr>
<tr>
<td>18</td>
<td>Y3S18AFD</td>
<td>22</td>
<td>First</td>
<td>Three</td>
<td>A-Level</td>
<td>Female</td>
<td>Deep</td>
</tr>
<tr>
<td>19</td>
<td>Y3S16PMO</td>
<td>25</td>
<td>2:2</td>
<td>Three</td>
<td>Polytechnic</td>
<td>Male</td>
<td>Deep</td>
</tr>
<tr>
<td>20</td>
<td>Y3S20PMO</td>
<td>25</td>
<td>2:1</td>
<td>Three</td>
<td>Polytechnic</td>
<td>Male</td>
<td>Deep</td>
</tr>
</tbody>
</table>
the coded data to identify areas of similarity and the presence of coherent and meaningful patterns of data (Braun & Clarke, 2006).

Although the tagging was performed manually using a yellow highlighter to note the phrases, it was not trivial as the researcher read all the phrases carefully to determine the underlying meaning of the participants’ words in the discussion context at the particular point of time. The process was iterative to ensure correct assigning and duplicated phrases were eliminated. Verbatim quotations that contain grammatical errors have not been corrected. Table 4-27 presents the phrases alongside corresponding themes and subthemes that have been subjected to tagging.

Table 4-28: Sample of identified themes, subthemes, codes and verbatim quotation used in qualitative analysis

<table>
<thead>
<tr>
<th>Themes/subthemes</th>
<th>Codes</th>
<th>Verbatim quotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process/Deep Approach</td>
<td>- Generating concept maps</td>
<td>Understand the big picture then go down to the specifics. I feel that'll make understanding concepts easier and give you a rough idea of what you need to study. (Personally I'll try to do a mind map of the topic before that. If I can’t fit it down/explain a particular concept confidently, I’ll give that topic a lower priority - study those you don’t know before you brush up on the ones you know) Also, don’t just remember stuff word for word. Try to understand the underlying concept. Once you get the concept, coming up with your own explanation is a lot easier (Y1S1AFD)</td>
</tr>
<tr>
<td></td>
<td>- Listing concepts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Mastering content</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Outlining</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Paraphrasing information</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Practicing for understanding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Academic success related</td>
<td>Discrimination, Sacrifices had to be made to ensure excellence. I had to put my studies before anything else. Study smart (Y2S1AMD)</td>
</tr>
<tr>
<td></td>
<td>- Attention focusing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Effective time management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Encouraging internal motivation</td>
<td></td>
</tr>
</tbody>
</table>

An identifier with five components follows each verbatim quotation:

- Year of study (Y1=First-year, Y2=Second-year, or Y3=Third-year)
- Interviewee number
- Entry pathway (A=A-Level or P=Polytechnic)
- Gender (F=Female or M=Male)
- Learning approach (D=Deep or S=Surface)
For example, Y1S1AFD stands for a quotation from a first-year, student no. 1 from the A-Level entry pathway who is female and whose learning approach was DA.

The following sections report the analysis of the verbatim quotation from the participants pertaining to the RQs using the structure of the 3P model (Biggs et al., 2001) as a framework. The three identified themes include presage, process, and product factors. Chapter 3 Section 3.7.1 provides a detail description of how to analyse the group interview transcripts using a deductive thematic analysis.

4.4.1 Theme 1: Presage factors

The first theme is ‘presage’ factors. This includes characteristics of learners that exist before the learning experience such as age, gender, curriculum content, learning environment, and amongst others as described in Chapter 2, Section 2.5.1. The four subthemes include the age, entry pathway, gender, and year of study.

Subtheme 1: Age. Mature students (aged 25 years and above) reported a sense of ‘feeling old’ and having fewer topics of interest outside lessons with younger students (aged 17-24 years), and therefore, preferred to work with students from the same age group if possible. One mature student best expressed this:

“In school, there is project work, but it is a group work..., and the younger classmates tend to procrastinate, taking their sweet time to complete their task. When we have group discussion, they talked non-sensible stuff like movies, where to hang out and to gossip” (Y3S19PMD)
Irrespective of age, nearly all computing students interviewed, but especially the DA students respected the teaching staff with most of them considering teachers their friends and seniors. They preferred teachers that demonstrated concerns regarding their academic performance and personal growth. Most of them admired and respected teachers that exuded brilliance and knowledge. They demonstrated confidence in approaching teachers to debate knowledge and sought to follow and learn their patterns of thinking.

“Taking notes down from lecturers that give advises on how to approach the coursework” (Y2S13AMD)

“Don’t be afraid to engage the lecturer either during lecture time or after lecture time” (Y3S17AFD)

Furthermore, the computing students valued a scaffolded instructional approach heavy on teaching towards prescribed goals. Under such an approach, the teacher can be seen as driving the learning rather than the students. This comment from Y3S19PMD shows his desire that the teacher teach to outcomes rather than moving off into broader topics or areas of ambiguity:

“What ever taught in class I pay attention, ask questions and take notes, I also discuss with the learning materials with the lecturers, follow instructions – nearer to exams, I just revise or practice past exam papers.”
Maturity appeared to affect collaboration where younger students reported that the older students were able to offer better organisation within a group, they had more efficient ways of tackling problems and were able to provide general advice.

“All of my groupmates are working part-time, they are more organised and systematic. They lead our group discussion, and usually, we can complete the work on time… the grades not too bad” (Y3S18AFD)

“The older classmates… they very meticulous. They make sure we explore all possible solutions to solve problems and make sure we understand. Not selfish to share their knowledge too” (Y3S19PMD)

The analysis of the student interviews with regards to age indicated that mature students felt separated from the younger students but did not report that it affected their studies. A feeling of esteem and respect towards academic staff was seen to be necessary to students regardless of age. The mature students were reported to be more organised and had better problem-solving skills than the younger students and provided younger students with opportunities of learning from their experiences and more efficient approaches to learning. Interestingly, the deep learners shared the same views as surface learners, regardless of age.

Subtheme 2: Entry pathway. Analysis of the interview data seems to show that the undergraduate computing students from different post-secondary institutions have varying perceptions of their higher education learning environments. However, many of the interviewees, both graduates from the A-Level and polytechnic, were critical in their comments regarding their learning
environments and placed great importance on effective teaching and learning. Seemingly, there was no significant gap between how A-Level and polytechnic graduates perceived their learning environments, in fact, their interview responses shown similarity in their perceptions.

**A-Level graduates**

“In junior college, the breaks between each lesson is very short, about 25-50 minutes. So, it is difficult to study a chapter. However, it is good for practices like Mathematics. Now, (referring to university) there are many breaks between lessons. So, it is easier to review the lessons after class. It is more flexible in terms of independent learning time and class schedule. The time taken to complete homework is longer so more time to prepare, less stress out. With proper time management, I feel that it should be easier than in junior college” (Y1S2AMD)

“Book consultations with junior college tutors regularly (once a week). But in university, hardly any avenues for us to book consultations with lecturers after class” (Y1S6AFD)

**Polytechnic graduates**

“The content in polytechnic projects can be created, edited and explored without constraint as long it is according to the topic. I would seek consultation with lecturers to approve the concept or plan of the project. It is a bit different in university… more rigid, more rules and regulations like no lecturers would allow a late or second chance submission without penalty of school fees or failure of courses” (Y1S5PMS)
“At polytechnic, we can test out theories through trying out on hardware and software we were taught to build. It was tedious, but it was good for revision as well as it gives me some experience in creating programmes and how the application of software/hardware works. In university… it is more academic (theory)-based” (YAS11PMD)

“To my approach of learning is via Problem Based Learning as I did my diploma in (polytechnic name). Where we learn the objective through a problem and solving the problem through research, findings, discussions and presenting solutions to the class. And now having lecture-based teaching in a university, I have to do my own findings or read up in order to do my own notes for studying” (Y2S12PMS)

However, various comments with regards to learning approaches tended to suggest that A-Level graduates preferred a deeper conceptual understanding of their computing courses. Possibly A-Level graduate students tended to adopt more DA due to their perceived need to understand concepts in their previous learning environment. This was seen within the quantitative analyses shown in Table 4-14, where the mean for DA for A-Level students was higher as compared to polytechnic students (A-Level=29.98, polytechnic=29.06). The following quotes are good examples of A-Level graduates’ sentiments to reflect such perceptions, though the second student is a surface learner.

“Before coming into university, my preferred studying method is understanding the topic by association. I will try to make connections of my learnings to real life … I do not think there will be any difference in my studying methods” (Y1S4AMD)
“A consistency in studying, revising and practising. As the subjects vary greatly from my previous education. I find that revising often and ensuring that the subject can be explained properly in my own words is very effective … Don’t be hesitant to look up words or phrases you are not very sure of, I often check the definition of words that I do not understand or not sure of its exact meaning, this will help you in brushing up your vocabulary and occasionally add in ways to construct sentences”

(Y1S8AMS)

In contrast, polytechnic graduates spoke about depending widely on rote-learning as a significant portion of reading materials and theory related to computing programmes.

“I just wanted to pass my modules and because of the tighter schedule (more modules and 2 semesters a year). I spend less time understanding the topic and just made notes to memorise. Furthermore, as modules are not related, memorising and forgetting everything after exams were better” (Y1S11PMD)

“Textbook approach, speed reading, and crapping out of phrases and points. What was tested in exams require mostly directly listing off from textbooks. No further reading or understanding out of the curriculum was needed” (Y1S5PMS)

“They (referring to A-Level graduates) more hardworking, not willing to share notes, so “kiasu” like competing with us. Cannot study with them as we were more outgoing. They usually put their best effort to get good result, I think A-Level trained them…” (Y1S5PMS)
The analysis of the student interviews with regards to entry pathway found that differences were reported in how the two groups approached their studies. The interview analysis appears to suggest that polytechnic graduates tended to lean towards a SA because of the perceived excessive amount of material in their curriculum. On the other hand, A-Level graduates reported using more DA possibly because they were motivated by external factors such as grades and future career options. Such preferences were seen within the quantitative analyses presented within Table 4-14 where A-Level students significantly scored higher for DM subscales when compared to polytechnic students (A-Level=14.47, polytechnic=13.93), and they also scored higher for DS subscales when compared to polytechnic students (A-Level=15.51, polytechnic=15.13). Additionally, this was seen within the quantitative analyses where there were variations in scale percentages for A-Level and polytechnic graduates based on DA scale, with the latter posting high scores as opposed to the former (see Table 4-12).

For most, the difference was the prevailing notion that graduates from Junior Colleges (JCs) practise more 'kiasuism', and hard work. The word 'kiasu' originated from Singapore to reflect a trait that captures a particular aspect of Singaporean society. Literally translated from the Hokkien dialect terminology, it means 'fear of losing out' or 'afraid to lose' (Bedford & Chua, 2017). The focus is not on losing fear, but instead on making efforts or striving to decrease the likelihood of failure (Ellis, 2014). Students from JCs were portrayed as more hardworking and were associated with the pressure to do well and, for example, the threat of 'kiasu'. Memorisation may be a poor strategy, but possibly a surer one for students from JCs who experienced the need to compete aggressively (Yee, 2010) However, whether polytechnic graduates were as competitive
while at school was not indicated from the interview responses. Neither did students talk about whether being hardworking or ‘kiasu’ affected their academic performance, although students perceived that graduates from A-Level were less extrovert.

**Subtheme 3: Gender.** The interview data did not provide much evidence of differences in how undergraduate computing male and female students approach their learning. Although some studies found significant differences in learning approaches between male and female students (Duff, 1999; Sadler-Smith, 1996), it is observed in the quantitative analysis presented in Table 4-12 that there were no percentage differences in both the main scales of the R-SPQ-2F between male and female groups.

However, one interesting feature was the perception of the female students about their male counterparts that the male students also depend on memorisation for their work which the female students considered them better at it. The following quotes by two female students nicely summarise the perceptions:

“Midway through the semester, I find I faced difficulties understanding the blockchain data architecture, so I asked (male student name) to explain the topic to me. He said do what he always does – memorise, and you can still score in exam” (Y2S14AFD)

“I still cannot understand how they can do this? Mug up everything and vomit it out literally in exams” (Y3S18AFD)
While it is common for surface learners to memorise contents, studies conducted on high achieving Asian students found that they achieve success in their studies because the memorising act alone led to understanding (Biggs, 1990; Kember & Gow, 1990; Biggs & Watkins, 2001). This explains the observation where the subscale percentage for male and female students differed on the DS, with male students scoring significantly higher than female students (see Table 4-13). Although male learners embraced memorisation as the learning approach, they could both reproduce the content taught and show their knowledge of learning materials because they reflected higher DA scores, as shown in Table 4-12.

Another aspect that was indirectly linked to the main topic of the thesis, indicated that female students appeared to enjoy their university experiences possibly because of the friendships cultivated which provided a support structure was expressed by the following female students. Male learners did not mention this evidence of 'friendships'.

“I will usually have a friend beside me as I am more productive, efficient and motivated to complete the assignments compare to doing the assignments at home, where I find myself being easily distracted and ended up completing the assignment at a later date” (Y1S9PFD)

“Study with friends. Peer pressure is one way that makes me want to work hard. Besides, it is also a form of networking and sharing of knowledge. Studying with friends helps me to expand my horizons to things that I may not have known if not for them” (Y1S1AFD)
“I have my study group. We meet up and do work almost once a week. A good way to foster friendship and for motivation as well” (Y1S6AFD)

Barton, Van Duuren, and Haslam (2006) reported that grouped students had a higher likelihood of scoring higher on the ‘openness to experience’ scale, which is largely linked to deep learning approach (Zhang, 2003) as opposed to students that studied independently. Additionally, group work might enhance motivation and self-efficacy of students (Davies, 2009). Moreover, this is seen within the quantitative analysis where subscale percentages for female and male students varied on the DM subscales, with male students posting higher scores as compared to their female counterparts (see Table 4-13). However, student interview analysis regarding gender lacked any clear indication regarding the correlation between SAL and gender.

Subtheme 4: Year of study: Many first-year students that were interviewed appeared to consider learning strategies a dominant aspect influencing their understanding. Their sentiments are captured within the following quotes:

“I take the time to understand and read more about the topics as I know what I will be doing next year is built on this year” (Y1S3PMD)

“Before coming into university, my preferred studying method is understanding the topic by association” (Y1S6AFD)

“I would use the study guide, Youtube and sometimes books from the library to help with my learning” (Y1S11PMD)
It is significant to note that those students who show a preference for understanding all appear to be using a DA to their study. Such preferences were seen within the quantitative analyses presented within Table 4-12 and Table 4-13 where 68% (192 out of 283) students showing a DA preference, and 53% (101 out of 192) of the students preferred the DS. While of the 32% (91 out of 283) students classified as adopting a SA, 64% (58 out of 91) score significantly higher on the SS. Thus, it shows that most DA and SA students tend to choose the strategy subscale (namely DS and SS) rather than the motive subscale (namely DM and SM) as mentioned:

“Go through past exam papers, highlight notes, and pay attention to tips in class” (Y1S5PMS)

Some first-year students indicated preferences for DA; however, they opted for rehearsing and memorising when they experienced difficulties in understanding new materials:

“If I am unable to understand the topic, I would copy and memorise the answers first” (Y1S2AMD)

“I spend less time understanding the topic and just made notes to memorise” (Y1S4AMD)

These male students scored on average higher with the deep learning approach compared to surface learning approach, but scored highly on the DS subscale. One of the female students explained that “Sometimes not having time to do that. Hence, now, I would sometimes jump into practices while still trying to start by topics” (Y1S9PFD). Such perceptions for the absence of time
might constitute the challenges undergraduate computing students encountered while moving from polytechnics and JCs to university. In general, students in university need to be more self-directed than in JCs or polytechnics, and take responsibility for their own self-management (Renjan, 2018), thus as mentioned by Y1S1AFD that “… sometimes extra effort needs to be put in because information is not always spoon-fed now as compare to JC and I have to read from different sources to find out more.”

Comparing learning strategies with first-year students, quantitative data of second years showed significantly lower learning strategy scores. Based on the interviews, there was a sense that second-year students demonstrated weaknesses in applying learning strategies. They likely sought to use minimum efforts in their academic work to fulfil the requirements of the course. One male student who applied the SA put it this way:

“… always read lecture notes without really understanding the materials. It was pure memory work…” (Y2S12PMS)

This apparent decline in efforts was captured in the sentiments below from two male students:

“I relied more on the "lecturer’s spoon-feeding" I did some external reading on my own although that was seldom” (Y2S13AMD)

“Usually cram a few hours before the exam” (Y2S15PFS)

It appeared that students have never been challenged appropriately within their academic work or cannot use relevant learning approaches (or strategies), thus
they might have considered it irrelevant (as compared to first years) to use specific learning approaches. For certain students, the courses were still ‘exam-oriented’, thus they kept using learning approaches they utilised within polytechnics and JCs as Y2S14AFD confirmed “It is still similar now … assessment methods are largely similar to A-Levels, in that 100% of the grades are determined by a single examination.”

Throughout the interview with year three students, there were similar sentiments as those for second-year students, that is, a sense that students had understood the course requirements and that their studies were oriented towards relevant content and achieving set objectives. The sentiments of the students are captured below:

“… mainly study using the notes and tutorials given by teachers as well as past year exam papers.” (Y3S17AFD)

“No need to read more than what’s covered in subject guide cause exams won’t test what’s not in it.” (Y3S18AFD)

Based on the feedback, it seemed that older third-year students upon discovering that the programmes they were pursuing did not require significant DA to perform well resorted to mostly memorising the necessary content. It is worth noting that some students seek pragmatic approaches towards achieving academic outcomes, a case in point is participants Y3S18AFD and Y3S17AFD, who had higher DA scores.

Therefore, students might choose the following approaches within their studies in an attempt to obtain potentially higher results; they (1) include orientating to
comprehend and use appropriate material, (2) read widely and comparing materials to prior knowledge, (3) memorise information required for assessments, (4) demonstrate alertness towards important points on the marking schemes, (5) focus on discrete elements with integration, and (6) use past examination papers in predicting questions. Even though memorising approaches characterise surface learning style, the students appeared to have adopted the perception that ‘rote learning’ constituted the most effective means of studying and three participants explained how they created means of increasing their learning, and this is shown below:

“For my exams, I made sure that I memorised key points” (Y3S18AFD)

“As for University, I applied the same technique, of course this time the exam wasn’t an open book, so I had to memorise more information than before” (Y3S19PMD)

“… as modules are not related, memorising and forgetting everything after exams were better” (Y3S20PMD)

Nevertheless, it was reported within the interviews that third-year students had a heavier workload as compared to their first-year and second-year counterparts. Third-year students needed to enrol in six half-unit courses alongside an academic research project as opposed to first-year and second-year students that only have to take four courses. Besides hours of class contact, they were required to spend significant time handling assignments and studying prescribed readings. Due to the huge course demands, most students alleged that they did not have enough time of meeting their deadlines, thus
opting for memorising as the learning approach. The captured views are given below:

“… There is a need to change my approach due to the amount of course works that were given” (Y3S17AFD)

“The time taken to complete homework is longer so more time to prepare…” (Y3S19PMD)

Furthermore, the preference for memorisation as an approach to learning was cited within the quantitative analysis provided in Table 4-18 whereby third-year students exhibited higher SS subscale averages as opposed to first-year and second-year students (year one=12.45, year two=13.09, year three=15.00). This also complimented the quantitative study findings where the SA mean for third-year students was the highest among all undergraduate groups (year one=22.83, year two=24.31, year three=27.75). The outcome was unexpected because it was believed that the year three students would demonstrate maturity as life-long learners and would utilise more DS. Additionally, the number of students classified as adopting a DA progressively decreased as students’ progress to the next academic year (year one=76.2%, year two=60.0%, year three=44.4%).

A few younger first-year students reported positive attitudes towards their academic work and stated that interest formed their rationale of enrolling into computing programme. Their sentiments are presented below:

“Being in a course that I find interesting also helps as I am curious and naturally want to learn more” (Y1S1AFD)
“Comparing then and now, I feel that I have better discipline, motivation and drive to study this course. I feel it is due to my interest in IT and my experiences…” (Y1S2AMD)

Similar to the first-year students’ groups, several second-year students enrolled in computing programme as the polytechnic or A-Level results prevented them from enrolling into the six autonomous universities in Singapore\(^7\). A further probe to determine whether this has affected their interests in academic work, many expressed their displeasure and apprehension in the initial stages; however, they discovered later that their enrolment in the programme was not the reason for that discontent and have embraced positive attitudes to their academic work. Responses from students include:

“… I have nowhere to go… Moreover, it is expensive to study overseas, so I choose this programme, but so far I can cope …” (Y2S13AMD)

“I applied for Psychology programme at … but my grades were not good enough to meet the entry requirement. I think IT not too bad quite easy to get jobs” (Y2S14AFD)

Finally, it emerged that second-year students were unsure and less enthusiastic about their future occupations as opposed to first-year students. As cited previously, second-year students showed that they ‘understood the academic structure’ and had ‘gained more slack’ than they initially were during

\(^7\) Autonomous universities in Singapore receive funding from the government and are given the flexibility to strategise, innovate, and differentiate themselves in education, research and service (MOE, 2018b)
their first year. One student stated that she disliked second-year courses "I study when exams are coming. I do not like programming..." (Y2S12PMS). Another female learner complimented this and stated that "I just want to pass and graduate" (Y2S15PFS).

Such perceptions were significantly demonstrated in their lower DM scores as opposed to the first-year students (year one=14.69, year two=13.68, year three=12.50), and higher score for SM when compared to the year one group (year one=10.37, year two=11.21, year 3=12.75) (see Table 4-18). A further probe in the interview revealed that the lower motivations from personal interests and higher ambivalence seemed to depend to some extent on fears of failing:

"I failed one course in my first year, and I need to retake this year. It is very miserable, and I do not want to fail again..." (Y2S12PMS)

"For me, I thought this degree is easy, so I didn't work that hard in year one. However, I just passed the courses. My parents were disappointed, and I do not want to fail them again... Have to work hard to score good grades" (Y2S16AFS)

While interviewing students in their third year, it became quite evident that the study goals of third-year students were a subject of greater focus. The students behind them, in the second year of study, were less focused on such goals. Without a doubt, there is a clear association with a higher level of education and focus on the completion of one’s programme and obtaining their degrees. Their sentiments are captured below:
“Last year, so study as much as we can and get the degree…” (Y3S17AFD)

“For me, I just want to get through the courseworks and exams and get the degree” (Y3S19PMD)

The motive of attaining degrees came across strongly from third-year students as opposed to all the other interviewed groups. It is notable that the year three students were small in number and might, therefore, represent the keenest year three computing students, so might not be representative of all year three students. Nevertheless, within the quantitative analysis, their mean was not significantly higher for the DM approach compared to the other groups (year one=14.69, year two=13.68, year three=12.5). The second motive of the study that emerged from the interviews pertained to the necessity of preparing for future endeavours following graduation - either for their career or further studies. Some of their feedbacks are captured below:

“Not sure what I want to do. But now in my final year, I want to get a good job to pay off my study loan” (Y3S18AFD)

“My aims changed as I can see what I study could be applied to my future job” (Y3S20PMD)

Similarly, significant differences existed within the quantitative data involving the SS scores of year three students as opposed to their year one and year two counterparts (F(2, 280)=8.496, p<0.001 for SS) (see Table 4-18). Nevertheless, based on the interviews, a notable feeling existed that third-year students had more intrinsic motivation as could be observed within the
foregoing sentiments where the respondents cited changes in studying objectives and have been more streamlined.

### 4.4.2 Theme 2 and 3: Process and product factors

The second theme is ‘process’ factors. As defined in Chapter 2, Section 2.5.2, the process component is centred on students’ approaches to learning (SAL). As such, student mentions of deep approach (DA) (e.g.: checking understanding, interest in ideas and content, use of evidence, creating outlines and structures), and surface approach (e.g.: fear of failure, high anxiety, insufficient time, inability to understand content at a deep level, lack of purpose, syllabus-boundness) were analysed through this lens.

‘Product’ factors is the third theme. This is defined as what the students did during their learning and includes one subtheme, namely learning outcomes.

**Subtheme 1: Deep approach and learning outcomes:** The examination of DA to learning from interview data indicated that understanding ideas and concepts constitute the main reasons for embracing deep approaches to learning. Students used approaches towards deeper understanding to achieve positive learning outcomes. For instance, in actively seeking a broad overall understanding of their work, students reported a sense of improvement in their examination grades. However, the interview data also suggested that students felt frustration when they could not understand but feelings of satisfaction, enjoyment, and possessing positive attitudes when they understood.

“… But, I find it easier to score high marks if I have an interest in the particular subject. Because it gives me the drive to learn more and it
makes knowledge retaining so much easier. And I enjoy studying about that particular subject” (Y1S2AMD)

“I suppose it does. Not only on what I have learned, but what I have understood from it. Gone were the days when one just had to state facts and formulas. In this new generation, education is skewed towards critical thinking and problem solving. Exams are made to do that, by forcing one to extend out of their comfort zones, to test what one had understood” (Y1S6AFD)

“… it does in a certain extent because grades determine if you have understood your knowledge of the subject precisely” (Y2S12PMS)

“For the modules that I have scored first class on, I feel that I have a better understanding compared to the ones that I didn’t score first class on” (Y3S18AFD)

Students reported that using DA and having developed understanding helped them towards thinking logically in their learning materials or when they were solving a problem. A sense of confidence and a feeling of readiness were associated with such an approach. Thinking logically and analysing problems were important skills perceived to be necessary for students’ real working environments and future use.

“Grades are there to measure the amount which I have understood during the course of study and how well I have answered questions given to me. Assuming that I pursue an occupation after graduation, what I have studied would be a basis for understanding…” (Y3S18AFD)
“I always revised what I learnt … I also wrote lots of notes and did some further research to help me with my modules. For example, I self-learnt Android Studio for my Final Year Project. Learning more stuff so I can secure a good job” (Y3S19PMD)

Besides, for some students, using deep approaches to learning appeared to be an important philosophy in life, particularly when they referred to what ‘learning’ and ‘understanding’ meant to them.

“ … Back in polytechnic, most of my learning consisted of using the lecture slides and notes provided … When in university, I realised that there was a greater emphasis on independent learning. To me understanding and learning are important … ” (Y1S3PMD)

“Even after graduation, we continue to learn. Lifelong learning … Enhance our understanding and I think gives me more opportunities and chance to try new experiences” (Y3S20PMD)

Interestingly, even though participant Y2S13AMD was aware of the importance of adopting a deep level of understanding in his learning, he also acknowledged that he used memorisation in his learning:

“For my exams, I made sure that I memorised key points. While making sure that the content of those points was thoroughly understood … This ensured that I have all that I need at my fingertips during my exams” (Y2S13AMD)
It would appear that participant Y2S13AMD had a strong preference towards deep conceptual understanding of what he was learning. Nevertheless, the interview data suggest that he contradicts himself and is capable of using superficial approaches, possibly through the threat of 'kiasuism'. He uses whatever approaches are appropriate to arrive at his intended aim. However, his contradictions did not appear to impede his search for understanding and meaning to do well.

The description of DA to learning as suggested from the interview analysis was that there were preferences for to work towards a meaningful understanding of various subjects such as to understand concepts and ideas and to make sense of what was learnt rather than to remember information. Besides, there were indications of relating relevance of what was learnt and being able to use those concepts and ideas in the real working situations and future use, and towards thinking logically while learning or solving a problem. The analyses suggest that adopting DA to learning contributed towards students achieving better grades and towards their enjoyment. Nevertheless, besides academic scores, students also demonstrated gains in attitudes including independent in learning, constructive perceptions to life philosophy, more confidence, and improvements in self-esteem. The DA used did not prevent students from utilising memorisation. However, data from the interview indicate that utilising cramming did not imply that students avoided efforts to uncover reading concepts or were not unwilling to take into account in-depth meaning for what they learnt.

Subtheme 2: Surface approach and learning outcomes. The analysis of SA to learning from the interview data suggested that there were often preferences to use superficial memorising of theories and calculation formulas for problem-
solving in tests and examinations. Students reported using methods such as highlighting, underlining, and extensive copying of notes to help in memorisation without fully comprehending meanings.

“My approach to studying is to start memorising chapter by chapter, but I speed-read through all the materials first and highlight key points for easy memorisation. Sometimes not having time to do that, I would selectively choose chapters to memorise” (Y1S8AMS)

“I will practice past year exam papers repeatedly and identified the topics usually comes out then focus on that few topics. Even papers that are older than 5 years, I will also practice it because in general concepts are still the same and through practicing more questions help in memorising” (Y1S10PFS)

“Last minute preparation for the exam is totally fine. You only have to do past year papers and memorising the study guide” (Y2S12PMS)

“Point form, keywords of the subject as reminders, breaking up sentence pattern and apply answers in parts” (Y2S16AFS)

Participant Y2S15PFS, on the other hand, reported using surface methods because she perceived no other way to learn for examinations and tests.

“Now, in university I think I am also doing the same. Keep tackling past year exam to identify chapters to focus in and memorise the keywords”
When asked whether she considered the approach constituted an ideal means of studying, she reacted:

"Although I score relatively well in modules like (module names), I have since learned that there are many things in those fields that I still do not understand after I graduate. For example, I still do not know how to apply the concepts to real-world applications" (Y2S15PFS)

For some students, using SA to learning was a ‘way out’ if they could not understand the lesson despite their effort towards wanting to understand or if they perceived that there was insufficient time to study. The description of surface approaches to learning as suggested from the interview analysis indicated that some students preferred to use superficial memorising of theories and calculation formulas for problem-solving in tests and examinations. In addition, students used methods such as highlighting, underlining, extensive copying of notes, and spurious gathering of information to help in answering the question without fully comprehending meanings. Nevertheless, it would appear that using SA could also be attributed to previous learning experiences, time pressure, or when students perceived they had no other way to learn despite attempts at understanding. However, the interview data indicated that students realised that depending on SA undermined the quality of their learning outcomes in terms of their academic performance, confidence, participation, actual understanding, and sureness and correctness of answers.
4.5 Conclusions

This chapter has presented the quantitative and qualitative analysis of this study. The quantitative analysis enhanced the understanding of the relationships among the variables examined in the study, as well as assessing the internal consistency of the R-SPQ-2F questionnaire. In general, the quantitative analysis suggests that:

- Students in the study either had an A-Level qualification (39.2%) or were Polytechnic graduates (60.8%). The median age of the participants was 22 years old. The median course mark for the students was 67. Slightly over 60% of the participants (60.8%) were in their first year of study.

- The Cronbach’s alpha of the internal consistency of each scale (0.82 for DA and 0.77 for SA) and subscale (0.69 for DM, 0.70 for DS, 0.64 for SM and 0.62 for SS) of the R-SPQ-2F in the present study were more than 0.60. These results suggest that the scales and subscales are acceptable for the analysis of the learning approaches of the undergraduate computing students in a private higher education institution. These results are in line with Biggs et al.’s (2001) version, which has been tested for validity and reliability.

- According to the survey results, most of the computing undergraduate students applied the deep learning approach (67.8%) in their learning compared to the surface learning approach (32.2%). There was a statistically significantly different relationship between learning approach and, average course mark and year of study. It was found
that the median course mark for students who applied the deep learning approach was statistically significantly higher than the average course mark for students applied the surface learning approach. Also, students tended to apply a deep learning approach in the first year of study more often than in the third year of study. However, it was found that there was no statistically significant relationship between learning approach and age, entry pathway or gender.

- For students utilising DA, it appeared that males statistically significantly preferred DS over DM compared to females. Other than that, there was no statistically significant relationship between the preference of DM/DS and age, entry pathway, course mark or year of study. For students utilising a surface learning approach, there was no statistically significant relationship between the preference of SM/SS and age, entry pathway, gender, course mark and year of study.

- It was also discovered that there was a trend of the preference of learning approach (DA versus SA) in the undergraduate computing students based on their year of study. In both first and second year of study, DA was preferred to SA by the students. However, there was no statistically significant difference between the DA and SA scores at year three.

- Independent sample t-tests were used for comparison of scales and subscales’ scores of R-SPQ-2F by the entry pathway of participants. There was no statistically significant difference in any of the two scales (DA and SA) and four subscales (DM, DS, SM, and SS) of R-SPQ-2F.
between students with A-Level entry pathway and students with polytechnic entry pathway. It was concluded that there were no effects of different entry pathways (diploma versus A-Level) on students’ approaches to learning.

- The study also examined if there was a relationship between SAL and other demographic factors, such as gender, age, year of study. It was found that there was no statistically significant difference in any of the two scales (DA and SA) and four subscales (DM, DS, SM, and SS) of R-SPQ-2F between male and female students, indicating no relationship between SAL and gender.

- However, there was a statistically significant relationship between age and SAL in terms of the DA. In particular, younger participants (17-20 years old) tended to utilise DA more than older participants (25 years old or older). There was also a statistically significant relationship between age and SAL in terms of the DM scores. Younger participants (17-20 years old) tended to utilise DM more than older participants (21-24 years old and 25 years old or older).

- It was also found that there was a statistically significant relationship between year of study and SAL, in terms of DA, SA, DM, DS, SM and SS. In particular, (1) first-year students had statistically significantly higher DA and DS scores than second-year and third-year students; (2) third-year students had statistically significantly higher SA and SS scores than first-year and second-year students; (3) third-year students had statistically significant lower DM scores than first-year students;
(4) third-year students had statistically significant higher SM scores than first-year students.

- To determine if there was a relationship between academic performance, and entry pathway and students’ approaches to learning (SAL), two general linear models were performed. For both Model 1 and Model 2, the dependent variable was square of academic performance. For Model 1, the independent variables included entry pathway and the two scales of R-SPQ-2F, DA and SA. For Model 2, the independent variables included entry pathway and the four subscales of R-SPQ-2F, DM, DS, SM and SS. According to both Model 1 and Model 2, the effects of the two main scales (i.e. DA and SA) and four subscales (i.e. DM, DS, SM and SS) on academic performance did not depend on the entry pathway as the interaction effects were not significant. It was found that there was no statistically significant relationship between academic performance and, DA, DM, DS and SM. However, there was a statistically significant relationship between academic performance and the main scale, SA, and the subscale, SS of R-SPQ-2F. It was also found that there was a statistically significant relationship between academic performance and entry pathway, indicating students with A-Level entry pathway performed better compared to the students with the polytechnic entry pathway.

The qualitative analysis findings complement the development and expansion of the comprehension of the students’ subscale scores and reported scales. Based on the interviews with participants, the study indicates that:
• There were relationships between the roles played by students’ age, entry pathway, gender, year of study, and how computing students’ approach their learning. However, the relationships among the variables, their adopted learning approaches and students’ academic performance were less clear.

• Approaches to learning were related to students’ entry pathway that suggested polytechnic graduates tended to lean towards SA, and A-Level graduates reported using more DA. Conversely, computing students’ age did not impact upon their approaches to learning but was associated with their perceptions of the teaching and learning environment. Teaching methods, pace and sequencing of course matter, lecturer enthusiasm, understanding, and commitments were related to students adopting either DA or SA. Further, the interview data did not provide much evidence of differences in how males and females approach their learning, other than female students appeared to state they enjoy their university experiences more than male students did. However, year two and year three students find that lack of interest, an overload of work, and inappropriate assessment procedures which encourage reproduction encourage SA and might contribute to students feeling stressed, anxious, being tired, or wanting to give up.

• Students who spoke of adopting DA were more positive and more confident about their academic performance. On the other hand, students who adopted SA expressed dissatisfaction with such approaches and felt that they undermined the quality of their academic performance.
Together, the findings of the quantitative and qualitative analysis indicate that student characteristics such as age, entry pathway, gender, and year of study, and their adopted learning approaches are important variables which could impact upon undergraduate computing students’ academic performance in a private higher education institution.
CHAPTER 5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Academic performance and students’ approaches to learning (SAL) has been investigated from different perspectives over the past 40 years (Baeten et al., 2010; Ballantine et al., 2008; Biggs, 1987; Biggs et al., 2001; Byrne et al., 2002; Diseth, 2003, 2007; Duff et al., 2004; Entwistle & Ramsden, 1983; Leung & Kember, 2003; Marton & Säljö, 1976a, 1976b, 1984; Ramsden, 2003; Sadler-Smith, 1996; Trigwell & Prosser, 1991a; Zeegers, 2001; Zhang, 2000). The main aim of the present study was to identify undergraduate computing SAL measured with the Revised Two Factor Study Process Questionnaire (R-SPQ-2F) (Biggs et al., 2001), and to use the questionnaire to investigate the relationship between SAL and participants’ age, entry pathway, gender, year of study, and academic performance. This study was also designed to find out whether participants’ entry pathway affects their approaches to learning and academic performance. Chapter four has reported in detail the findings from both the quantitative and qualitative studies for the R-SPQ-2F main scales and subscales. The current chapter will further link the findings of the study based on the three research questions (RQs) laid out in chapter one, and examine the significance of these findings relative to the literature reviewed in chapter two to provide a more in-depth understanding of computing undergraduate SAL observed from the respective student characteristics.
5.2 Summary of research

Motivating computing students to embrace deep approaches to learning has a likelihood of promoting higher levels of success and career enjoyment because they can retain information for a prolonged duration (Felder & Brent, 2005), forming the basis for life-long learning (Abraham et al., 2006) while having critical analysis and thinking skills regarding learning materials, expands their body of knowledge (Byrne et al., 2002; Trigwell & Prosser, 1991a; Zeegers, 2001) and makes them versatile and adaptable within their approach to learning (Entwistle & McCune, 2013). The design of this study sought to investigate the current learning approaches (deep versus surface) adopted by two different entry pathways namely A-Level and diploma graduates enrolled in undergraduate computing courses and to investigate the correlation between learning approaches and academic performance in the context of a Singaporean private higher education institution.

5.3 Summary of results

5.3.1 The R-SPQ-2F

The R-SPQ-2F instrument (Biggs et al., 2001) was used to assess the SAL of the students. It is important to validate the reliability of R-SPQ-2F before performing statistical analyses based on the data that the study instrument generated. Therefore, through testing, applying the internal consistency reliability using Cronbach’s alpha coefficient, and factor analyses, it was reported that R-SPQ-2F constituted a reliable and valid instrument. The deep approach (DA) scale Cronbach’s alpha statistic value, 0.82 (see Table 4-7), obtained here is similar to that of Everaert et al. (2017), Henoch et al. (2014), Immekus and Imbrie (2010), Kyndt et al. (2012), and Mogre and Amalba
(2014), reporting scores for DA of 0.76, 0.75, 0.81, 0.83, and 0.80 respectively. Similarly, the Cronbach’s alpha statistic for the surface approach (SA) scores in the study was 0.77 (see Table 4-7), which is similar to Everaert et al. (2017), Immekus and Imbrie (2010), Kynadt et al. (2012), and Mogre and Amalba (2014) who had alpha values of 0.75, 0.80, 0.79, and 0.76 respectively. According to Cohen et al. (2011), internal reliability was deemed acceptable if the Cronbach’s alpha was greater than 0.70, such as with the R-SPQ-2F main scale scores in this study. Thus, the R-SPQ-2F can be used with confidence to investigate SAL from computing degrees in a private higher education institution in Singapore, as it is a valid and reliable instrument.

An overall participant response rate of 76% was achieved (see Section 4.3.1). This is slightly higher than that of Siddiqui (2006), who achieved a response rate of 73% in their investigation of SAL among undergraduate students in Pakistan. The 76% response rate here is slightly lower than that of Subasinghe and Wanniachchi (2009)’s response rate of 82% in their study of SAL in Sri Lankan medical students. Higher response rates lead to smaller confidence intervals around sample statistics. The response rate is one indicator that can be used to determine the potential contribution of a study to a specific body of knowledge (Baruch & Holtom, 2008). The participant response rate as achieved for this study is in an acceptable range, and it can, therefore, be assumed that the information arising from this study provides a significant insight into the SAL of undergraduate computing students in Singapore. Even though the response rate is reasonable, it is not possible to easily extrapolate the findings from this study to the general population of computing undergraduate students in other institutions. In this study, convenience, instead of random, sampling was used. The use of this latter method of sampling would not have been feasible in this study, as it would likely have rendered a
participant study sample size that is too small for the results to be regarded as valid. The use of convenience sampling ensured that the participant sample was sufficiently large to justify the use of further statistical analysis of results and the interpretation of such.

Though SAL are often culturally based, and students from a different culture would, therefore, have different learning approach, thinking and behaviour (Ramburuth & McCormick, 2001). While it has been argued that Asian students from a Confucian Heritage Culture\(^6\) (CHC) are typically passive and quiet learners, reluctant to speak out or ask questions in class for fear of being incorrect. It is interesting to note here that the current study involves a largely monocultural group of computing undergraduate students who have English as their first language and are studying in a Western-style higher education institution. Thus, any further discussion on the cultural aspects was not taken into consideration by the researcher within this study, and any differences discovered in findings were fitted into the models of Western education research.

5.3.2 Research question no. 1

‘What approaches to learning (deep versus surface) do computing undergraduates’ possess within the context of a Singapore transnational higher education institution?’

Profile of computing students

Analysis of the R-SPQ-2F of the 283 undergraduate computing students revealed that 192 participants (67.8%) adopted a predominantly DA to learning,

\(^{6}\) Confucian Heritage Culture (CHC) refers to the education culture of countries such as China, Singapore, Hong Kong and Japan (Biggs, 1998).
while 91 participants (32.2%) adopted a predominantly surface learning approach (see Table 4-13). Additionally, the results show that the computing students had higher mean DA scores (29.42 ± 6.369) than that of SA scores (23.84 ± 6.169). These are on a scale of 0.0 (minimum) to 50.0 (maximum). Shah et al. (2016) recorded DA and SA mean scores as 32.62 ± 6.33 and 25.14 ± 6.81, respectively. Mogre and Amalba (2014) similarly reported mean DA scores of 31.23 ± 7.19 and mean SA scores of 22.62 ± 6.48. While Jayawardena et al. (2013) noted that the mean values of Sri Lankan dental students’ DA and SA scores were 31.79 ± 6.1 and 22.74 ± 5.5, respectively. The DA preference of undergraduate computing students is thus similar to that shown in medical students in these latter two studies. Most studies, therefore, emphasise the adoption of DA to learning (Jayawardena et al., 2013; Mogre & Amalba, 2014, Shah et al., 2016) rather than a surface learning approach.

In fact the result is also consistent with the studies of de Raadt et al. (2005), Fox, McCanus, and Winder (2001), Hasnor et al. (2013), Liang et al. (2015), and Subasinghe and Wanniachchi (2009) which suggest that the majority of the students were inclined towards DA to learning and the less predominant learning approach among students is the SA. The results however are in disagreement with the work of Ladan et al. (2014), who researched on the approaches to learning as mere indicators of the academic achievement among the undergraduate students in Ahmadu Bello University at Nigeria. Here the research indicated that 81% of the students were conversant with learning approaches and SA was the dominating model that the majority of the students implemented. The research took into account many factors including family, school, social and peers, that impacted the approach model that the student implemented in learning. Although, findings of the current study are contrary to findings of the previous study by Ladan et al. (2014), the difference in the result
could be as a result of the difference in context in terms of disciplines, teaching and learning environments, and country.

**Relationship between age and SAL**

An important result related to the maturity of the undergraduate computing students indicates that the older students (defined as over 25 years) scored less on the DA differing significantly from students who were aged 17 to 20 years old. In addition, students aged 17 to 20 years old tended to utilise deep motive (DM) more than older students (21-24 years old and 25 years old and above). In summary, the present study found that younger students prefer DA and DM approaches (see Section 4.3.7). The results from this study contradict other studies that found younger students tend to more often use SA to learning (Biggs, 1987; Laird et al. 2005; Yonker, 2011). For example, Biggs (1987) administered the 42-item Study Process Questionnaire (SPQ) using a cross-sectional dataset of 2365 students enrolled in arts, education and science courses in Australia found age had a very strong impact on learning approaches. Biggs (1987) reported that as the student grows older their adoption of SA decreases, while the use of DA and achieving approaches increases. Similar age effects of SAL has been reported by Yonker (2011) with 56 psychology students aged between 18 and 52 that showed a strong positive correlation between age and learning approaches as measured using the R-SPQ-2F instrument. Yonker (2011) also affirmed that mature students more often adopt deep learning approaches compared to younger students. However, other studies by Duff et al. (2004), Mattick et al. (2004), Papinczak, Young, Groves, and Haynes (2008), Shankar et al. (2006), and Tiwari et al. (2006) found no significant relationship between age and learning approaches.
Thus, it seems counterintuitive, then, why the majority of first-year students in computing, show a clear understanding of and belief in the merits of their use of strategies for deep learning approaches which present a stark contrast to the evidence in current literature. One possible explanation could be students’ learning approaches varies according to the learning/teaching method, time constraints, academic workload, assessment technique, course content and student support experienced (Diseth et al., 2006; Entwistle, McCune & Hounsell, 2003; Kember, 2004; Ramsden, 1987). Furthermore, students are able to change to and from deep to surface approaches to learning to complete the current academic undertaking (Ramsden, 2003). This study showed that the programme course and nature of the support received by the students could have promoted the initial adoption of a deep learning approach. First-year students in a computing curriculum, for example, are educated with a particular and precise curriculum design that is created to make certain that the students enrolled acquire behaviours and skills that are connected with educational success (e.g. critical reading and thinking, motivation and goal setting, time management, peer mentoring). As well, in the academic study skills curriculum, students learn the management of information strategies, the linking of information from various references, and the skill of paraphrasing. These are explicitly taught and assessed early on, reiterated, and practised continually. The students are given the opportunity to audit their performance and reflect on their skill development. With this preparation, it follows that these students may seem to develop a deep learning approach as they were educated to learn strategies that promote such thought.

Furthermore, the researcher revealed that there was abundant support for the promotion of this approach. From internal record review, there was a significant level of contentedness in the lecturers for that group (see Appendix G), as well
as the teaching quality, educational environment provided, and the first-year programme material. The measurements of ‘good teaching’, the focus on ‘independent learning’ (Ramsden, 2003), and student or ‘learner-centred’ conditions (Liard et al., 2005) can help embrace a deep learning approach in students. Therefore, it seems apparent and likely that the quality of education received, the educational environment, and the students’ contentment has played a part and perhaps were a significant influence on the first-year students developing a deep learning approach.

**Relationship between gender and SAL**

The study showed that there were no gender differences in terms of preference for deep and surface learning approaches, while there was a gender imbalance among computing students in higher education in Singapore. The female students scored lower on the DM and DS subscales as compared to the male students who scored higher on both subscales (see Table 4-14). However, the quantitative analysis found no statistically significant differences in how male and female computing students approached their learning (see Section 4.3.6). Studies by Byrne et al. (2002), and Wilson et al. (1996) supported the finding from the current study while other studies found male students more likely to use DA than female students (Duff, 2002; Duff et al., 2004; Furnham et al., 2009).

Furthermore, studies by Chiou et al. (2012), Kreber (2003), May et al. (2012), Richardson (1993), and Zeegers (2001) also indicated no gender differences in SAL but Gijbels et al. (2005), and Tarabashkina and Lietz (2011) find males more likely than females to take a SA. Differences in the measurements used and in the learning environment positioning of the sample could account for the differences indicated. Although gender may be an important moderating
variable in SAL, the present study has found gender is a non-significant predictor of SAL for full-time undergraduate computing students. Moreover, there were no indications in the interviews to show that male and female students approached their learning differently (see Section 4.4.1). However, the parameter of gender is one that has not been fully examined and warrant further evaluation both in computer education students as well as students pursuing other disciplines.

**Relationship between the year of study and SAL**

The findings in this study found that learning approaches of the undergraduate computing students are different according to the year of study. The students’ use of DA to learning declined from first through second to their third year of study while the use of SA to learning increased throughout their undergraduate careers (see Table 4-13). Gow, Kember, and Cooper (1994) investigated the relationship between year of study and approaches to learning, and the results of their study reported that accounting students’ use of DA declined from the first year to the second year, and then increased towards the end of the third year. Gow and Kember (1990) used regression analysis (n=1043) to investigate the relationship between the subscales of the Study Process Questionnaire (SPQ) and year of study. They found the year of study was a significant predictor of the DM, DS, achieving motive and achieving strategy subscales, suggesting first-year students were more likely to report themselves using deep and achieving approaches to learning than final year students. This situation might occur because undergraduate computing students are in transition from school to university and their academic workload and examination pressures increase as they progress to the second year of study (Baeten et al., 2010; Pimparyon et al., 2000). Qualitative data of earlier investigations also tend to agree with the aforementioned concept that several
factors influence how students approach their studying and learning, including teaching methods, teaching design, curriculum overload, learning environment, and the assessment of students’ learning.

Although, this study’s results are consistent with Busato, Prins, Elshout, and Hamaker (1998), Gow et al. (1994), and Zeegers (2001) findings that SAL do change over time, the year of study was a significant predictor of approaches to learning in this study. This result is interesting as previous research suggests that approaches to learning are not influenced by the year of study being undertaken. Thus, differences found between this study and previous studies may be associated with the choice of study design or how different institutions courses are run, in that both the quantitative and qualitative aspects of this study were cross-sectional instead of longitudinal. It is recommended that longitudinal research be used, such as that undertaken by Zeegers (2001) to further study the relationship between the year of study and approaches to learning.

Since Gow et al. (1996) argued that learning approaches were seen to be changeable for people dealing with the different demands of the learning environment such as excessive workload, an emphasis on examination results, great time pressure and inadequate language proficiency, each of which could lead to the SA. Thus, the researcher is of the view that a longitudinal study would be helpful to examine the consistency and variability in SAL. Nevertheless, the researcher adopted the cross-sectional study as she is worried about the amount of time the longitudinal study is taking, and moreover the Doctorate of Education (EdD) candidature period also constrained her to conduct only a cross-sectional study.
5.3.3 Research question no. 2

‘Are there any effects of different entry pathways (diploma versus A-Level) on students’ approaches to learning?’

Relationship between entry pathway and SAL

It was found that the majority of A-Level entry pathway and diploma entry pathway students used a DA to learning, thus showing that both groups are mostly similar in their learning approaches despite the difference in emphasis in post-secondary education and route to higher education (see Table 4-13). In addition, the findings of this study about entry pathways being not significantly related to learning approaches of undergraduates students (see Table 4-15) are in line with Crawford et al. (1998), Fox et al. (2001), and Leung et al. (2008). They are also similar to Vanthourmout, Donche, Gijbels, and Van Petegem (2009) whose study on the association between the initial and change in approaches to learning showed that SAL remain relatively consistent in a new learning environment. The findings of this study are consistent with Wilson and Fowler (2005) that concluded a significant positive correlation between students’ DA and SA scores in the new learning environment and their initial DA and SA scores, and as a result, they are less likely to change their approach. Additionally, studies by Fox et al. (2001), Gijbels, Segers, and Struyf (2008), McParland, Noble, and Livingston (2004), and Shankar, Balasubramaniam, and Dwivedi (2014) were all correlative studies and had similar conclusions, like this study.

The findings mentioned above are supported by Fuller and Chalmers (1999) research that reported their study did not identify any significant differences in the learning approaches of higher education and Institutes of Technical and Further Education (TAFE) students using the Approaches to Study Inventory
(ASI) (Entwistle & Ramsden, 1983). Fuller and Chalmers (1999) suggest the explanation that various TAFE institutions have a full scope of learning with a broader approach to education that values the growth of cognitive skills connected to adaptability, innovativeness and problem-solving, all within the competency-based learning (CBT) model. These premises are supportive of the concept that the learning environment in TAFE institutions may encourage the DA to learning to a level higher than what can be anticipated given their purpose and role. However, the higher education institution itself may not be so supportive of this approach as one might expect.

However, research performed by Abhayawansa, Tempone, and Pillay (2012), which looked at two specific undergraduate cohorts in accounting, evaluated their approach to learning. Students enrolled on TAFE qualifications (TAFE-to-university) was one cohort, and the other comprised a cohort of students who were admitted to the university (Year 12-to-university) in typical fashion. There was a definite difference in SAL as determined by the manner in which the student entered school. Ultimately the researchers found that the students with previous TAFE learning histories seem to present with a significant factor that impacts the SAL of matriculating from TAFE to university students. Abhayawansa et al. (2012) argue that the university environment is perceived as more demanding by TAFE students than the previous TAFE learning environment. This is demonstrable when they are evaluated in term of the standard of work, expectations of one’s study, ability to self-learn, fewer class hours, and the availability of academic support (Cameron, 2004; Trembath, Robinson, & Cropley, 1996). Hence, students who transition from TAFE to a university course of study may have a more systematic approach to their learning from the beginning, and this is likely a significant contributor to the
higher incidence of deep learning acceptance and practice in TAFE-university students.

Another study which focused on the relationship between SAL, contextual factors and personological factors was conducted by Zeegers (2001). Zeegers (2001) monitored the change in learning approaches over 30 months and examined the relation between university entry mode (including age and sex of students) on students’ learning approaches with a sample of 200 science students at an Australian higher education institution. Although the researcher found no significant relationship between university entry mode on students’ learning approaches, Zeegers (2001) reported that the non-recent school leavers (NSL) display a higher DA and achieving approach while the recent school-leavers (RSL) were more inclined to surface learning. This pattern, Zeegers (2001) argues, indicates that mature students (i.e. NSL) typically have a higher mean score on the DA and a lower mean score on the SA as compared to the younger students (i.e. RSL).

In the current study, a plausible explanation is that the homogeneity of the ten years of the primary and secondary school education systems in Singapore have largely moulded the students initial learning approaches, thus, suggest the similarity in learning approaches observed between A-Level and diploma entry pathway students. Furthermore, as explained by Curtain (2004) TAFE institutions adopted a broader view that values the growth of cognitive skills connected to adaptability, creativity and innovation, critical thinking and problem-solving. This is similar to the current study in that the main role of polytechnic education is to provide quality practice-oriented training and produce suitably trained manpower to support the changes in Singapore’s
industrial development. Thus, the learning environment in polytechnics may be encouraging a DA to learning.

In contrast, the qualitative data suggested that graduates from A-Level were more hardworking and tended to be influenced by the cultural phenomena of ‘kiasuism’ which also encouraged DA to learning. Furthermore, interviews in the study showed that polytechnic graduates relied on SA to learning in reaction to their perceptions of the learning environment with regards to the excessive amount of material in their curriculum. The findings from the qualitative analysis revealed fresh perspectives that were not in fact evident from the statistical analysis that concluded that A-Level and diploma graduates’ entry pathways were not significantly influential in SAL (see Table 4-15). Thus this is a recommended area for further research.

5.3.4 Research question no. 3

‘Are there any relationships between students’ approaches to learning and academic achievement?’

Relationship between academic performance and SAL

Students that adopt DA seem to perceive learning as the information transformer that should be motivated intrinsically (Biggs et al., 2001), and to apply learning approaches that emphasise learning materials’ meaning (Biggs et al., 2001). In contrast, SA students seem to see learning from the perspective of knowledge reproduction that should be motivated extrinsically (Biggs et al., 2001), and to embrace approaches that focus upon learning materials’ reproduction (Biggs et al., 2001). Interestingly, the findings within the current study found that there was no relationship between DA and academic
performance, which was in line with studies by Byrne et al. (2004), and Gijbels et al. (2005). Even though the present study found the estimate for the DA effect is not quite significant (i.e. \( p=0.077 \)), possibly due to the relatively small sample size (\( n=283 \)), the direction of the effect is in line with the studies mentioned above. However the lack of significance is also in line with studies of Hooijer (2010), and Howell and Watson (2007), which showed that there was not a significant correlation between DA and academic performance. Furthermore, a study undertaken by Diseth and Martinsen (2003) on 192 undergraduate students in Norway, alongside a study conducted by Diseth et al. (2006) on 478 undergraduate students in Norway both reported that academic achievement did not significantly depend on DA.

However, in addition, the findings found a negative correlation between SA and academic performance. This suggests that the more the computing students adopt SA in the undergraduate studies, the lower their academic is. Thus, this outcome implies that students need to limit their adoption of SA in order for the students to achieve excellent academic performance. Furthermore, studies conducted by Biggs (2003) and Prosser and Trigwell (1999) supported the finding mentioned above that students who use a SA to learning are inclined to have a lower performance score.

In general, the aforementioned studies show that an increment in success level is associated with increased DA and strategic learning scores and a reduction in success was associated with increased SA learning scores. Because of this, it could be inferred that several factors may cause the negative relationship between SA and academic performance. Perhaps such a result could be because the methods of assessment adopted by higher education institutions are not supportive of students’ deep understanding. In the event that students
mainly focus on procedural or factual reproduction at the expense of course comprehension, then the insignificant correlation between academic performance and DA might be blamed on the educators’ focus on students’ response quantity at the expense of students’ quality response in course works and examination scores (Biggs, 1999). As supported by Biggs (1999), Marton and Säljö (1976a, 1976b), and Stiernborg et al. (1997) who all stated that assessment methods have a strong impact on how students approach their studies.

On the other hand, the qualitative results did suggest that students who adopted DA to learning believed they had attained high academic performances. These students indicated that they acquired knowledge and managed the assessments or examinations through both memorisation and understanding so they could integrate and apply the knowledge. They indicated that they had to plan the time to go through the materials repetitively, with some students going through the learning materials many times before an examination or assessment. However, they indicated that repetitively memorising information without understanding did not assist them in attaining high grades. A handful of the deep learners went further to elaborate on how they needed to be able to have a holistic conceptual understanding and picture of the information in their minds.

At the same time, the qualitative data suggested that the students who adopted SA to learning had primarily focused on memorising facts and information. The reason most frequently cited for memorising was being pressurised by a lack of time. The qualitative data also suggested that there were a handful of students who reported SA to learning scores but had used understanding in their learning. These particular students also had high academic performances
and were from diploma entry qualifications group. This was because these students, who reported the adoption of SA to learning, were also employing DA to learning. These students reported memorising and understanding, working in tandem. According to Lee (1996, p. 36), "memorisation precedes understanding, and is for deeper understanding".

The qualitative data in this present study which revealed the relationship between memorisation and understanding further lends support to an investigation by Marton, Dall’Alba, and Kun. (1996), who found that memorising and understanding can occur in tandem among Asian students. According to Marton et al. (1996), the Asian repetition practice or memorisation could serve two different purposes where "on one hand, repetition can be associated with mechanical rote learning and on the other hand, memorisation can be used to deepen and develop understanding" (p. 82).

In addition, some of these students who reported SA to learning and had attained high academic performance scores attributed their academic success to taking appropriate study strategies. According to these students, they excelled in seeking cues from the learning contexts. These qualitative findings were consistent with the "paradox of an Asian student" described by Watkins and Biggs (1996), where Asian students worked hard to improve their performance, but they also learned how to study more appropriately to excel in their studies, instead of relying on their abilities. In contrast, according to Biggs (1996), who cited studies from Hess and Azuma (1991), and Hollaway (1988), Western students tended to attribute success and failure to their ability and lack of ability respectively.
Generally, the basis that learning approaches that students adopted could determine the students’ academic performance seems not correct for undergraduate computing students within the current study. Therefore, the quantitative and qualitative results are also inconsistent with the literature findings regarding student learning, and best explained by Ramsden (1992) who claimed that when the literature is integrated, strong correlations between learning approaches and learning outcomes emerge, on two conditions that “surface approaches are usually more strongly linked to poor learning than deep ones are to effective learning, and the connections between grades and learning approaches are less marked than those between measures of learning quality and approaches” (p. 59). The present study is limited by the sample which comprises only three cohorts of undergraduate computing students in one institution. Further research is necessary to investigate how the higher education institution learning environment affects their learning approach.

**Relationship between entry pathway, academic performance and SAL**

The descriptive analysis revealed a non-significant correlation between academic performance and SAL; however, when considering the entry pathway, the relationship is statistically significant. The finding showed that the students with A-Level entry pathway performed relatively better in terms of academic performance than students with polytechnic entry pathway. The significant difference in terms of academic performance between the A-Level and polytechnic entry pathway could be attributed to the differences in their educational background, which is observed through their entry qualifications, and the type of schools they attended (Geiser & Santelices, 2007). Although, Rolfe, Ringland, and Pearson (2004) found that even though a significant difference in academic performances did not exist between A-Level entrants and their diploma counterparts, the students’ academic achievement before
university studies to a lesser extent affected their performance. This finding was complimented by studies by Ibe-bassey (1988) and Mlambo (2011) which found that different entry qualifications for students have mainly impacted on the students’ academic performance on end-of-semester degree examinations. The findings from this study, therefore, suggest that entry qualifications are good predictors in determining the academic performance of undergraduates computing students.

Furthermore, in this study, there is a statistically significant relationship between entry pathway and academic performance, which shows students from the A-Level entry pathway have more academic success than students from the polytechnic entry pathway. This is an important finding to the study institution, as from a practical perspective, providing appropriate academic support is essential to the success of students from the polytechnic entry pathway, thus the students could move to a higher degree classification.

5.4 Limitations of the study

It is acknowledged that the current study had a few limitations. Due to availability and time constraints, the data were collected at one point in time for both the survey and group interviews included a convenience sample composed of three cohorts of computing students (i.e. students from 2016, 2017 and 2018 cohort), all attending the same institution in Singapore.

The first limitation of this study, thus, was that the quantitative survey’s sample size was small because it was confined to a single institution, thus potentially limiting generalisability across other institution that offers the same discipline.
In the future replication of the current findings using different samples from different institutions would be desirable.

A further limitation is that the study was based on a self-reported questionnaire, namely R-SPQ-2F, asking students to self-reflect on their SAL. The results might be under-estimated or over-estimated depending on the students’ general understanding and interpretation of the survey questions. From this study, there are no other validly acceptable measurements to show that students’ cooperation with research is an honest reflection of their normal behaviour. There is a possibility of dishonest response from the students, which in essence lowers the reliability of the individual scales (Kember & Gow, 1990). The students, at times, may not be serious about the data they fill in the questionnaires and additionally may not comprehend their learning approach. Quality data collection processes rely on the pre-set conditions of the context at the provision time. In order to enhance the results of future study, repeating the study several times throughout the academic year may lead to more accurate and reliable results.

Another limitation is researcher bias. In conducting this study, the researcher holds an academic leadership role, and along with her teaching experience at the study institution, she may bring her thoughts and feelings during the focus group. Finally, the researcher felt that her lack of experience in conducting research might be a substantial limitation to this study. Thus, the researcher consulted other researchers and conducted pilot studies to test it before she began to conduct the current study.

The way students learn depend on their perception of the learning environment and the demands that are set upon them. Other institutional demands such as
assessment methods, overloaded curriculum, and study pressure may also influence learning approaches. Thus, from a practical perspective, it is recommended that the amount of assessed work and the quality of the assessment types, especially those occurring later in year three, are changed to discourage the adoption of a surface approach to learning in year three students in the study institution. For example, the researcher is currently in discussion with the study institution’s university partner on various methods of effective assessment in computing and considers the ways in which assessments influence SAL.

5.5 Implications of the study

In general, this research has delineated a clear picture of the characteristics of individual students in regards to how they approach their learning process, and how they develop relationships in their academic environment, as well as how they perform in a computer education programme. Several findings are consistent with Asian study outcomes and comply with the theoretical contentions about Asia. Student learning can be viewed as caused by the complicated interplay of characteristics of the individual student, academic performance and approaches to learning. Comprehension of these associations might influence designing of curriculum, students counselling (i.e. providing counselling intervention to at-risk students), as well as the building of the learner’s model. The outcomes of the study, therefore have a number of inferences for researchers and educators.

Besides, this study’s outcomes can serve as insights into the manner in which academics interpret learning, and particularly the way academics are viewing
the first year computing SAL. It was discovered that while students’ year of study increases, their DA use declines. As pointed out by the literature, the rationale behind this might be the students’ heavy workload (Cope & Staehr, 2005). It is worth keeping in mind that universities are currently teaching undergraduates of different educational backgrounds owing to diverse access pathways to university. Academics should be made aware and helped to understand that how students approach learning is a reflection of the learning contexts. The students apply SA to learning the moment they recognise that the learning environment is demanding superficial learning from them (see Section 4.4).

On the other hand, when they identify higher-order thinking is required of them or the demands of an understanding learning environment, they are more likely to implement DA to learning. The students are able to shift their approaches to learning. Academics should, therefore, be aware that examination questions’ and other assessments ought to be structured in a way that necessitates students to implement DA to learning. The application of a suitable assessment could, therefore prevent students from implementing apparent learning, for instance, recall of facts and memorisation. Previous studies (Biggs & Watkins, 1995; Trigwell & Prosser, 1991a; Watkins, 2001) have shown that deep learning approaches were encouraged by the intrinsic interest the students mainly had to learn material, a positive and well-equipped learning environment, if they had an appropriate workload, and what type of assessment methods are employed. Students ought to study the way of dealing with increasing amounts of information. Diverse learning approaches in a rapidly changing society could act as tools for applying and attaining essential knowledge. The main notion is that students using the DA in different settings
are more successful in their future lives, and as they go through higher education.

5.6 Recommendations for future studies

The outcomes of the present study should be viewed as guidelines for future studies instead of specific solutions. In Singapore, it is useful to take note of the outcomes of the present study, but they are not generalisable to each and every undergraduate computing student and certainly not directly to other Southeast Asia countries. There is a need to examine the approaches to learning in other higher education institutions to know which approach is most preferred by computing students more generally with different samples before a definite conclusion, can be made, as there were some limitations in this study. These limitations ought to be dealt with in future studies. In future studies, researchers could consider using a larger sample drawn from several institutions of higher education in Singapore, and also in other Southeast Asia countries, for the outcomes to be generalised to each and every student in the country.

Several other recommendations as described here could prove worth pursuing in future iterations of this and related studies as part of ongoing research into undergraduate computing SAL and SAL more generally. This research gave a cross-sectional study view. In the study of computing programmes, the research gives a result of the comprehension of the current SAL condition. Cross-sectional studies cannot easily establish cause-effect relationships since they only collect data at a specific point in time. Therefore, a longitudinal study of the students from their first-year to their last year of study would be more
reliable in the analysis of the factors that impact SAL in computing education. In addition, a longitudinal study would be beneficial in further developing understanding by educators of how weaker students approach their learning. It could also discover whether, in a situation where they are offered the benefit of support and intervention and timely identification, these students are going to develop higher-level learning attributes and enhanced results.

This study did not set forth to carry out a comprehensive evaluation of curriculum content, students’ workload, the assessment techniques, and teaching practices, precisely with a view to evaluating the influence of these factors on the learning approaches. For example, Watkins and Biggs (2001) discovered that students teaching and learning environment is an essential feature in influencing SAL. They discovered that Asian students who happen to be surface learners may implement DA in learning owing to the learning environments that the students came across. It would, therefore, be advantageous for future studies to study students’ learning environment perceptions that could impact on students’ selection of approaches to learning as well as affecting the computing students’ academic success.

Motivation is an important characteristic for students since it is associated with their engagement level in the process of learning. It is a factor that has been brought up several times in the literature, therefore measuring the motivation of a student together with the procedures applied in this thesis, might result in increased understanding of the effect of entry pathway in comparison with the motivation of an individual in a particular discipline, for instance, computing. It might be interesting to examine the causes of motivational factors that affect academic performance and learning approaches in undergraduate computing students.
Although the participant samples in this study were monocultural, extra emphasis ought to be placed on investigating multicultural differences relating to SAL. More researches are required to discover if the associations between academic achievement and learning approaches are found across diverse educational and cultural settings. Comparative studies could ascertain features that could be advantageous to Singapore’s multicultural education system, as well as to the systems of education of other Southeast Asia countries that are involved in multicultural learning. Therefore, there are opportunities for future studies to examine the relationships as mentioned above, collecting data from students taking the same computing programmes offered by partner universities in foreign countries.

5.7 Conclusions

This section presents the conclusions that result from the study in light of the research questions (RQs) and literature reviewed in chapter two. The present findings concluded that the undergraduate computing students at a private higher education in Singapore preferred the deep approach (DA) to learning rather than the surface approach (SA) to learning (see Table 4-13). It was noted that the median course marks for students who adopted the deep learning approach were statistically significantly higher than the students who adopted the surface learning approach. This was expected, as students who applied the DA tend to have higher scores on the performance as reported by Biggs et al. (2001).

Although there were more male students than female students for each learning approach, it was found that there was no significant difference
between gender and computing students’ learning approaches (see Table 4-16). Concerning entry pathways, the results of this study found no significant difference existed between entry pathways and students’ approaches to learning (SAL) (see Table 4-15). This indicates that although entry pathways into higher education institutions may differ, this did not influence student adopting their preferred approaches to learning.

However, there was an association between age, year of study, and SAL. This finding suggests that older students have a higher likelihood of adopting surface learning approaches rather than deep learning approaches (see Tables 4-17 and 4-18). These results could be attributed to the year/cohort effects as the learning environment and materials’ demands, including the quantity of time the third-year students have to acquire the information, strict deadlines, and assessment format might explain for the difference in the results acquired across and within years while analysing the correlation between year of study and SAL. Since SAL are not fixed characteristics (Biggs et al., 2001), and to further discourage SA and encourage the adoption of DA, the study institution can influence the SAL by possibly changing the teaching approach, redesigning the subjects and courses, and particularly the assessments.

Interestingly, the findings revealed that approaches to learning among undergraduate computing students at the study’s institution could not predict their academic performance. Furthermore, the findings of the study indicated that the influence of approaches to learning on academic performance did not depend on the entry pathways. However, the results found that there was a statistically significant relationship between academic performance and entry pathway, indicating students with A-Level entry pathway performed better compared to the students with the polytechnic entry pathway.
Finally, the researcher intends to share the findings of this study, and its conclusion by making these results available to educators, universities, and administrators. Workshops will be held, and the findings will be shared with the education community-at-large through conference attendance and scholarly publication. The summary of the publication list is in Appendix H. Future studies should be carried out to verify the present findings through consideration of the recommendations that have been proposed. The present study’s findings ought to be viewed as future research’s guideline instead of specific solutions.
REFERENCES


Chan, K. W., & Leung, M. T. (2001, December). *Construct validity and psychometric properties of the revised two-factor study process*


Geiser, S., & Santelices, M. V. (2007). Validity of high-school grades in predicting student success beyond the freshman year: High-school
record vs. standardized tests as indicators of four-year college outcomes. Retrieved August 31, 2019, from https://escholarship.org/uc/item/7306z0zf


Immekus, J. C., & Imbrie, P.K. (2010). A test and cross-validation the Revised Two-Factor Study Process Questionnaire factor structure among


Mlambo, V. (2011). An analysis of some factors affecting student academic performance in an introductory biochemistry course in the University of


Reid, W. A., Evans, P., & Duvall, E. (2012). Medical students’ approaches to learning over a full degree programme. *Medical Education Online*, 17(1), 17205. https://doi.org/10.3402/meo.v17i0.17205


APPENDIX A: Revised Two Factor Study Process Questionnaire (R-SPQ-2F)

Revised Two Factor Study Process Questionnaire (R-SPQ-2F)

Name:

EMP ID:

*Programme:

*Entry mode: A-Level / Diploma / Others

*Gender: Male / Female Age:

*delete as appropriate

This questionnaire has a number of questions about your attitudes towards your studies and your usual ways of studying.

There is no right way of studying. It depends on what suits your own style and the course you are studying. It is accordingly important that you answer each question as honestly as you can. If you think your answer to a question would depend on the subject being studied, give the answer that would apply to the subject(s) most important to you.

Please mark only one most appropriate response by checking (√) the space in column A, B, C, D, or E to each question. Do not spend a long time on each item. Your first reaction is probably the best one. Please answer each item. The letters stand for the following response:

A - this item is never or only rarely true of me
B - this item is sometimes true of me
C - this item is true of me about half the time
D - this item is frequently true of me
E - this item is always or almost always true of me

Do not worry about projecting a good image. Your answers are confidential. Thank you for your cooperation.
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I find that at times studying gives me a feeling of deep personal satisfaction.</td>
</tr>
<tr>
<td>2</td>
<td>I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied.</td>
</tr>
<tr>
<td>3</td>
<td>My aim is to pass the course while doing as little work as possible.</td>
</tr>
<tr>
<td>4</td>
<td>I only study seriously what’s given out in class or in the course outlines.</td>
</tr>
<tr>
<td>5</td>
<td>I feel that virtually any topic can be highly interesting once I get into it.</td>
</tr>
<tr>
<td>6</td>
<td>I find most new topics interesting and often spend extra time trying to obtain more information about them.</td>
</tr>
<tr>
<td>7</td>
<td>I do not find my course very interesting so I keep my work to the minimum.</td>
</tr>
<tr>
<td>8</td>
<td>I learn some things by rote, going over and over them until I know them by heart even if I do not understand them.</td>
</tr>
<tr>
<td>9</td>
<td>I find that studying academic topics can at times be as exciting as a good novel or movie.</td>
</tr>
<tr>
<td>10</td>
<td>I test myself on important topics until I understand them completely.</td>
</tr>
<tr>
<td>11</td>
<td>I find I can get by in most assessments by memorizing key sections rather than trying to understand them.</td>
</tr>
<tr>
<td>12</td>
<td>I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra.</td>
</tr>
<tr>
<td>13</td>
<td>I work hard at my studies because I find the material interesting.</td>
</tr>
<tr>
<td>14</td>
<td>I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.</td>
</tr>
<tr>
<td>15</td>
<td>I find it is not helpful to study topics in depth. It confuses and wastes time, when all you need is a passing acquaintance with topics.</td>
</tr>
<tr>
<td></td>
<td>A (Never or rarely)</td>
</tr>
<tr>
<td>---</td>
<td>---------------------</td>
</tr>
<tr>
<td>16</td>
<td>I believe that lecturers shouldn’t expect students to spend significant amounts of time.</td>
</tr>
<tr>
<td>17</td>
<td>I come to most classes with questions in mind that I want answering.</td>
</tr>
<tr>
<td>18</td>
<td>I make a point of looking at most of the suggested readings that go with the lectures.</td>
</tr>
<tr>
<td>19</td>
<td>I see no point in learning material which is not likely to be in the examination.</td>
</tr>
<tr>
<td>20</td>
<td>I find the best way to pass examinations is to try to remember answers to likely questions.</td>
</tr>
</tbody>
</table>

-------- End of survey --------

Thank you for completing this survey.

APPENDIX B: Draft focus group interview’s questions

Purpose statement:
“To identify whether different entry pathways’ graduates have different or similar approaches to learning when they were admitted to a computing degree programme, and to assess whether their approaches to learning affect their academic performance.”

1. How did you approach your learning (or studying) before you came into the university, and compare to that to now? Why is that?
   [applicable for all students]
   - What about now compare to first year? / What about now compare to second and first year? Why is that?
   [applicable for second and final year students]

2. What are the different/special strategies you use for exams? Why is that?

3. What about courseworks? What do you do differently (or similarly)?

4. Can you share what you do that is important to help you do well in this programme? Why do you do that?

5. Do your grades reflect what you have learned?
APPENDIX C: Ethical approval from study institution

27th March 2017

Request for permission to conduct research study

Dear [Name],

My name is Lim Kim Ying. I am a registered Doctor of Education (Ed. D.) student in the Graduate School of Education at the University of Bristol.

The research I wish to conduct for my Doctoral thesis involves "a mixed methods approach to understanding the relationship between computing students’ approaches to learning of different entry pathways and academic achievement". I am researching the approaches to learning (deep versus surface) possess by two different entry pathways (diploma versus A-level) studying the computing degree programme, and to investigate the relationship between students’ approaches to learning and academic achievement within the context of a Private Education Institution (PEI) in Singapore. This study will be conducted under the supervision of Dr. Jocelyn Wishart (University of Bristol, United Kingdom) and Professor Michael Crossley (University of Bristol, United Kingdom).

I am hereby seeking your consent to allow me to recruit the Bachelor of Science (Honours) in [Field] and the Bachelor of Science (Honours) in [Field] students from cohort 2015, 2016 and 2017. I have provided you with a copy of my research proposal which includes copies of the research instruments which I intend to use in the research process, as well as a copy of a GSoE research ethics form which I have submitted to the University of Bristol Ethics of Research Committee. The individual results of the study will be kept strictly
confidential and all anonymous data will be combined for the reporting. Should this study be published, only combined results will be documented and the institution will remain anonymous. No costs will be incurred by either the institution or the individual participants. Upon completion of the study, I undertake to provide you with a bound copy of the dissertation.

If you require any further information, please do not hesitate to contact me (email kl14557@bristol.ac.uk) or my supervisor (email J.M.Wishart@bristol.ac.uk).

Your permission to conduct this study will be greatly appreciated.

Yours sincerely,

Lim Kim Ying

Approved by:

[Signature]

Date
APPENDIX D: Ethical approval from the University's Ethics Committee

Research Governance and Ethics Officer <Liam.McKervey@bristol.ac.uk>
To: M1500786@bristol.ac.uk
On: Monday, 27 March 2017 at 11:56 PM

Your online ethics application for your research project "A mixed methods approach to understanding the relationship between computing students' approaches to learning of different entry pathways and academic achievement (working title)" has been granted ethical approval. Please ensure that any additional required approvals are in place before you undertake data collection, for example NHS R&D Trust approval, Research Governance Registration or Site Approval.

For your reference, details of your online ethics application can be found online here:

http://www.bristol.ac.uk/red/ethics-online-tool/applications/50381
APPENDIX E: Briefing slides

Study of computing students’ approaches to learning
Participant information briefing
- Different students adopt different approaches to learning
- This study aims to understand computing students’ approaches to learning
- Findings of this study might offer some insights into the institution learning environment, and to students knowing their own approaches to learning might help them to improve their quality of learning and academic success

Study of computing students’ approaches to learning
Participant information briefing
- Invite you to participate in this study
- 15 minutes to complete the questionnaire, and 45 – 60 minutes to participate in focused interview
- Detailed instructions on how to fill up the questionnaire, and participate in focused interview are provided
- There are no right or wrong answers

Study of computing students’ approaches to learning
Participant information briefing
- Participation is voluntary, and you are allow to withdraw at any point of this study without to provide any reasons
- Invite you to participate in questionnaire and / or focused interview
(Focused interview aims to further explore computing students’ approaches to learning)

Study of computing students’ approaches to learning
Participant information briefing
- Participate in questionnaire: share individual report explaining your approaches to learning, the outcome of having such learning approaches, and strategies on how to improve your approaches to learning
- Participate in focused interview: receive Starbucks SGD$10 pre-loaded card
- Complete the consent form if you are to participate in this study
APPENDIX F: Informed Consent Form

Informed Consent Form

Project title:
A mixed methods approach to understanding the relationship between computing students’ approaches to learning of different entry pathways and academic achievement (working title)

Researcher:
Ms. Lim Kim Ying

(You will be given a copy of this consent form to keep for your own records)

I acknowledge that:

- I have been explained and understand what the study involves, and have had the opportunity to ask questions

- I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason

- I understand that my participation in the focused interview will be audio recorded, and I consent to the use of this material as part of the study

- I consent to the processing of my personal information and I understand confidentiality and anonymity will be maintained and it will not be possible to identify me from any publications

- I voluntarily and freely give my consent and agree to participate in this study


Name of participant  Date  Signature

This form has been modified from this document available at:
http://ethics.grad.ucl.ac.uk/forms/appform_sample.pdf
## APPENDIX G: Summary of Lecturer Effectiveness Rating for First-Year Courses

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Lecturer Name</th>
<th>Class</th>
<th>Lecture Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course A</td>
<td>Lecturer A</td>
<td>L01</td>
<td>4.41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L02</td>
<td>4.39</td>
</tr>
<tr>
<td>Course B</td>
<td>Lecturer B</td>
<td>L01</td>
<td>4.21</td>
</tr>
<tr>
<td>Course C</td>
<td>Lecturer C</td>
<td>L01</td>
<td>4.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L02</td>
<td>3.87</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L03</td>
<td>4.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L04</td>
<td>3.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L05</td>
<td>4.09</td>
</tr>
<tr>
<td>Course D</td>
<td>Lecturer D</td>
<td>L01</td>
<td>4.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L02</td>
<td>4.00</td>
</tr>
</tbody>
</table>

* Attain a minimum average of 3.8 on a 5-point scale in the assessment that is used to measure the effectiveness of the lecturer.

(Source: Records from researcher)
APPENDIX H: Summary of Publications

The following is a list of works presented/published by the researcher during the course of the doctorate.

1. **Conference papers**


2. **Conference publications**

3. **Manuscript under preparation**
   Lim, K. Y. *Impact of gender and year of study on computing students approaches to learning.*

   Lim, K. Y. *Approaches to learning and academic performance of Singapore computing students.*