CSSHE
SCÉES

Canadian Journal of Higher Education
Revue canadienne d'enseignement supérieur
Volume 43, No. 3, 2013, pages 1-18

Student approaches to learning in relation to online course completion

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Abstract

This study investigates the relationship between approaches to studying and course completion in two online preparatory university courses in mathematics and computer programming. The students participating in the two courses are alike in age, gender, and approaches to learning. Four hundred and ninety-three students participating in these courses answered the short version of the Approaches and Study Skills Inventory for Students (ASSIST). Results show that students demonstrating a deep approach to learning in either course are more likely to complete. In the mathematics course, a combination of deep and strategic approaches correlates positively with course completion. In the programming course, students who demonstrate a surface approach are less likely to complete. These results are in line with the intentions of the course designers, but they also suggest ways to improve these courses. Furthermore, the study demonstrates that ASSIST can be used to evaluate course design.

Résumé

Cette recherche examine la relation entre les différentes approches envers les études et la réussite des cours adoptées par les étudiants de deux différents cours universitaires offerts en ligne : l'un en mathématiques, l'autre en programmation. Dans les deux cours, les participants présentent les mêmes caractéristiques quant à l'âge, au sexe et à l'attitude vis-à-vis des études. Quatre cent quatre-vingt-treize étudiants inscrits à ces cours ont répondu à la version abrégée d'une recherche sur les approches et les compétences d'études chez les étudiants intitulée « Approaches and Study Skills Inventory for Students » (ASSIST). Les résultats démontrent que les étudiants qui abordent l'apprentissage de manière sérieuse dans l'un ou l'autre des cours ont plus de chances de réussir. Dans le cours de mathématiques, une combinaison d'approches sérieuses et stratégiques est positive pour réussir le cours, tandis que les étudiants du cours de programmation qui adoptent une approche superficielle envers l'apprentissage présentent moins de chance de réussite. Bien que ces résultats soient conformes aux intentions des créateurs de ces cours, ils proposent aussi certaines améliorations possibles. L'étude démontre qu'on peut aussi utiliser ASSIST pour l'évaluation de la conception de cours.

Course completion is an outcome of interest in online courses, as the dropout rate is often higher when compared with on-campus courses (Levy, 2007). In this study we investigate two preparatory university courses offered online, with variation in completion rates: 37% in a mathematics course and 69% in a programming course. The courses target the same student group, and on-campus equivalents have completion rates over 90%. The aim of this study is to explore whether the Approaches and Study Skills Inventory for Students (ASSIST) can be used as an effective instrument to evaluate students in an online course and, if so, whether students' approaches to learning can explain the difference in course completion.

Background Information

Approaches to Learning and Studying

The approaches to learning theory derives from qualitative analysis of in-depth interviews with students who describe their learning behaviour and intentions when studying a text (Marton & Säljö, 2005). From students' focus on extracting meaning from this text but with different emphasis on outcome and process, two distinctive approaches were identified: deep-level and surface-level processing. The difference between them could be explained by a passive or active attitude to learning (Dahlgren & Marton, 1978). Distinctions are made according to the references students make about intention and organization, where motivation increases deep-level processing and anxiety increases surface-level processing (Entwistle, 1977).

A deep approach to learning is characterized by the student's will and intention to realize an understanding of the study material in order to relate it to a larger context. A surface approach is characterized by a focus on mechanistic repetition to memorize information instead of understanding it, in order to automatically reproduce it (Marton & Säljö, 2005). Subsequent research added a third and complementary category: a strategic approach to studying. This is an achieving orientation, in which the student's ambition is to organize learning in an effective way to fulfill course requirements (Tait & Entwistle, 1996).

The three approaches can be divided into different subscales, in order to further detail aspects of studying. In the short version used here, each approach has three subscales that express variants of motive and strategy. For the deep approach, the subscales are (1) seeking meaning, (2) relating ideas, and (3) use of evidence, all of which are driven by a meaning orientation and deep motivation. The strategic approach subscales are (1) time management, (2) achieving, and (3) organized studying. The surface approach is divided into (1) unrelated memorizing, (2) lack of purpose, and (3) fear of failure. This latter group comprises students who have a more extrinsic motivation with a reproducing orientation (Baeten, Kyndt, Struyven, & Dochy, 2010).

There is also evidence that students' approaches to learning are driven by their motivation and attitude; that is, "by the extent they are able to adopt congenial approaches to studying" (Richardson, 2007). These approaches are not contradictory; all students are believed to have some aspects of all three. Each may emerge in different combinations based on the context (Diseth, 2003).

Academic Achievement

Approaches to learning have been reported to have an impact on the outcome of learning; high academic achievement has been positively related to a deep or strategic approach and negatively related to a surface approach (Diseth & Martinsen, 2003; Diseth 2003). This relationship occurs provided that the assessment requires high levels of understanding from the students (Anderson, Lee, Simpson, & Stein, 2011). It is argued that this relationship is typically found among graduate students, whereas undergraduate science students may be more inclined to adopt a combination of strategic and surface approaches (Entwistle, Tait, & McCune, 2000).

Alternatively, studies among undergraduate psychology and medical students have found that a deep approach did not predict academic achievement; rather, a strategic approach is the best predictor in these disciplines (Diseth & Martinsen, 2003; Newble & Hejka, 1991). These findings are attributed to the learning environment: one field has a strictly fixed and defined curriculum, and the other has an overloaded curriculum, which counteracts a deep approach to learning. The pressure on students to achieve is also mentioned as a possible explanation, related to the demand for high examination grades in these specific subject areas.

Higher education curriculum often relies on the assumption that students arrive with an understanding of basic concepts and principles in core subjects (Dahlgren & Marton, 1978). To be able to adopt a deep approach to learning, adequate prerequisites are needed; a poor background in the subject or the failure to use previous knowledge while learning will detract from using a deep approach (Entwistle, McCune, & Hounsell, 2002).

The approaches to learning theory has been found to relate to pass rates and grades in an online environment, but no relation has been found to course completion (Anderson et al., 2011). Lower scores on the surface approach and higher scores on achievement motivation are both related to getting a good grade (Richardson, Morgan, & Woodley, 1999).

Online Course Retention

The retention rate in online courses ranges in general between 60% and 75% (Levy, 2007). In Sweden, where this study was conducted, it is as low as 56%, as compared with an average of 79% for all courses in higher education (HSV, 2011). The Swedish National Agency for Higher Education (HSV, 2011) reports that one explanation may be that online courses are generally given as individual courses. The retention rate in online individual courses is 47%, while in online program courses it is 80%. The retention rate for program courses given online is roughly the same as for the equivalent given on campus, but individual courses given online have about 20% higher retention rates than the corresponding courses given on campus.

Tinto's (1987) theory of student departure emphasizes academic and social integration of students, where both students and universities bear the responsibility. This is a dominant conceptual framework in the field of retention in higher education (Hatos & Suta, 2011; Melguizo, 2011). Critics of the theory claim that the empirical support for the theory is weak and point out a lack of attention to the influence of external factors and to demographic, technological, and institutional changes. Melguizo (2011) points out that most of the research in the field of retention is quantitative, and she recommends a more qualitative and interdisciplinary approach in order to address the issue of college persistence and attainment. However, in self-paced, independent online courses, where interaction with institutional members and other students is limited, the model may be hard to apply.

Major factors in students' decisions to complete an online course are satisfaction with the online experience (Hatos & Suta, 2011) and computer/technological literacy required to handle the technology used (Dupin-Bryant, 2004). Less experienced students in an early term of their academic studies are more likely to drop out (Levy, 2007). This decision is related more often to lack of persistence than to knowledge gains: "Persistence as a phenomenon characterizes the constellation of behaviours, attitudes, skills needed by the student to successfully complete an online course" (Hart, 2012, p. 39).

Method

Participants

An invitation letter was sent via email to all students who signed up for one of the two courses (mathematics and programming) and who acquired an account for at least one of them in June and July 2010. The letter informed the students of the purpose of the study and the volunteer participation. A few hours later another email was sent containing both a link to the web questionnaire and a link that registered the student as declining participation in the study. Students not selecting either of these options were sent reminders one, two, and three weeks later.

There were 2,075 invitations distributed. Out of these, 420 students declined participation. From the remaining 1,655 students, 493 students responded, for a response rate of 30%. According to Dillman et al. (2009) and Cook, Heath, and Thompson (2000), this response rate is in the range of what can be expected for large-sample surveys similar to this study.

Courses

Participants were sampled from two preparatory courses in mathematics and programming, both delivered online with self-paced learning. The courses are held during the whole year, but a large proportion of participants attend during the summer. These courses are designed to even out the variations in levels of knowledge among new students applying to university programs containing mathematics in Sweden. To qualify for participation in these courses, students must pass at least the third level of five levels in mathematics as part of the core secondary school curriculum. This level is also a requirement for admission; there are no requirements for prior knowledge in computer science or programming. The target students are the same for the two courses, and they are all invited to both courses.

All students have access to mentors who are available by either phone or email to assist with any questions that may arise during the course. There is also a course forum where students have the opportunity to engage in discussion with their peers and the mentors.

The preparatory course in mathematics, which provides five European Credit Transfer and Accumulation System (ECTS) credits, gives the students an advanced repetition of secondary-level mathematics required for studies in higher education. It is divided into five subsequent parts, each consisting of related exercises with a basic test and a final test. For each of the final tests, the student has to solve a problem, first individually and then in a group of three other students. The programming course (three ECTS credits) introduces some basic elements of programming and computer logic thinking. The course consists of four different exercises embedded in the course material to give a basic understanding of, for example, how a file system is constructed.

Both courses use computer assessment, mostly generic questions (Bälter, Enström, & Klingenberg, 2013), as well as multiple-choice and fill-in the blanks questions. If the student gives an incorrect response, they receive feedback immediately after the test is completed, with a reference about where to read more about the subject. This is designed to promote high levels of scholastic attitude and learning outcomes, and the premise that immediate feedback is related to student motivation (van der Kleij, Eggen, Timmers, & Veldkamp, 2012). The requirement for performance and completion is simple: when a student has successfully completed all the assessments during the course, they pass the course. Course completion is equal to passing the course; the only grades are pass or fail.

Dropout Students

By the Swedish definition of who counts as a course participant (i.e., a student who will render revenue to the university), a student has to be active during the first three weeks of a course. This study focuses on the courses during the summer semester.

Students who have dropped out give the following reasons: they changed their minds about participating in the course; they chose another course; they were able to get a job during the summer; or they signed up for courses only in order to get financial aid for studies and never planned to attend the course at all. Few students found the courses too difficult to handle. There is no tuition fee for European students for education in Sweden, so there is no cost involved to sign up for courses and then change your mind.

A Swedish report has shown that 76% of those who took at least one ECTS credit (approximately two thirds of a week of full-time studies) completed 80% of the ECTS credits for which they registered (HSV, 2011). This study applies to students who make a serious attempt to pass the course; therefore the focus is on those students who submitted at least one assignment during the first three weeks of the course.

Questionnaire

The Approaches and Study Skills Inventory for Students (ASSIST) is an evolved revision of the Approaches to Studying Inventory (ASI) developed in the late 1970s (Entwistle & Tait, 1994). The short version of ASSIST is easily distributed and administered. It consists of 18 conceptually overlapping questions designed to allow students to describe how they go about learning and studying.

The questionnaire used in this study is a Swedish translation of the short version of ASSIST. In Table 1, each question as well as its subscale is shown. The translated questionnaire has passed through a cross-cultural validation process by people independent from the project to improve the translation and to ensure consistency in wording and meaning with the original version. During the development, face validity from the researchers' point of view and from the students' perspective was tested. The version of the Swedish translation of ASSIST used in this study has been revised to meet the requirement of internal reliability (Öhrstedt, 2009) as tested and supported in the Finnish translation (Heinström, 2005).

The students score each item on a scale of 1 to 5. Responses are scored according to a scoring key where three subscale score variables are formed. This corresponds to the scoring rubric for the three study approaches. Earlier versions of the short ASSIST questionnaire were criticized for lack of stability compared with the full version, and the reliability of the full version has been questioned (Richardson, 1995). The version used here has been found to be reliable, and the short version correlates with the full version with a correlation coefficient of 0.93 for the deep and surface approaches and 0.91 for the strategic approach (Heinström, 2005).

Since the study concerns online courses, question number 16 (surface approach, subscale "unrelated memorizing") was removed ("I'm not really sure what's important in lectures, so I try to get down all I can"), as it does not apply in the courses studied. This means that the aggregated scores for the approaches are measured on different scales; deep and strategic range from 6 to 30, and surface ranges from 5 to 25.

In addition to the ASSIST survey, a question on the students' experience of prior higher education was added. This question was added in order to see if this exogenous factor correlated with, and possibly impacted, the students' approaches and/or completion of the course.

Statistical Analysis

The results were analyzed to determine independence of samples, correlations, and the effects of each study approach through regression analyses. The chi-square test for independence was used in order to determine whether there is a significant association between the various approaches and completion. Kendall's tau coefficient (τ) was used

Table 1
Scale Reliability Analysis of the 17 ASSIST Questions for Both Courses

			Programming	Mathematics
Deep approach			**0.70**	**0.66**
Seeking meaning	02	When I'm reading an article or book, I try to find out for myself exactly what the author means.	0.68	0.65
	06	Before tackling a problem or assignment, I first try to work out what lies behind it.	0.67	0.63
Relating ideas	10	When I'm working on a new topic, I try to see in my own mind how all the ideas fit together.	0.63	0.60
	15	Ideas in course books or articles often set me off on long chains of thought of my own.	0.66	0.58
Use of evidence	12	Often I find myself questioning things I hear in lectures or read in books.	0.68	0.67
	17	When I read, I examine the details carefully to see how they fit in with what's being said.	0.64	0.59
Strategic approach			**0.79**	**0.75**
Time management	03	I organize my study time carefully to make the best use of it.	0.73	0.71
	05	I work steadily through the term or semester, rather than leave it all until the last minute.	0.76	0.71
	07	I'm pretty good at getting down to work whenever I need to.	0.78	0.73
Achieving	09	I put a lot of effort into studying because I'm determined to do well.	0.75	0.71
	11	I don't find it at all difficult to motivate myself.	0.76	0.73
Organized studying	13	I think I'm quite systematic and organized when it comes to revising for exams.	0.76	0.70
Surface approach			**0.57**	**0.70**
Unrelated memorizing	01	I often have trouble in making sense of the things I have to remember.	0.47	0.62
	08	Much of what I'm studying makes little sense: it's like unrelated bits and pieces.	0.48	0.60
Lack of purpose	04	There's not much of the work here that I find interesting or relevant.	0.61	0.70
Fear of Failure	14	Often I feel I'm drowning in the sheer amount of material we're having to cope with.	0.47	0.64
	18	I often worry about whether I'll ever be able to cope with the work properly.	0.53	0.67

Note. The higher the value of scale alpha if an item is deleted, the less the item correlates to the scale as a whole. (For example, if Q04 is removed from the surface approach section, Cronbach's alpha would be 0.61, compared with 0.57 if the question is kept.) A Cronbach's alpha of 0.70 is usually seen as the cut-off for being acceptable, but since these values are in line with previous uses of the instrument, it is good enough for our objective.

to measure the strength of association between course completion and approaches, and Spearman's rank order correlation coefficient (ρ) was used to measure the association among the three approaches. Once we established the existence of association and correlation, binomial logistic regression was used to evaluate the effect of each study approach on course completion. The three approaches act as independent variables, and pass-or-fail acts as the dichotomous dependent variable. Welch's two-sample t-test was used to analyze whether group means differ, since the variance cannot be assumed to be equal.

For all of the statistical analysis, a significance level of $\alpha = 0.05$ is used.

Results

The results indicate that the internal consistency of the test is in the lower range. However, the Cronbach's alpha values for the deep (0.70 in the programming course and 0.66 in the mathematics course), strategic (0.79/0.75) and surface approaches (0.57/0.70) respectively correspond to previous scores of the instrument in this Swedish translation (deep 0.59, strategic 0.78 and surface 0.66) as well as to the use of a Finnish translation (0.66/0.67/0.63) and the original short version (0.76/0.76/0.72) (Heinström, 2005; Öhrstedt, 2009). A Cronbach's alpha of 0.70 is usually seen as the cut-off for being acceptable, but as well as being a function of item intercorrelation, it is also a function of the number of items in a scale and the dimensionality (Cortina, 1993).

The Chronbach's alpha value for the surface approach is on the lower side for the programming course. This is mainly due to question 04 ("There's not much of the work here that I find interesting or relevant"), which has a low item-to-scale total correlation (see Table 1). This could mean that the question is badly articulated, but since the inconsistency is most visible in the group who did not complete the course, it could point to a dissonance in this specific group.

Sample

There were 1,095 students enrolled in the mathematics course and 1,148 in the programming course during this period; with an overlap of 168 students, a total of 2,075 individuals were involved in these two courses. Among these, 493 students answered the questionnaire. Of these 493 students, 207 were enrolled in the mathematic course and 355 in the programming course, with an overlap of 69 students. Since the overlapping students represent only 14% of the respondents, the courses were analyzed separately, with these students being included in both groups. Students who attended both courses did not differ significantly from the students in general.

The mean age among the respondents was 23.6 years in the mathematics course, with participants from 18 to 46, and 23.7 years in the programming course, with participants from 18 to 66; there were no significant age differences between the students who passed the course and those who did not. The nonrespondents were older than the respondents, with mean ages of 23.6 and 25.8, but the difference was not significant.

The gender distribution did not differ between the two groups, with females approximately 39% of the students among the respondents as well as the non-respondents.

Missing Values

Three respondents answered only a few questions and were removed from the analysis. They are not counted in the total number of participants (Table 2). A total of 38 students did not answer one or two of the questions, and among these, five students were in both courses. The mean sample value for each question in each respective course was imputed for these missing values.

Table 2
Number of Participants by Gender in Subgroups

	Male	Female	Total
Mathematics, pass	45	22	67
Mathematics, fail	86	54	140
Mathematics, all	131	76	207
Programming, pass	162	105	267
Programming, fail	48	40	88
Programming, all	210	145	355

Course Completion

Completion rates differed in that respondents in the programming course performed better than the nonrespondents (75.2% versus 69.3%) but the opposite was true among students in the mathematics course (32.4% versus 36.6%), although the difference was of significance only in the programming course ($p < 0.05$).

There was no statistically significant correlation between gender and completion; this was consistent for respondents and nonrespondents. In addition, there was no significant difference in completion between those who had a prior experience of studies in higher education before the course and those who had none.

Completion Correlation and Association

The three different approaches were separated into three categories to create frequency tables, with low being the first quartile, medium the second and third quartile, and high the fourth quartile. Through the chi-square test, a possible association between completion and the strategic approach was found in the mathematics course ($p < 0.002$) and between completion and the deep approach in the programming course ($p < 0.005$). No significant association exists in other approaches.

Both the deep approach and the strategic approach correlate positively with completion in the mathematics course, as indicated in Table 3. In both the time management subscale (strategic) and the relating ideas subscale (deep), there is a strong positive correlation with completion; the probability of passing increases as the score in each subscale rises ($p < 0.01$). The achieving subscale (strategic) is also positively correlated with completion (Table 4). The surface approach does not correlate with completion.

Table 3

Association (τ) Between Approaches and Completion, and Correlation (ρ) Between Approaches

	Pass, Deep	Pass, Strategic	Pass, Surface	Deep, Strategic	Deep, Surface	Strategic, Surface
Mathematics, pass	-	-	-	0.35**	-0.08	-0.11
Mathematics, fail	-	-	-	0.24**	-0.25**	-0.28***
Mathematics, all	0.14*	0.16**	-0.05	0.28***	-0.20**	-0.22**
Programming, pass	-	-	-	0.27***	-0.22***	-0.25***
Programming, fail	-	-	-	0.31**	-0.30**	-0.09
Programming, all	0.11*	-0.02	-0.09*	0.27***	-0.25***	-0.21***

Note. τ is a value from -1 to 1. If the items were independent, the coefficient would be 0; 1 is achieved if all pairs are concordant and -1 if they are all discordant. The critical value for ρ with significance level of 0.05 is 0.195 for all groups except mathematics, pass (0.250) and programming, fail (0.217). The direction of the rank order relationship is determined by the + or the -.

*$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

In the programming course, completion correlates positively with a deep approach (Table 3), in particular the seeking meaning and relating ideas subscales (Table 4), and negatively with a surface approach, in particular with the fear of failure subscale. The pattern is visible in both subgroups, but more prominent among the students who passed the course.

Table 4

Mean Scores for Subscales

	Deep			Strategic			Surface		
	SM	RI	UoE	TM	A	OS	UM	LoP	FoF
Maximum score	10.0	10.0	10.0	15.0	10.0	5.0	10.0	5.0	10.0
Mathematics, pass	7.7	**7.9**	7.0	**11.1**	**7.8**	3.7	4.2	1.8	5.3
Mathematics, fail	7.4	**7.1**	6.7	**10.1**	**7.2**	3.5	4.1	1.9	5.5
Mathematics, all	7.5	**7.4**	6.8	**10.4**	**7.4**	3.6	4.1	1.8	5.5
Programming, pass	**7.8**	**7.5**	7.0	10.2	7.2	3.6	4.2	1.9	**5.4**
Programming, fail	**7.3**	**7.0**	6.7	10.3	7.2	3.7	4.4	1.9	**6.0**
Programming, all	**7.6**	**7.4**	6.9	10.2	7.2	3.6	4.2	1.9	**5.6**

Note. Deep: SM = seeking meaning; RI = relating ideas; UoE = use of evidence. Strategic: TM = time management; A = achieving; OS = organized studying. Surface: UM = unrelated memorizing; LoP = lack of purpose; FoF = fear of failure.Values shown in bold are those found to correlate with course completion.

Means in Approaches

Students passing the programming course had a higher mean in the deep approach than those students who failed ($p < 0.02$) and a lower mean in the surface approach ($p < 0.04$), as indicated in Table 5. They did not differ significantly in mean approach from students in the mathematics course. For the mathematics course, students who passed had a higher mean in the deep approach ($p < 0.02$) as well as in the strategic approach ($p < 0.01$).

Table 5
Mean Values with Standard Deviation and Cronbach's Alpha to Measure Internal Consistency for Subgroups

	Deep			Strategic			Surface		
	$\tilde{x}$	s	α	$\tilde{x}$	s	α	$\tilde{x}$	s	α
Mathematics, pass	22.6	3.7	0.61	22.7	4.6	0.79	11.3	4.1	0.75
Mathematics, fail	21.2	3.9	0.67	20.8	4.5	0.72	11.5	3.6	0.66
Mathematics, all	21.6	3.9	0.66	21.4	4.6	0.75	11.5	3.7	0.70
Programming, pass	22.3	3.8	0.68	20.9	4.9	0.79	11.5	3.4	0.60
Programming, fail	21.0	4.2	0.72	21.2	5.0	0.80	12.3	3.0	0.45
Programming, all	22.0	4.0	0.70	21.0	4.9	0.79	11.7	3.3	0.57

Note. For the surface approach, the scale is 5-25, and for the deep and strategic approaches, it is 6-30. A Cronbach's alpha of 0.70 is usually seen as the cut-off for being acceptable, but since these values are in line with previous uses of the instrument, it is good enough for our objective.

A significant gender difference was found in the programming course, where males had a lower mean in the strategic approach ($p < 0.001$), with the time management subscale as the most prominent.

Relationship Between Approaches and Probability of Completion

The logistic regression for the mathematics course resulted in positive β for both the strategic and deep approaches. This indicates that the probability of completion increases when the score of a deep approach increases ($p < 0.02$) or the score of a strategic approach increases ($p < 0.01$), as demonstrated in Figure 1. (Figures 1 and 2 show not the real distribution of answers but a mean distribution reached through logistic regression.) There is a strong correlation between the deep and strategic approaches, in that the higher the students' strategic approach score is, the more likely it is that they will score high on the deep approach.

A positive correlation between a deep approach and a strategic approach was visible also in the programming course. Both approaches correlate negatively with a surface approach. In the programming course the predicted probability for a student to pass increases when the score on the deep approach increases ($p < 0.01$). There is a direct, negative relationship between a surface approach and the likelihood of passing the course; it is more probable that those with a low score on the surface approach will pass the course ($p < 0.05$), as indicated in Figure 2.

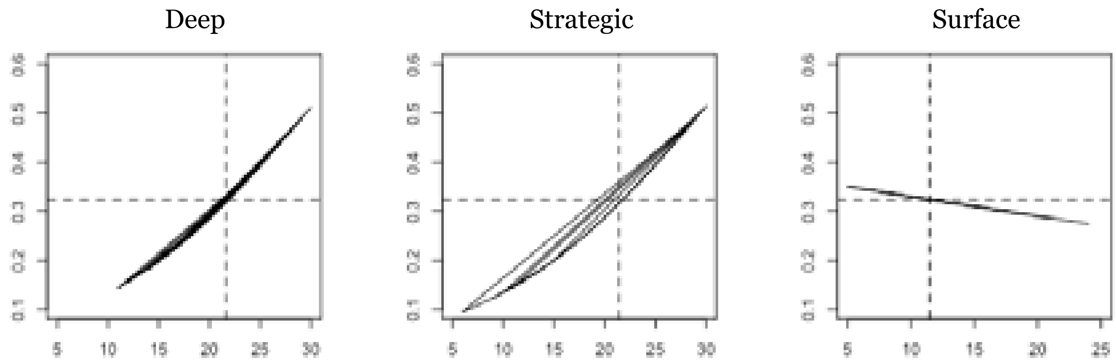

Figure 1. Probability of passing in the mathematics course. Additional lines denote the mean score for each approach (*x*-axis) and the throughput in the course (*y*-axis).

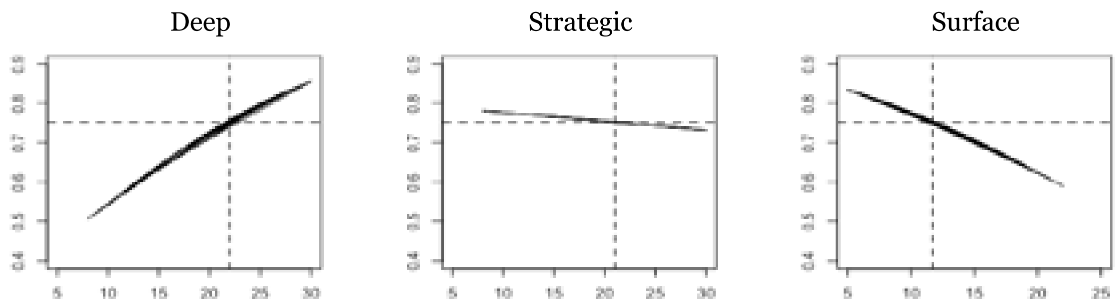

Figure 2. Probability of passing in the programming course. Additional lines denote the mean score for each approach (*x*-axis) and the throughput in the course (*y*-axis).

Discussion

This study focuses on preparatory courses in programming and mathematics during the summer semester. The greatest difference between the two courses is that the students have studied mathematics for at least 12 years, but programming is not part of the core secondary school curriculum. This means that the mathematics course is intended to be a preparatory *repetition*, while the programming course is a preparatory *introduction* to its subject. The completion rate is 37% in the former and 69% in the latter, with target students being the same for both courses. Equivalent courses given on campus for target students have completion rates over 90% in both disciplines, which poses the question of whether the difference in completion rates is about course design rather than discipline.

There is no difference in completion rates based on prior experience of studies in higher education. According to Levy (2007), there is increased probability that less experienced students will drop out. This finding is not replicated in our study and may be related to the model of online learning or the subject area. Both courses are technical. The outcomes may be caused by the subject matter with its cultural and structural properties (Dahlberg & Marton, 1978).

Programming Course

Introductory courses consist of learning facts and principles, tasks where a surface approach may be appropriate, particularly given time constraints in a course (Entwistle et al., 2000). That the opposite was demonstrated in this study is positive, since a surface approach is more linked to transient learning. One reason could be the design of the course; a coherent and congruent curriculum and the embedded assessment with fast feedback encourage motivated learning (van der Kleij et al., 2012). The fear of failure subscale was found to correlate the most with non-completion, see table 6, which could indicate anxiety traits in the students (Entwistle et al., 2000). Fear of failure is usually found to be effective in motivating high academic achievement, where the student is bound by a passive role and is preoccupied with thoughts of failure and intimidation by senior lecturers (Entwistle, 1977). However, programming is a subject where failure in the sense of error messages from compilers is unavoidable and even something that a programmer needs to learn from. To be discouraged and preoccupied by this kind of failure will have a negative impact on the students' learning, in terms of both process and motivation. That this course is short in academic credits as well as non-graded may also explain the negative correlation with the subscale, as the pressure on the student is reduced compared with the pressure felt in longer, graded courses.

A deep learning approach has a positive impact on self-directed lifelong learning (Anderson et al., 2011). That course completion is positively correlated to a deep approach is most likely due to the same factors that cause a surface approach to be negatively correlated to it.

No correlation between completion and a strategic approach was found, which may be related to the course being short and non-graded; Diseth (2003) suggests that there is no relationship between a strategic approach and academic achievement when there is no reward for achieving a high grade.

For the students to be able to adopt more of a deep or strategic approach in their future studies, it is crucial that they have adequate prerequisite knowledge and conceptual understanding of the subject (Entwistle et al., 2002). The completion rate is fairly high for an online course, and two subscales of a deep approach, seeking meaning and relating ideas, are here both positively correlated with completion. But the lack of relationship between completion and a strategic approach could prove to be problematic for the students in the long run, since a deep or strategic approach is more positively linked to high academic achievement and a more active engagement and interest in the subject (Diseth & Martinsen, 2003; Entwistle et al., 2000).

Mathematics Course

Students in the mathematics course should already know the content and need only to refresh their knowledge. A surface approach did not significantly affect the probability of completing the course. A combined deep/strategic approach would be preferable, because the probability of completion increases as the score in the deep or strategic approach increases. Since that combination is encouraged, this indicates either that the mathematics learned in secondary school gives these students sufficient knowledge about the subject, or that the current design of the course or the students' combination of intent and motivation in studying the course is sufficient (Dahlgren & Marton, 1978; Entwistle et al., 2002; Anderson et al., 2011.

The subscales that significantly correlate positively with completion were relating ideas (deep approach) and time management and achieving (strategic approach), all of which could be related to the students' intent and motivation, see table 6.

Table 6
The Effect of Various Approaches on Completion

	Mathematics	Programming
Deep approach	**Positive** *	**Positive** **
Seeking meaning	-	Positive **
Relating ideas	Positive **	Positive *
Use of evidence	-	-
Strategic approach	**Positive** **	**None**
Time management	Positive **	-
Achieving	Positive *	-
Organized studying	-	-
Surface approach	**None**	**Negative** *
Unrelated memorizing	-	-
Lack of purpose	-	-
Fear of failure	-	Negative *

*$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

Based on the results from this study, the mathematics course intentions, its outline and the students' approaches are aligned, so the course convey/mediate what they are supposed or expected to. The fixed linear order through the course may encourage the students to continue. Students who follow the pre-made study plan while studying disciplined are more likely to complete the course.

Conclusion

This study used ASSIST to explore completion rates in students in two online preparatory courses in mathematics and programming. Results show that ASSIST has a satisfactory internal consistency and reliability to be used with online courses. The translated version could therefore be used as an instrument to evaluate the effect of course design on students' approaches to learning and studying and on their completion rate.

Since the target students are the same for the two courses, the aim of the study was to investigate whether ASSIST could be used to explain the difference in completion rates between the courses. On this aspect, the data showed no correlations. However, in the mathematics course, students demonstrating a deep or strategic approach were more likely to complete the course. In the programming course, a deep approach was also positively correlated with completion, while students demonstrating a surface approach were less likely to complete. The relating ideas subscale of the deep approach was positively correlated to completion in both courses. This indicates that students who are learning-oriented do well, and even though the courses are both given online, they reward students who adopt a deep approach to learning.

This is in line with earlier research that shows that students who perceive the assessment as memorization and the workload as high are more likely to adopt a surface approach to learning (Trigwell, Prosser, & Waterhouse, 1999). The self-paced aspect of the courses should prevent students from perceiving the workload as high, and there are aspects in the assessment that are meant to oppose memorization. A surface approach to learning has been found to be linked to a passive information transmission from the teachers' side in on-campus education (Trigwell et al., 1999); linking conceptual questions in the course material has been a way to try to defeat this passivity.

We therefore argue that ASSIST can be used to evaluate online course design with respect to which approaches to learning and instructional strategies the courses encourage and discourage, ultimately affecting both knowledge gains and course completion.

Future Work

Based on these results, there will be further research with course designers and instructors to determine effective modifications in the courses to encourage a more deep or strategic approach to learning (Diseth & Martinsen, 2003; Newble & Hejka, 1991). The modifications will be made with the existing course designs and the results of the study as well as the limitations of technical systems and financial resources in mind. It will be done with the hope of increasing the completion rate and, ultimately, better preparing the students for their future education.

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