Bridging module for first year Computing Science students

By

Tamás Csillag

A dissertation by practice submitted in partial fulfilment of the requirements for MA in Training and Education (QQI)

Centre for Promoting Academic Excellence

Griffith College Dublin

2016

Declaration

I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of the MA in Training and Education, is my own; based on my personal study and/or research, and that I have acknowledged all material and sources used in its preparation. I also certify that I have not copied in part or whole or otherwise plagiarised the work of anyone else, including other learners.

Signed: ____________________________

Dated: ____________________________

Abstract

Student retention in higher education, especially of first year students has been the centre of research for the past decades (Kantanis, 2000; Ramsay, Elphinstone, and Vivekananda, 2005; Hillman, 2005). Multiple factors have been identified that affect the likelihood of a particular student completing first year and subsequently being awarded a degree. One of the tactics to assist students in transitioning to higher education is support and encouragement from academic departments.

Based on an earlier study (O'Riordan, 2014), an early support module has been incorporated into the BSc in Computing degree program which aims to equip learners with the skills necessary to manage learning on their own and academic life in general. The aim of this project is to develop a similar module, which would provide the necessary field-specific skills for computing science students to successfully transition from secondary level education or in coming back to education in their selected field.

To inform the development of the module, the author has consulted relevant literature and analysed similar bridging course programs running in multiple institutions. For the selection of topics for the module, interviews were conducted with fellow lecturers and first year students in the College and the results analysed. Based on these results and from other sources in literature, topics in Maths, Physics and Business were identified for inclusion.

The module was defined as a 12 week program aimed at level 6 of the National Framework of Qualifications (NFQ), to help incoming students prepare for their level 7 studies. The curriculum was developed based on the defined Learning Outcomes. The Module will be delivered online.

Materials prepared for the Module include presentations, videos, practice worksheets in different formats and quizzes for formative feedback. These enable students to practice what they have learned during the presentations and assess their own progress.

Further work is to be carried out on developing additional course material and refine existing items based on the feedback of students and lecturers. The selection of topics could also be modified based on feedback and possible future changes in the Learning Outcomes of the supported degree programmes.

Contents

Table of Contents

Abstract 3

Contents 4

Acknowledgements 7

Introduction 8

Research 10

Literature review 10

First year Computing Science issues 10

Bridging courses 11

Online delivery 11

Course review 13

Griffith College 13

Study hub 13

Australia 14

Interviews 15

Ethical issues 15

Email based interviews 15

Lecturers consulted 16

Results 17

Conclusions 17

Development 19

Defining the Module 19

Positioning 19

Level 19

Credits, workload 20

Learning Outcomes 20
Curriculum 21
Module descriptor 22
Framework 22
Presentations 23
Practice materials 23
Knowledge checks 24
Assessment 24
Technology 26
Online delivery 26
Choice of LMS 26
Mobile delivery 27
Multimedia and interactive elements 28
Discussion 30
Research phase 30
Student results 30
Interviews with lecturers 30
Assessment and practice technologies 31
MCQs 31
Spreadsheets 31
Numbas 32
Module handbook 33
Time constraints 33
Conclusion 35
Designing the Module 35
Delivery 35
Monitoring 35
Further research 36

References 37

Appendix 1 – Module descriptor 40

Appendix 2 – First year BSCH Module Learning Outcomes 43

Appendix 3 – Course outline 45

Appendix 4 – Ethics approval form 46

Appendix 5 – Mobile App 48

Acknowledgements

This project is the result of the efforts of many people:

Thanks for Alice Childs, Fiona O'Riordan, Angela O'Keefe and all our lecturers, whose support was paramount in helping me go all the way!

Thanks to all the lecturer colleagues who agreed to be interviewed and went over and beyond by providing additional ideas and insights.

Thanks to all my bosses: John, James and Madhu for letting me take all that time off to attend school.

And a special thanks to Timi for putting up with me during the course, her feedback and ideas on the project and her not always gentle encouragements to finish what I've started!

Introduction

Student retention in higher education, especially of first year students has been the centre of research for the past decades (Kantanis, 2000; Ramsay, Elphinstone, and Vivekananda, 2005; Hillman, 2005). Multiple factors have been identified that affect the likelihood of a particular student completing first year (Tinto, 1988) and subsequently being awarded a degree. Nora (2001) proposes four tactics to assist students in transitioning to higher education, including support and encouragement from academic departments. Adams, Ryan and Keating (2000) establish that early academic support is an important factor in student success.

Based on an earlier study (O'Riordan, 2014), an early support module has been incorporated into the Bachelors degree program which aims to equip learners with the skills necessary to manage learning on their own and academic life in general. The aim of this project is to develop a similar module, which would provide the necessary field-specific skills for computing science students to successfully transition from secondary level education or in coming back to education in their selected field. As it is not practically possible to provide a bridging module from every part of the secondary level curriculum, we aim to establish the most common areas where support would be needed.

The overall aim of the project is the creation of an actual bridging module (Module) for first year computing science students, which is:

- Available online before and during their first year,
- Addresses knowledge gaps identified in previous years,
- Provides practice opportunities and feedback on progress,
- Can be regularly reviewed for adding new content,
- Can possibly be used to track the skills level of first year students, year-on-year.

In this paper, we will take a look at the development process of this Module, the issues faced while implementing it and the conclusions that can be drawn from the outcomes of the project.

We will start with examining the academic literature about the issues first year students are facing, experiences with bridging courses and specifically Mathematics bridging courses. A research phase for collecting information to aid targeting the Course will be defined and implemented, with its conclusions discussed.

Development of the Module will be shown: how the Module was positioned, the definition of the Learning outcomes, designing the curriculum and capturing these in the Module descriptor. We will take an in-depth look the presentations and practice opportunities provided to the learners.

We will briefly touch on the technological aspects of the Module, including the choice of the Learning Management System, mobile delivery options and the use of various technologies for practice and assessment.

The Discussion chapter will detail the issues faced and reflect on the lessons learned during the project, including the research phase and the implementation phase.

The paper will conclude with the potential delivery modes of the Module, monitoring student progression through the module and possible further development and research opportunities.

Research

In this section we will take a look at the sources informing the development of the Module. We start by reviewing the relevant literature on transitioning issues, experiences with bridging courses in general and online delivery methods. In the research section we will take a look at the chosen research methods, how the research was implemented, the results received and the analysis of these results.

Literature review

In the next sections we will take a look at the current issues encountered with first year students of Computing Science courses, bridging courses in general, delivery methods of these courses and research methods for designing such a course.

First year Computing Science issues

Mathematics has been identified time and time again (Boland, 2002; Jennings, 2009; Gordon and Nicholas, 2013) as the number one issue within the first (and subsequent) years of third level education: "The study of mathematics at university features not only in science and engineering degree programs but also in many other tertiary disciplines including pharmacy, economics, agriculture and information technology. Failure to study mathematics at an appropriate level may have serious consequences for a student's success at university" (Poladian, Nicholas, 2013, p.2). Gordon and Nicholas take it even further, saying "Mathematics is in crisis in many countries" (2013, p.109).

Other issues include transitioning from Secondary school to the more autonomous learning in Third level. "As students transition from the support frameworks of schools, they commonly find it difficult to manage the level of autonomy and flexibility, which comes as part of the higher education environment" (Fisher, Cavanagh, Bowles, 2011, p.226). "Many students experience difficulties in the transition to first-year university studies, which is the time when the risk of discontinuing studies is greatest" (Wintre, Yaffe, 2000, p.9).

The student numbers on Computing Science (CS) programs are also declining: according to Yardi and Bruckman, the number of CS graduates fell 50% between 1998 and 2006. They attribute this to the general perception towards computing: “Studies show that teenagers perceive computing to be boring, antisocial, and irrelevant to their lives” (Yardi, Bruckman, 2007, p.39).

Bridging courses

To address the gap in mathematics, so called “bridging courses” have been used for quite a while: “Many universities, [...] attempt to ameliorate the difficulties encountered by mathematically under-prepared students by offering preparatory programs (Bridging Courses) that enable students to obtain prerequisite or assumed knowledge in mathematics before commencing their degree program.” (Poladian and Nicholas, 2013, p.23).

Jennings argues that during the design phase of a bridging course, no assumptions of prior knowledge should be made and the current level of understanding of the students should be identified: “Before teaching new work, tertiary staff should find out what students know, through for example, a diagnostic test. Having this quiz online would allow instant access to results and the ability, if deemed necessary, to run revision sessions in the first few weeks of semester” (Jennings, 2009, p.279). This could enable tailoring the course topics and content to the needs of each group at the start of semester.

Online delivery

Computer based, online delivery modes have seen increasing use over the last decade. They can be accessed from practically anywhere and at any time of day, enabling remote delivery of courses, support online testing in real time providing “instant access to results” (Jennings, 2009, p.279).

While the benefits, especially the flexibility of online delivery methods have been widely praised, it also raises questions on suitability and quality of interaction: “There are shortcomings with the communications areas, such as the asynchronous bulletin boards and the synchronous chat/messaging, in Learning Management Systems (LMS) when they are required for mathematically rich discussions” (Leventhall, 2004, p.2).

Online delivery on a mobile (portable, handheld) device is defined as M-Learning: “M-learning is a new and independent part of e-learning. M-learning can be defined as “any educational provision where the sole or dominant technologies are handheld or palmtop devices.”” (Park, Nam, Cha, 2012, p.592). This can be viewed as simply a more convenient way of delivering content, but Berking et.al argues that it’s much more: “mobile learning does not simply amount to a different mechanism for delivering content to learners; it represents an emergent way of thinking that implies a paradigm shift” (Berking et al, 2012, p.3).

Course review

The following sections will detail some existing bridging and preparatory courses that were reviewed in the preparation of this Module.

Griffith College

Griffith College also runs a Maths preparatory course for Leaving Certificate students:

“Maths is probably one of the subjects for the Leaving Certificate that students find the most challenging and it is the one subject that is 100% essential if you wish to study at 3rd level. Here at Griffith College we will be running FREE ordinary level Maths Revision classes for 5th and 6th year students. The revision courses are based on the new project maths Leaving Certificate syllabus.” (Griffith College, 2015). These courses also include “class notes, videos, check lists and exams questions” (Maths Revision, 2015).

Study hub

In Ireland, Eir (a telecommunications company) runs the StudyHub online site. The primary purpose of the site is to provide Leaving certificate preparation materials for secondary level students, but it inherently serves as a preparatory course for third level studies as well. Among others, the subjects include Maths, Physics and Business as well. The accessible materials include “videos, downloadable and printable lesson notes, past Leaving certificate exams and solutions, topic quizzes and audio downloads” (podcasts) (Studyhub, 2016).

Topics are organized into so-called “Study Packs”. These are made up of the following:

“Each Study Pack, contains both a lesson video and an exam solutions video for each exam topic. Each Study Pack also contains lesson notes, covering each of the video lessons and exam solution videos. Many Study Packs have a 'multiple-choice' quiz to test a student's knowledge of the video content.” (Examsupport, 2016)

Australia

Higher education institutions in Australia also use bridging courses to address these problems: "fewer students are studying higher level mathematics in secondary school and universities are now offering bridging courses in mathematics to provide students with the necessary mathematical background to succeed in their tertiary studies" (Jennings, 2009, p.273). University of Queensland (Jennings, 2009) and University of Sydney (Poladian, Nicholas 2013) run courses as “preparatory programs (Bridging Courses) that enable students to obtain prerequisite or assumed knowledge in mathematics *before* commencing their degree program” (Poladian and Nicholas, 2013, p.23).

The University of South Australia pioneered the use of spreadsheets as teaching tools:

"Innovative teaching methods have been devised to enhance students’ understanding of mathematics. These have revolved around the use of spreadsheets to illustrate mathematical concepts. Spreadsheet based design has been chosen because of its what-if capabilities, the virtually instantaneous response to alteration of parameters, its graphical capabilities and its inherent use of recursion which proves eminently suitable for many mathematical applications." (Boland, 2002, p.2)

Online or blended delivery of these courses is noted by both Boland (2002) and Leventhall (2004).

Interviews

The following sections will detail the actual research part of the project: the interviews conducted with lecturers of first-year students and the conclusions drawn from these to develop the Learning Outcomes.

Ethical issues

Ethics is an important consideration in any social research. After careful consideration, the research carried out in this study was considered as low risk:

There are no direct, non-aggregated student results used in any part of study, so individual results cannot be traced back to any particular student.

The author is not teaching or assessing any of the first year students, therefore the chance of a conflict of interest if very low.

The study did not collect any sensitive information (gender, age, etc.) about any student, which could have any effect on approval.

As any social research project, the study was submitted to the Research Ethics Committee of the College in November 2015 (see Appendix 4 for the approval form) and received authorization before proceeding.

Email based interviews

Email has been identified as a viable platform for conducting interviews (Gordon et al, 2007; Gordon and Nicholas, 2013), as it provides several advantages: the participants can be separated by location and time; there is no need for transcribing; both parties can take time to understand the question or reply of the other and develop their answer or next question based on that; both parties have convenient access to the entire course of the interview which can be referenced. The disadvantages might include heavily edited answers, the lack of body language and other displays of emotions and potentially longer time to conduct the interviews. For the purposes of this study, the advantages outweigh the potential issues, therefore this method was chosen as a primary interview form.

Lecturers consulted

All lecturers consulted are with the Computing faculty of the College and have been teaching for over 10 years. They all teach first year students on multiple courses, including degree and certificate programs.

Results

Interviews were conducted with lecturers in multiple rounds in email format. To the initial question, “What do you see as a major issue for first year students?” a very typical answer was “Maths, maths and more maths”. When asked to elaborate, participants identified basic Leaving Certificate level maths issues such as ratios, trigonometry, working with indices and logs, which is in line with the findings of Jennings (2009,). 100% of the respondents identified maths as an issue.

In a later round participants were asked to list non-maths issues, where the results were much more diverse: topics such as basic physics for hardware, networking and games development modules, computing in the context of business and even inclusivity in relation to user interfaces came to light as being areas of deficiency.

Specific subjects and topics were identified as weak in relation to student knowledge and understanding. In a breakdown, 50% of respondents identified physics topics, such as mechanics, waves and electronics in this regard; 50% identified academic skills such as research and writing; a further 25% identified business in relation to computing and finally 25% named soft skills such as “inclusive thinking” or “teamwork” as being areas of weakness.

Conclusions

Based on the results, Mathematics seems to be the biggest issue facing students. As such, 50% of the module time was allocated to maths, which translates into 6 weeks. This is ideal for delivering 6 selected topics. The identification of the exact topics within maths that need to be addressed were based on both the interview responses and research results taken from bridging courses running in the UK and Australia (Jennings, 2009), who list the problematic topics in order of precedence as follows:

Question	**% correct**	**Topic**
Q11	79	Function substitution
Q8	78	Ratios
Q3	65	Expanding quadratic
Q10	58	Trigonometry application

Q9	56	Trigonometry
Q2	54	Transposing equations
Q5	48	Solving quadratic
Q4	36	Factorising quadratic
Q6	35	Simplifying powers
Q12	29	Optimisation
Q1	27	Algebraic fractions
Q14	21	Chain rule
Q16	17	Definite integral
Q7	10	Logs
Q13	10	Product rule
Q15	10	Integral

Table 1 (Jennings, 2009, p.277)

Using both datasets, the topics to be included in the Module were determined as: ratios, fractions, trigonometry, trigonometric functions, indices and logs. While more topics could be taken, the timeframe of the Module only permits a limited number of choices.

Another 25% of the Module was allocated to physics. The topics to be included were as reported by the respondents: basic mechanics (laws of motion) and basic electronics and logic gates.

The final 25% of the Module was assigned to business topics, as the first year has two business related modules. Topics include computing in business, business models of information technology companies and an introduction to cloud computing concepts.

The soft skills identified are not addressed by the Module, as they are either out of scope (inclusivity) or are being addressed by another module during the first year of the BSc in Computing programme.

Development

The following sections will detail the development process of the module. First we will look at the positioning of the Module, which informed the choice of activities to be used. The Learning Outcomes of the Module will be based on the Programme LOs and the stage 1 Module LOs of the BSCH (BSc in Computing, Honours) curriculum of the College. These were consulted to make sure that the module content is aligned with these outcomes. Based on these and other informing criteria, the curriculum of the Module was developed. The following section will detail the decisions made on the assessment of the Module and the background of these choices. We will then briefly focus on the technological aspects of the implementation of the Module, including the LMS, media formats and delivery methods.

Defining the Module

Positioning

To be usable as a module in the College, be QQI accreditable and as a best practice in general, it is necessary to position the Module on the National Framework of Qualifications (NFQ), the 10 level framework provided by Quality and Qualifications Ireland (QQI). This is based both on the intended audience of the Module, and the breadth of the Module, as in how much material is covered, what is the expected workload of the students. The following subsections will look at these classifications. Once these are determined, they will be recorded on the Module Descriptor of the Module.

Level

As the Module to be designed is a bridging course for first year students starting on a level 7 course, the possible levels of choice are 6 or 7. As the QQI defines level 6:

"Modules include advanced vocational/occupational skills, enabling certificate holders to work independently or progress to higher education and training." (NFQ QQI, 2015)

At this level we can expect learners to learn definitions, reproduce and solve mathematical equations so they can apply them subsequently in their level 7 studies.

Credits, workload

Credits on the ECTS system relate to the expected time and effort spent on the study of a subject. One credit equals 20-30 hours of study/practice time at this level. Typical credit values in higher education are in the 5-10-20 range, with large, semester long project works possibly reaching 30.

The Module is not intended to present a major workload to the students; it should be delivered in around 100 hours to the students, including presentations, videos, practice materials and assessments. While it would be an option to not associate a credit value with the Module, that could lead to issues with motivation, as students prioritize modules based on a cost-benefit approach, and don't spend energy on courses which are considered 'worthless', as they do not change their final results or Grade Point Average GPA (Murphy, 2010).

With these considerations, the module has been assigned a 5 credit value, which is aligned with the expected hours needed for completion.

Learning Outcomes

The Module learning outcomes define what the module has set out to accomplish. After successfully finishing the Module, a student should be able to complete the tasks set out in these. Two sources influenced the creation of the Learning outcomes:

The Module needs to be aligned with the actual degree course that it is bridging to. This course is the BSc in Computing (Honours), as run by the Computing faculty. The module learning outcomes for the modules on this programme are readily available in the module descriptors of individual modules (these can be found in Appendix 2). During development, these outcomes were used as the destination where students should be at a level to be able to accomplish these.

The other source was the output of the research phase: the experiences of first year lecturers on where student have issues with achieving their learning outcomes. These are the problematic areas where the Module should concentrate its resources.

Based on the target level of the Module and the above inputs, the following Learning Outcomes were defined:

1. Solve problems relating to fractions and ratios
2. Apply trigonometric functions to simple problems
3. Define the concept of indices and logs
4. Explain the laws of simple mechanics
5. Define logic operations
6. Identify the roles of computing in business

Curriculum

Once the Learning Outcomes were clearly defined, the Subject Matter of the Module could be defined. Based on the results of the interview phase, the Module is made up of 50% mathematics, 25% physics and 25% business. Based on the workload defined previously, the curriculum was divided into 12 topics, ideally each to be completed in a week, including presentation, practice and formative assessment. This translates into 6 weeks of mathematics, 3 weeks of physics and 3 weeks of business studies. The order of these topics is not set, they can be taken in any sequence. Based on pre-assessment, some parts of the Module could even be skipped.

The final topics chosen are as follows:

Mathematics	Ratios Fractions Trigonometry Trigonometric functions Indices Logs
Physics	Laws of motion (simple mechanics)

	Acceleration Electronics
Business	Applications of computing Business models Cloud computing

Table 2 Topics selected

Module descriptor

The parameters of the module, including the level and credits, the intended Learning Outcomes and the curriculum are set in a Module descriptor, which is standardized across the College. This Module descriptor is accessible to students as it is online with the introduction part of the module. It is included in this paper as Appendix 1.

Framework

The framework developed for each topic contains 4 elements:

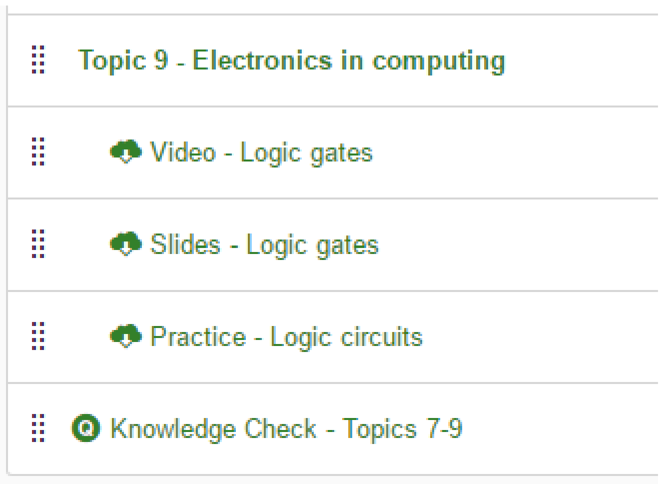

Figure 1: Topic framework

1. A video presentation
2. The slides used in the video to be used as printable notes and accessibility considerations
3. Practice materials or links to external resources
4. A knowledge check after every 2-3 topics for self-assessment

Presentations

Presentations make up the instruction part of the Module: they provide learners with the basic principles and facts to memorize and understand. Based on cognitivist Mayer's Multimedia Principle: "Retention is improved through words and pictures rather than through words alone" (Cisco, 2008), presentations contain both the written form of the concept, method or rule to be learned as well as a graphical representation of it. Going further with his Modality Principle, "Students learn better from animation and narration than from animation and on-screen text" (Cisco, 2008), narrated videos are preferred to simple slideshows.

As such, the primary modes of delivering subject matter during the Module are either presentations in slideshow format, or fully narrated videos of these presentations (with the slides included as reference).

Taking into consideration the findings of Leventhall (2004, p.7), which state that "To teach the language of mathematics, we need verbal/spoken descriptions as well as written. The notation is shorthand for the spoken word. Clearly, to communicate with others, the mathematical language must be learnt", using narrated videos for the maths related topics as much as possible was the preferred approach.

Practice materials

"Constructivism holds that people are actively building knowledge and understanding by synthesizing the knowledge they already possess with new information" (Jordan, Carlile, Stack, 2008, p.55). After most presentations, practice materials were developed to help learners experiment with the new concepts in a safe and visual environment. These include options such as a web-based interactive plotting programs displaying the effects of gravity on a stone thrown upwards, or an Excel sheet where the parameters of a Sine function can be changed, immediately shown by the graph on screen.

Students can take as much time as they want with these tools, or even share their experiments and experiences with other students (social constructivism).

Knowledge checks

For formative assessment and feedback to students, a knowledge check quiz was developed covering the preceding 2 (maths) or 3 (physics, business) topics. After consideration, multiple choice quizzes were selected as the preferred format for these tests. These are relatively easy to implement and can be collected into a reusable library, can be marked in real time in an automated fashion, decreasing the workload on the lecturer and post-test explanations can be added to the test to enable student review:

“Multiple choice tests and a meaningful post-test review have been shown to improve student's performance on a later test. This benefit is referred to as the testing effect.” (Laplant, 2015)

“[...] multiple-choice questions, in both formative and summative assessment mode, have the advantages of facilitating comprehensive student learning, and allowing analysis of student understanding.” (O'Dwyer, 2012, p.10)

Assessment

Every course has to deal with questions relating to assessment, the purposes of which are typically twofold: to provide feedback for the student on areas needing attention and practice opportunities, as well as actually measuring the learning that has happened.

Formative assessment provides feedback for students, giving insight to areas where further development might be needed and also potentially providing motivation with positive results. As the idea of a bridging course is to take students from potentially different levels and get them to a common level, from where they can start their actual studies, the Module lends itself to this type of assessment quite well. If assessments can be retaken, they can be valuable practice tools as well, while providing feedback on the performance. If taken before actually reading or watching the presentation materials, they can be used as a “Do I already know this?” type of test, which might suggest that sections of the material can be safely skipped by the student.

Summative assessment deals with measuring the learning and is used for grading. As the module has credits associated to it, summative assessment needs feature in the Module assessment methodology. The implementation of this would be similar to the formative assessments taken previously.

Technology

In the following sections we will take a look at the technological aspects of the Module: the online delivery method, choice of Learning Management System (LMS) and multimedia assets.

Online delivery

The online delivery method was chosen for three reasons:

The College has successfully moved all courses and their supporting material to their online Learning Management System (LMS) platform, Moodle. This makes it easier for students to access all documents and materials relating to a course in one centralized, standard location. It provides access to Module descriptors, presentations, notes, recorded videos, practice materials and past papers.

As the Module is delivered during the summer, before the first year actually commences and students potentially move to student accommodations in the vicinity of the College, online delivery makes the Module far more accessible to all new students.

The College has a history of successfully delivering fully online courses for several faculties. As these degree courses are a lot more complex than a single bridging module, including the ease of assessment, delivery of the module should not pose any major issues.

Choice of LMS

The College has been using Moodle as the LMS for over 10 years. This project is also an experiment into how a newer LMS, potentially containing less legacy features compares to Moodle. The following criteria were used to select the LMS:

- Freely available, preferably open source
- Supports the following features:
    - Presentations
    - Videos
    - Downloads
    - SCORM packages
    - Quizzes

- Preferably available on mobile devices
- Preferably compatible with Moodle (moving courses in-between and/or interoperability)

Based on these requirements, Canvas was chosen as it checks off all of them. It is an open source software, can be freely installed, but also has a free cloud-hosted version supported by the vendor. It supports all the activities needed for the Module, has dedicated mobile apps for Apple and Android devices and can import-export courses between itself and Moodle.

“Large research universities with profiles comparable to ours already use and trust Canvas. It is regarded as dependable, rich with features, and intuitive. It can be integrated with campus systems and data sources, as well as with relevant third-party applications. And crucially, it has demonstrated that it can meet UC Davis’s high-level requirements in terms of usability, reliability, accessibility, security, learning tool integration, mobile use, and frequency of updates.” (UC Davis, 2016)

Mobile delivery

The concept of eLearning has been around for almost 2 decades now. With the advent of the smartphone and tablet and the widespread availability of mobile Internet access, using these devices to access online learning content seems like a natural development. According to a Thinkhouse survey from 2014, 84% of Irish teenagers own a smartphone and 56% don’t even bother with websites that can’t be viewed on a mobile device (thinkhouse.ie, 2014). Based on these numbers, supporting mobile devices seems inevitable.

While Park goes one step further to differentiate mobile learning from eLearning, the Module does not contain mobile-only elements:

“Education in Korea is now moving from e-learning to mobile learning (m-learning) as mobile technology becomes popular in both formal and informal education in Korea. While e-learning is based on the use of both wire and wireless Internet, in m-learning the learner takes advantage of learning opportunities offered by mobile technologies such as cell phones, smart phones, palmtops, tablet personal computers (PCs), personal digital assistants (PDAs) and portable multimedia players

(PMPs). M-learning is a new and independent part of e-learning. M-learning can be defined as “any educational provision where the sole or dominant technologies are handheld or palmtop devices”.” (Park et al, 2012, p.592).

Berking et.al sees mobile learning as a radically new approach:

"Mobile learning should be viewed as a way to augment the learner through the use of ubiquitous technology that can provide access to learning content and information, anytime and anywhere. Mobile learning does not simply amount to a different mechanism for delivering content to learners; it represents an emergent way of thinking that implies a paradigm shift." (Berking et al, 2012, p.3)

The finished module is fully mobile ready with the use of the Canvas app on IOS or Android devices (see Appendix 5).

Multimedia and interactive elements

Multimedia elements in the Module are largely made up of narrated videos. The voiceover of these videos was created with a speech synthesizer to save on the production time by not having to record several times to correct mistakes. These videos are simple linear recordings. While multiple software products exist to make such videos interactive, by providing menus, popups and links within the material, they typically rely on software platforms (Adobe Flash or Java) not present on mobile devices, breaking functionality.

Interactive elements were implemented both with Numbas, a software package developed by Newcastle University specifically to deliver maths and science related questions and exams. It is fully web-based, compatible with most modern web browsers, supports writing complex equations, graphing functions in real time while changing parameters and other media. It can be used for formative and summative assessment, can display explanations of answers and the exam or question(s) can be packaged up into a standard SCORM container, which can be used by Moodle, Canvas or any other compatible LMS.

Discussion

In this section, we will take a look at the issues encountered during the development process and how they were addressed, the use of different tools for practice and assessment and what was left out of the project due to time constraints.

Research phase

Student results

The initial direction of the research phase was to collect student test and exam results and apply statistical analysis to identify the areas and topics to be address by the Module. Ethical approval was granted to use aggregate and anonymized student results for this purpose. However both the logistics of receiving the necessary data and the aggregate nature of the tests made this approach not feasible. Class tests and exams typically contain multiple questions and cover several learning outcomes, and the final marks do not contain the breakdown between these, making these results not detailed enough. After consideration, research was changed to interviews with lecturers instead.

Interviews with lecturers

Accessibility of lecturers during the winter holiday season and subsequent exam period proved to be a challenge. While all participants were very helpful and interested in the project, due to their work on corrections, extra classes, administration, exam delivery and getting ready for the new semester, their available time was limited. To make up for this, an email-based interview approach was used to allow flexibility of timing for both parties. While multiple rounds of email exchange were required, this still helped with timing and was easier to use the results without having to transcribe recorded conversations.

Assessment and practice technologies

MCQs

Multiple choice quizzes (MCQs) are a versatile way of assessing student learning and are also easy to score for immediately available feedback for students, while minimizing the workload of the lecturer. They can be applied to any level of learning based on Bloom's taxonomy. For the purpose of this Module, we are interested in the first two levels: remembering and understanding, as it is delivered on level 6 of the NFQ. According to Laplant:

"Items that test the remembering level might involve simple recall of terminology, definitions methods, formulae and equations." "To demonstrate understanding level learning, a multiple choice item might require the translation of a given scenario from words into an equation or process graph." (Laplant, 2015)

Going with best practices, most MCQ items were developed with 3 false answers:

"While traditionally multiple choice items have four to five options, some have six or seven. However research shows that three options are optimal and that when adjusting for guessing, the fourth alternative increases reliability of the item only marginally. This fact has been proven both empirically through observational studies, sophisticated item analysis, and information theory." (Laplant, 2015)

While research by Leventhall in 2004 has "showed that current mathematical equation creation/editing tools (such as in word processors) had menu driven interfaces and those users surveyed did not like them, finding these slow and awkward to use for large amounts of material" (Leventhall, 2004, p.4), Canvas still provides the same menu-based approach to creating equations and other mathematical expressions for its quizzes, but support for these is built-in and automatic at least, as opposed to earlier plugin systems.

Spreadsheets

Excel spreadsheets are used by the Module to demonstrate mathematical and physical concepts. These do not teach the material themselves, but are an aid in their understanding: "It could be referred to as a re-naming of CAI as computer aided illustration rather than computer aided instruction. It is used not to solve mathematical problems, but rather to illustrate mathematical concepts to improve understanding." (Boland, 2002, p.4).

Spreadsheets were developed to illustrate concepts in trigonometry: like the sides of a right angled triangle or the properties of the Sine function. Students can alter the parameters in these functions and equations and results will be automatically recalculated and displayed to them.

The physics section also makes use of such spreadsheets, to demonstrate the concept of logical operations as switches are connected in parallel or sequentially. Students can experiment with these switches and observe the results, without the need to install full software packages which would have similar, although extended functionality. This is also relevant for mobile delivery, as these software products are typically only available on desktop operating systems.

Numbas

"Numbas was created at Newcastle University, and is used in every first-year module at the School of Mathematics and Statistics." "Numbas is perfect for maths testing, but can be applied to many different subjects." (numbas.org.uk, 2016). It is fully web-based, compatible with most modern web browsers, supports writing complex equations, graphing functions in real time while changing parameters and other media. It can display explanations of answers and the exam or question(s) can be packaged up into a standard SCORM container, which can be used by any other LMS.

Numbas is used in the Maths and Physics sections of the Module. While as a SCORM package, it could be used for summative online assessments, (due to free hosting limitations) the Module uses it as a standard webpage, for practice purposes. In the Acceleration and gravity topic, a Numbas question is used to draw the trajectory of a stone thrown upwards, based on the equation entered by the user. It can be used for experimenting and constructing knowledge based on earlier knowledge: if the stone never falls back down based on the graph, (which would be unexpected based on previous knowledge), the student can conclude that the equation entered must be wrong somewhere, can refine it and try again.

Module handbook

As the Module is not planned to be delivered in a staggered, week-by-week fashion, but students would get immediate full access to all materials, which might overwhelm them: "Divide longer or more complex learning activities into manageable sections that challenge but do not overwhelm students. Students who find a learning activity too complex and are not able to break down the activity into smaller steps may not have the confidence to proceed and might postpone working on the activity." (Jones, 2009, p.276.).

To address this issue, a short student handbook was developed, mostly based on the content typically found in such handbooks, as identified by White (1958): curriculum, schedules, grading and study suggestions.

Time constraints

The timespan of the project was between September 2015 and April 2016. During this time the project contained a research phase, a definition phase and an implementation phase. The research phase took more time than expected as the interviews were originally planned during an exam period, which was inconvenient for the respondents. During the implementation phase production of the Module materials: presentations, videos, quizzes and practice tools took the most amount of time. As a time saving measure, to avoid re-recording the narration of videos due to errors (as the author is not a native speaker of English), speech synthesizer software was used.

To reach the target deadline, a decision was made not to produce any material for the Computing in Business section. The implemented MCQ quizzes were also not fully loaded with questions, but enough for demonstrational purposes. These will need to be addressed before the module can actually be used by students.

A full peer review by lecturers from the Computing faculty was also not possible during the timeframe of the project. Once the material has been fully developed, the Module can be used by students and both student feedback and results of summative assessments could be gathered, measuring the efficiency of the Module.

Conclusion

Designing the Module

During the design phase, the first challenge was to identify the content which should be in the Module and then the decision on which topics or parts to leave out of the Module, as there is not enough time in a 12 week timespan to do a full review of years of Secondary School material. The decisions were supported by both local research and a wider dataset, it still could and should be refined after the module commences, based on student feedback and results.

Creating more material: presentations, practice questions and workbooks, quizzes and supplementary materials can also be an ongoing process, making sure the students are not overwhelmed and intimidated by all the material they suddenly see after starting the Module. Existing material should be refined, corrected and enhanced based on feedback from students and faculty alike.

Delivery

Delivery of the Module is scheduled to be during twelve weeks in July-August-September, while students would retain access to the Module during their entire first year. This enables them to potentially complete the Module by the time the semester starts, without putting pressure on them with deadlines to keep. All parts of the module would be immediately available, allowing students maintain their motivation by dipping into topics of interest first and potentially skip parts where they do not need further support.

Monitoring

As Poladian and Nicholas (2013, p.25) suggest, “there are inherent difficulties in defining and measuring success in bridging courses”. Godden and Pegg (1993, p.300) suggest that formal evaluation of bridging mathematics programs may be contrary to the aims of the programs, and undermine their major strengths of flexibility and student-centred approach. They argue that traditional evaluative techniques are 'just not possible' and 'risk losing the essence of the support and assistance so necessary for these students'." As the College has no standard maths skills test before the first year commences, there is currently no quantitative way of measuring the effects of the Module. Student engagement with the different topics can be monitored, including test results and the number of retakes. Student feedback on the module and lecturer interviews could be used to capture individual views on the effectiveness of the individual activities and the Module as a whole.

Further research

Due to timing constraints, the third section of the Module, Computing in Business could not be completed. Before the Module can be actually delivered, materials relating to this section would need to be completed. This work is planned to take place during the second half of 2016.

The choice of topics and even entire sections can be revisited at a later stage. This review could be based on student feedback of the Module and individual topics or activities, analysis of engagement data gained from the LMS and subsequent interviews and feedback from members of faculty who teach first year students who have taken the Module.

From a technological perspective, it would be interesting to gather data on the devices used to access the Module: are mobile platforms the new norm or is the Module accessed using more traditional means, like laptop or desktop computers? This information could influence the development of subsequent materials, including size, formats and other aspects.

References

Adams, G.R., Ryan, B.A. and Keating, L., 2000. Family Relationships, Academic Environments, and Psychosocial Development during the University Experience A Longitudinal Investigation. *Journal of Adolescent Research*, *15*(1), pp.99-122.

Berking, P., Haag, J., Archibald, T. and Birtwhistle, M., 2012. Mobile learning: Not just another delivery method. In *Proceedings of the 2012 Interservice/Industry Training, Simulation, and Education Conference*.

Boland, J., 2002, July. The mathematics bridging course at the University of South Australia. In *Proceedings of the Second International Conference on the Teaching of Mathematics*.

Cisco, *Multimodal Learning Through Media: What the Research Says*, accessed 11 January 2016, http://www.cisco.com/c/dam/en_us/solutions/industries/docs/education/Multimodal-Learning-Through-Media.pdf

ExamSupport 2016, accessed 21 March 2016, http://www.examsupport.ie/

Fisher, R., Cavanagh, J. and Bowles, A., 2011. Assisting transition to university: Using assessment as a formative learning tool. *Assessment & Evaluation in Higher Education*, *36*(2), pp.225-237.

Godden, G. and Pegg, J., 1993. Identified problems impeding effective evaluation of tertiary bridging mathematics programs. In *Proceedings of the Sixteenth Annual Conference of the Mathematics Education Research Group of Australasia (MERGA-16)* (pp. 297-302).

Gordon, S. and Nicholas, J., 2013. Students' conceptions of mathematics bridging courses. *Journal of Further and Higher Education*, *37*(1), pp.109-125.

Gordon, S., Petocz, P. and Reid, A., 2007. Teachers' conceptions of teaching service statistics courses.

Griffith College Maths Revision Courses 2015, accessed 21 March 2016, https://www.griffith.ie/offices/schools/services/mathsrevision

Hillman, K., 2005. The first year experience: The transition from secondary school to university and TAFE in Australia. *LSAY Research Reports*, p.44.

Jennings, M., 2009. Issues in bridging between senior secondary and first year university mathematics. In *Proceedings of the 32nd Annual Conference of the Mathematics Education Research Group of Australasia. MERGA32* (pp. 273-280).

Jones, B.D., 2009. Motivating Students to Engage in Learning: The MUSIC Model of Academic Motivation. *International Journal of Teaching and Learning in Higher Education*, *21*(2), pp.272-285.

Jordan, A., Carlile, O. and Stack, A., 2008. *Approaches to learning: a guide for teachers: a guide for educators*. McGraw-Hill Education (UK).

Kantanis, T., 2000. The role of social transition in students': adjustment to the first-year of university. *Journal of Institutional Research*, *9*(1), pp.100-110.

Laplant, Dr., P. (2015). *The Case for Multiple Choice Tests*, edX 2016, accessed 21 March 2016, https://courses.edx.org/courses/course-v1:IEEEx+MCExam01x+2015_T3/

LC Maths 2014, accessed on 21 March 2016, http://maths.gcd.ie/mod/resource/view.php?id=1486

Leventhall, L., 2004, July. Bridging the gap between face to face and online maths tutoring. In *International Congress of Mathematics Education-10, Copenhagen, Denmark*.

Murphy, P. (2010). Changing student attitudes to learning through assessment. Retrieved from http://icep.ie/wp-content/uploads/2010/02/09_7_Murphy.pdf

NFQ QQI 2014, accessed 21 March 2016, http://www.nfq-qqi.com/

Nora, A., 2001. The depiction of significant others in Tinto's “Rites of Passage”: A reconceptualization of the influence of family and community in the persistence process. *Journal of College Student Retention: Research, Theory & Practice*, *3*(1), pp.41-56.

Numbas. (2016). Retrieved March 21, 2016, from http://www.numbas.org.uk/sectors/higher-ed-maths/

O’Dwyer, A. (2012). Experiences of assessment using multiple-choice questions on advanced modules taken by Level 8 and Level 9 engineering students. *AISHE-J: The All Ireland Journal of Teaching and Learning in Higher Education, 4(1)*. Retrieved from http://ojs.aishe.org/index.php/aishe-j/article/view/70

O’Riordan, F. (2014). Improving Learner Retention and Progression June 6th. Retrieved from http://www.teachingandlearning.ie/t-l-scholarship/national-seminar-series/seminar-series-2014/improving-learner-retention-progression-june-6th/

Park, S.Y., Nam, M.W. and Cha, S.B., 2012. University students' behavioral intention to use mobile learning: Evaluating the technology acceptance model. *British Journal of Educational Technology*, *43*(4), pp.592-605.

Poladian, L.E.O.N. and Nicholas, J.A.C.K.I.E., 2013, November. Mathematics bridging courses and success in first year calculus. In *9th Delta Conference on teaching and learning of undergraduate mathematics and statistics* (pp. 24-29).

Ramsay, S., Elphinstone, L. and Vivekananda, K., 2005. Utilising an Organisational Learning Model to Improve Student Retention at Griffith University.

StudyHub 2016, accessed 21 March 2016, http://studyhubdata.com/exams/view/2

Thinkhouse. Irish Mobile Youth Report 2014. Retrieved from http://thinkhouse.ie/downloads/mobilereport/Full-Report-Thinkhouse-Mobile-Youth-Survey.pdf

Tinto, V., 1988. Stages of student departure: Reflections on the longitudinal character of student leaving. *The Journal of Higher Education*, pp.438-455.

UC Davis, *Move to Canvas*, accessed 23 February 2016, <http://movetocanvas.ucdavis.edu/home/frequently-asked-questions/>

White, R.M., 1958. Student Handbooks: Observations and Recommendations. *The Personnel and Guidance Journal*, *37*(1), pp.43-46.

Wintre, M.G. and Yaffe, M., 2000. First-year students' adjustment to university life as a function of relationships with parents. *Journal of adolescent research*, *15*(1), pp.9-37.

Yardi, S. and Bruckman, A., 2007, September. What is computing?: bridging the gap between teenagers' perceptions and graduate students' experiences. In *Proceedings of the third international workshop on Computing education research* (pp. 39-50). ACM.

Appendix 1 – Module descriptor

Stage	1
Semester	1
Module Title	Computer Science Fundamentals
Module Number/Reference	1
Module Status (Mandatory/Elective)	Mandatory
Module ECTS credit	5
Module NFQ level (only if applicable)	6
Pre-requisite Module Titles	N/A
Co-requisite Module Titles	N/A
Is this a capstone module? (Yes or No)	No
List of Module Teaching Personnel	

Contact Hours				**Non-contact Hours**			**Total Effort (Hours)**
Lecture	**Practical**	**Tutorial**	**Seminar**	**Assignment**	**Placement**	**Independent work**	
				10		90	100

Allocation of Marks (Within the Module)

	Continuous Assessment	**Project**	**Practical**	**Final Examination**	**Total**
Percentage contribution	100%				**100%**

Intended Module Learning Outcomes

On successful completion of this module learners will be able to:

1. Solve problems relating to fractions and ratios
2. Apply trigonometric functions to simple problems
3. Define the concept of indices and logs
4. Explain the laws of simple mechanics
5. Define logic operations
6. Identify the roles of computing in business

Module Objectives

This module will provide the learner with the fundamentals to start their studies in computing science. The module consists of three components: maths, physics and business. The maths component gives a grounding for subsequent programming modules. Physics supports the computer architecture and networking modules. Business supports the business oriented modules.

Module Curriculum

Maths

- Ratios
- Fractions
- Trigonometry
- Trigonometric functions
- Powers
- Logs

Physics

- Laws of motion
- Acceleration and gravity
- Electronics

Business

- Applications of computing
- Business models
- Cloud computing

Reading lists and other learning materials

Recommended reading

Stallings, W., *Computer Organisation and Architecture (8th 'Edition),* Prentice Hall, 2010

Coppel, William A., *Number Theory: An introduction to mathematics*. Springer Science & Business Media, 2009.

Velte, Toby, Anthony Velte, and Robert Elsenpeter. *Cloud computing, a practical approach*. McGraw-Hill, Inc., 2009.

Secondary reading

Tanenbaum A. S., *Structured Computer Organisation (5th Edition)*, Prentice Hall, 2006

Module Learning Environment

Accommodation

Lectures are delivered on the online learning platform (Moodle) of the College. Materials available include video presentations, slideshows, notes and quizzes.

Library

All learners have access to an extensive range of physical and electronic (remotely accessible) library resources. The library monitors and updates its resources on an on-going basis, in line with the College's Library Acquisition Policy. Lecturers update reading lists for this course on an annual basis as is the norm with all courses run by Griffith College.

Module Teaching and Learning Strategy

The module will be delivered through a combination of online videos, note sets and practical worksheets and demonstrations. Self-assessment quizzes will be available after sets of topics.

Module Assessment Strategy

The module assessment consists of a series of continuous assessments and a final examination. All assessments are delivered online.

Element No	Weighting	Type	Description
1	0%	Quizzes	A series of after-topic self-assessment quizzes
2	100%	Final test	End of module examination (online multiple choice quiz)

The quizzes will be based on assessing material covered in the previous topics. The end of module exam assesses the learners overall understanding of the material.

Appendix 2 – First year BSCH Module Learning Outcomes

MODULE 1 COMPUTER PROGRAMMING

Learning Outcomes

1. solve programming problems of modest complexity in a systematic, well organised way
2. specify precisely the syntax and semantics of a programming language construct
3. select an appropriate program construct (or datatype) to achieve a given task
4. document accurately the design of a program on-the-fly
5. determine the basic efficiency of an algorithm
6. reproduce in detail the design and analysis of a range of standard algorithms
7. design a systematic suite of tests for a given program and implement it
8. prepare the text of a program in a well-formatted, conventional manner and develop these programs using an integrated development environment

MODULE 2 FOUNDATIONS OF COMPUTING

Learning Outcomes

1. solve simple problems effectively using a selection of algorithmic techniques such as invariants
2. reason algebraically in a calculational style with Boolean expressions
3. use concepts and notations of discrete maths to formulate simple models and reason about them by calculation
4. apply calculational techniques effectively to a selection of problem domains in computing
5. explain using vivid examples the underlying ideas of computation, and outline how they can be modelled mathematically
6. implement programs to solve certain mathematical problems

MODULE 3 I.T. IN SOCIETY

Learning Outcomes

1. explain the development of commercial computing and the relationship between data, information and knowledge
2. discuss the emergence of e-Commerce and the resulting technologies
3. analyse the differences, similarities and tensions between electronic and traditional commerce
4. explain the characteristics of decision making and the information needs to support decisions at the various levels though an organisation
5. analyse the contribution of e-Business technologies to strategic objectives
6. demonstrate competent skills in the use of e-Business technology
7. prepare and deliver a presentation using word processing and presentation software
8. demonstrate an understanding of ethical issues in the I.T. industry

MODULE 4 BUSINESS INFORMATION SYSTEMS

Learning Outcomes

1. explain the hardware and software components of an information system
2. discuss the need for information systems to incorporate consideration of people processes and procedures
3. explain the reasons organisations may initiate information systems developments
4. discuss the various means to finance development of information systems within organisations
5. describe how information systems projects may be monitored for performance against resource usage

MODULE 5 COMPUTER HARDWARE

Learning Outcomes

1. demonstrate the ability to convert numerical data from one format to another
2. design and simplify logic circuits using Boolean algebra and Karnaugh maps
3. identify and describe the internal hardware architecture and system software of a computer and illustrate how these components function and interact
4. distinguish between the architecture of various processors
5. disassemble and reassemble a modern PC competently and install and configure new hardware on a PC while implementing health and safety procedures
6. identify the different devices and device drivers used in a modern PC
7. practise fault analysis and formulate possible solutions

MODULE 6 SYSTEMS SOFTWARE

Learning Outcomes

1. design and implement simple assembly language programs
2. describe the phases of program translation between source code to executable code
3. analyse different addressing modes
4. discuss the history of programming languages
5. explain the requirements of a multitasking system
6. distinguish between user and system modes; discuss system calls and interrupts
7. identify the concepts behind virtual machines and their benefits
8. install and examine modern operating systems

Appendix 3 – Course outline

1. Maths
    a. Topic 1 - Ratios
        i. Video - Ratios
    b. Topic 2 - Fractions
        i. Video - Fractions
    c. Knowledge Check - Topics 1-2
    d. Topic 3 - Trigonometry
        i. Slides - Trigonometry
        ii. Practice - Trigonometry
    e. Topic 4 - Trigonometric functions
        i. Slides - Trigonometric functions
        ii. Practice - Trigonometric functions
    f. Knowledge Check - Topics 3-4
    g. Topic 5 - Powers
        i. Slides - Indices, powers
        ii. Practice - Fractional powers
    h. Topic 6 - Logs
        i. Slides - Logs
        ii. Practice - Understanding logs
        iii. Practice - Logs - Change of base
    i. Knowledge Check - Topics 5-6
2. Physics
    a. Topic 7 - Laws of motion
        i. Slides - Laws of motion
    b. Topic 8 - Acceleration and gravity
        i. Practice - Gravity
        ii. Practice - Speed and gravity
    c. Topic 9 - Electronics in computing
        i. Slides - Logic gates
        ii. Practice - Logic circuits
    d. Knowledge Check - Topics 7-9
3. Computing in Business (to be developed)
    a. Topic 10 - Applications of computing
    b. Topic 11 - Business models
    c. Topic 12 - Cloud computing
    d. Knowledge Check - Topics 10-12

Appendix 4 – Ethics approval form

This form should be completed by the researcher (with the advice of the research supervisor), for all research which involves human participants.

Research Title	Bridging course for first level computing science students
Researcher(s)/Student	Tamas Csillag (2887204)

Part (a)

		Yes	No	N/A
1	Will you describe the main research procedures to participants?	X		
2	Will you tell participants that their participation is voluntary?	X		
3	Will you obtain written consent for participation?		X	
4	If the research is observational, will you ask participants for their consent to being observed?			X
5	Is the right to freely withdraw from the research at any time made explicit to participants?	X		
6	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	X		
7	Will you debrief participants at the end of their participation?		X	
8	Will your research involve discussion of topics which the participants might find sensitive?		X	
9	Will financial inducements (other than reasonable expenses or compensation for time) be offered to participants?		X	
10	Will your project involve deliberately misleading participants in any way?		X	
11	Is there any realistic risk of any participants experiencing either physical or psychological distress or discomfort?		X	
12	Does your research involve participants who are particularly vulnerable or who may feel unable to give informed consent e.g. prisoners; children; people for whom English is not their first language; learners in a programme you teach on?		X	
13	Will any non-anonymised and/personalised data be generated and/stored?		X	

If you answered YES to any of questions 8 to 13 please complete Part (b) of this form. If there are any other ethical issues that you think the Committee should consider, please explain them in Part Two of this form. It is the researcher's obligation to bring to the attention of the Committee any ethical issues not covered on this form.

Part (b)

For each question 8 to 13 that you answered YES, please give a summary of the issue and action to be taken to address it (no more than 300 words in total):

Signed (by Researcher): *Tamás Csillag*

Date: 29/09/2015

Appendix 5 – Mobile App

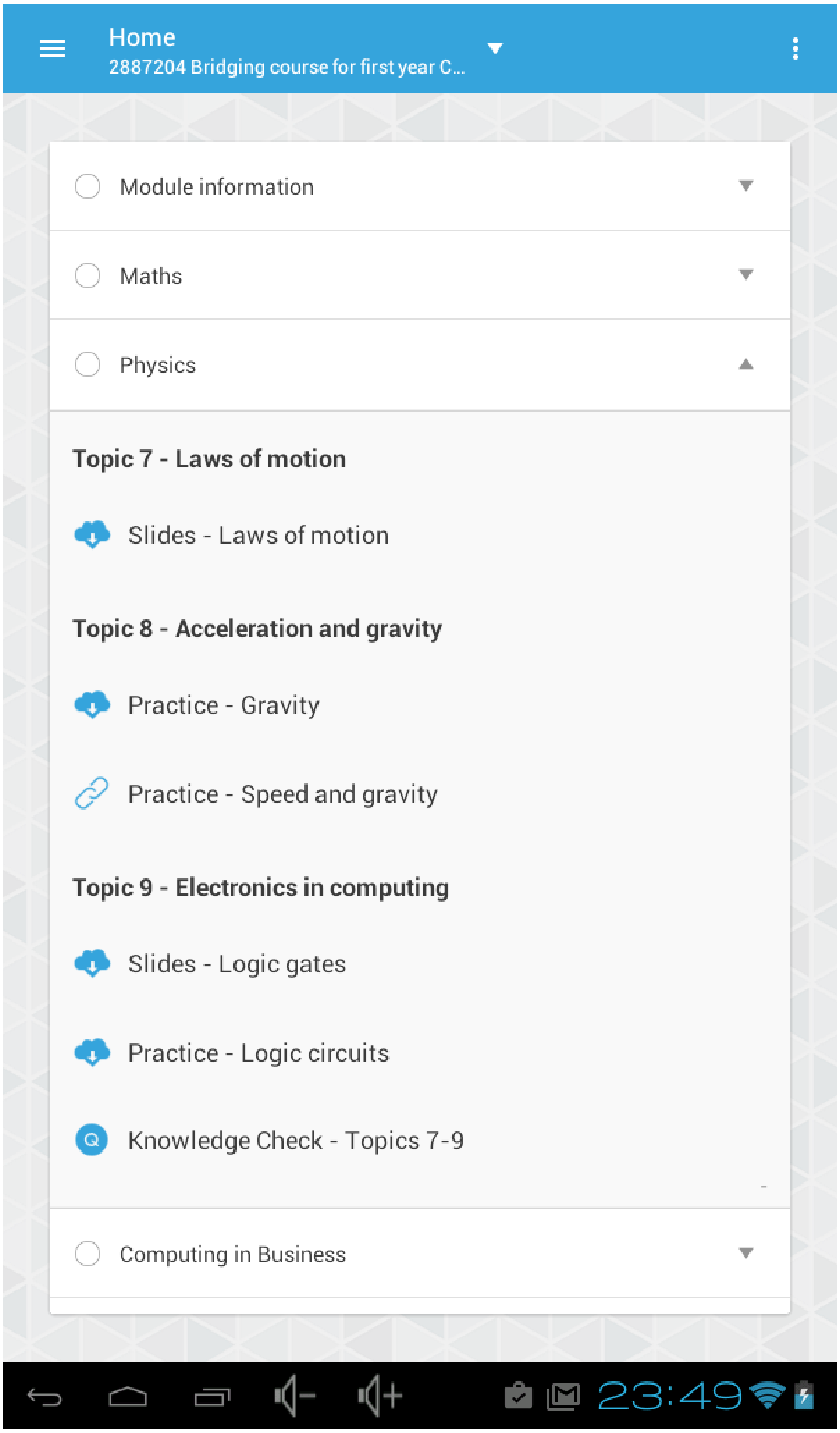

Figure 2: The module with the Canvas app on Android