2. Mathematics Preparedness Course

The mathematics preparedness course is a two-week non-credit course, which has been offered in the summer to incoming first-year students since 2007. The purpose of the course is to better prepare students for university calculus courses. It provides intensive training in fundamental mathematics skills that are essential for the success in university calculus courses. The materials covered include algebraic manipulations, inequalities, and functions including trigonometry functions and inverse functions. The course is targeted toward students who do not have a solid background in mathematics or are not confident about their mathematics knowledge. It is intended to assist these students for a smoother transition from high school to university. It also provides an opportunity for students to get used to the learning environment and instruction style in the university.

2.1. Course structure

The course usually runs for two weeks during late summer. The paper focuses on the results of summer 2012, where three identical sections were offered to accommodate 117 students in total. This number represented 8% of the total number of students who were required to take one of the calculus courses in the following semester. Students in each section met three times per week for three two-hour lectures, and were required to complete three assignments and a final assessment. Although it was a non-credit course, students' performance were nevertheless evaluated based on their performance on the assignments and exam. In addition to their final grade, students were also given verbal comments on their progress shortly after they completed the final exam.

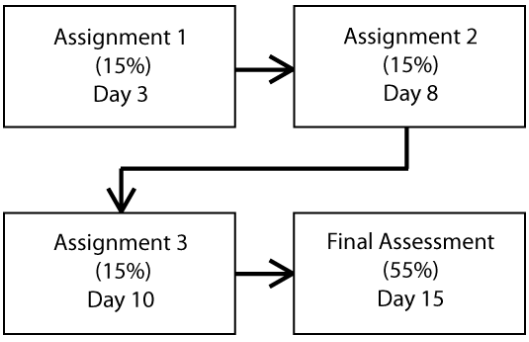

Figure1. Timeline of the course components

Supplementing lectures, 24 hours of small-group consultation sessions were made available to students each week. These consultation sessions were run by teaching assistants. Students were encouraged to take advantage of these sessions for help on written assignments or with questions in the course manual.

2.2. Instructional design

A growing number of educators argue that the effective approach to learning mathematics should be based on the constructivist learning model [1, 2], where students are actively involved in the learning process. In this model, instructors are considered facilitators rather than dispensers of knowledge, and students construct their own knowledge through realistic exercises and social interactions.

In the mathematics preparedness course, various collaborative learning techniques [3, 4, 5, 6] are employed to facilitate a constructivist learning environment. Interactive lectures and consultation sessions are designed to mimic mathematical thinking and communication within the discipline and to facilitate learning. Extensive small-group consultation sessions are incorporated in the course to cultivate learning through interactions between students and the teaching assistants. Furthermore, plenty of group activities are included in the lecture sessions and during small-group consultations to promote interactions between students and to foster active and thorough learning of the material.

One example of such collaborative activities is using a Three-Step Interview Technique to encourage students to exchange information, ideas, and opinions in an open and enjoyable learning environment. This technique starts with the students forming a group of three, with designated roles: interviewer, responder, and recorder. Based on a topic or question provided by the instructor, the interviewer poses a question to the responder, who provides an answer, while the recorder takes notes. Roles rotate after each 10-minute interview. The cycle is repeated until each student in the trio has been in each role (3 cycles). This is particularly useful for helping students network and improve their communication skills.

Activities such as the one mentioned above help students formulate ideas, learn to communicate clearly, and practice to be attentive and respectful listeners. In addition, students learn the concepts more deeply and will remember them for a longer period of time. The collaborative activities help students to connect what they hear and what they say to knowledge they already possess [8, 9].

Students are also strongly encouraged to be inquisitive. As it is argued in [7], "Questions help us construct knowledge. They point to holes in our memory structures and are critical for indexing the information that we attain when we develop an answer for that inquiry." Questions also provide an excellent guide for the instructor to elaborate on concepts and provide more interesting and relevant examples on the spot. Additionally, students'

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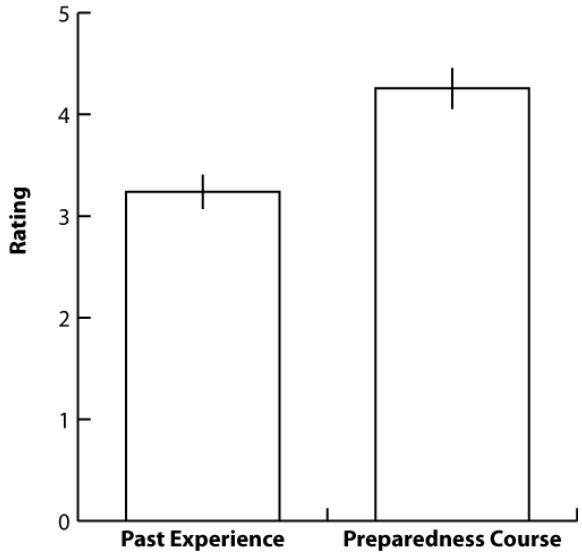

Figure 5. Improvement in students' learning experiences in mathematics

The post-survey also showed that 84% of the students expressed that the course helped them adjust to the learning environment in the university, allowing an easier transition between high school and university.

5. Conclusions

The Math & Statistics Learning Centre at the University of Toronto Scarborough offers a two-week mathematics preparedness course to facilitate incoming students' readiness for university calculus courses. In this study, the effectiveness of the course in summer 2012 was evaluated.

The course was able to target students with a weak mathematical background, and was found to have a positive impact on these students' readiness for the university calculus courses. After merely two weeks of training, students' fundamental mathematical skills improved significantly. They also became more confident in their skills following completion of the course. Hence, this summer program is proven effective in placing students in a better position for their first-year calculus courses.

In addition to improvements in students' mathematical skills, the course was also found enjoyable and was rated positively. Students also expressed that the course helped them adjust to the transition from high school to university.

Finally, the course was able to increase the chance of success in students' first-year calculus courses. A higher passing rate was observed in students who underwent the preparedness course compared to students who also had a poor mathematics foundation but did not take the preparedness course. As a follow-up, we tracked the performance of a small sample of the students in the course in one of the first-year calculus classes offered at UTSC in the following semester. Out of the 31 students we were able to track, 24 of them (77%) eventually passed the calculus course. The passing rate is substantially higher than the 50% rate expected from students who received less than 70% on the diagnostic test.

Acknowledgment

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