Chapter 4
The impact of interactive engagement methods on students’ academic achievement

Abstract
Interactive engagement (IE) is a process that promotes students’ conceptual understanding through activities, combined with immediate feedback from peers and/or lecturers. The present study investigates the impact of IE on students’ academic performance, using the comprehensive model of educational effectiveness. Engineering students (n = 158), randomly divided into three groups (self-assessment, collaborative learning, and control) provided the study data on questionnaires, as well as with their test scores. Analyses of covariance reveal significant differences across groups, along with significant interaction effects. These findings have notable implications for improving students’ academic achievement.

This chapter is based on:
4.1 Introduction

To promote students’ conceptual understanding of various topics, interactive engagement (IE) processes seek to provide immediate feedback from peers and/or lecturers on the students’ performance on various activities (Hake, 1998). During lectures, engaging in activities can encourage students’ participation, because the activities stimulate their critical thinking, demand interactions with other students, and should lead to more deep learning. That is, IE encourages active participation between students and lecturers, as well as among students themselves, throughout the entire learning process. According to extant findings, interactively engaged students learn more, retain more information, and enjoy learning more than students who are not interactively engaged (Barkley et al., 2005; Davis, 1999; Dowson & McInerney, 2001; Schulman, 2002). Furthermore, students who are actively engaged dedicate their attention, time, and energy to the learning process (Kuh, 2003), such that student engagement offers an excellent predictor of actual learning (Carini, Kuh, & Klein, 2006).

Educational institutions generally measure student success according to their academic performance. In turn, multiple studies show that IE methods improve student performance, which is, the ultimate aim of any educational institution (Bernhard, 2000; d'Inverno et al., 2003; Felder, 2011; Felder & Silverman, 1988; Hake, 1998, 2007; Handelsman, Briggs, Sullivan, & Towler, 2005; Leese, 2009; Mazur, 1997, 2009; Ullah & Wilson, 2007). In this study, we test this link further by considering self-assessment and collaborative learning as potentially effective indicators of IE methods. Gokhale (1995) defines collaborative learning as a teaching method in which students work together in small groups to attain a common goal. Thus, students seek a better understanding of the content and attempt to complete activities assigned to them in their groups using collaborative techniques. These efforts should have positive effects, because knowledge building occurs when students develop arguments and negotiate their ideas with peers (Dillenbourg, 1999; Vrasidas & McIsaac, 2001). Self-assessment methods instead refer to a process where students evaluate their own work for learning to improve their performance. These tactics should increase students’ academic performance (Chappuis & Stiggins, 2002; Klenowski, 1995; Rolheiser & Ross, 2000; Ross, 2006), because active
engagement in self-assessment activities likely increases students’ motivation (Wessels, Fries, Horz, & Effelsberg, 2007). Thus, we predict that through these teaching methods, students collaborate and construct their own understanding of content, which improves their academic performance.

Despite widespread support for such methods, universities that experience the ongoing need to adjust to increasing student enrolment (Laurillard, 2008) may worry that vast student bodies and large, lecture-style classes are unsuited to the application of IE methods (Nicol & Boyle, 2003). However, Guthrie and Carlin (2004) argue that improved educational technologies, emerging in recent years, actually enable large groups of students to remain actively engaged in the classroom during the learning process. These technologies include learning management systems such as Blackboard and personal response systems known as clickers (among others). In this sense, we expect that IE methods can improve participating students’ academic performance, irrespective of class size. With this study, we investigate specifically the impact of interactive engagement methods (self-assessment and collaborative learning) on students’ academic performance; we also consider whether these effects might be mediated by self-efficacy, task value, time spent on the task, and self-regulation.

4.2 The conceptual model

We propose a conceptual model to help explain the mechanism by which IE exerts a significant effect on students’ academic performance. To test each of the variables in the model, we conducted an experiment that reflects the principles proposed in the comprehensive model of educational effectiveness (Creemers & Kyriakides, 2008) and its four levels: student, classroom, school and context. For this study, the focus is on the classroom and student levels, which pertain most closely to students’ learning and the attainment of academic performance. The model by Creemers and Kyriakides (2008) specifically indicates that students’ academic performance depends on their aptitudes, social background, motivation, time spent on the task and opportunities used. We add self-assessment and collaborative learning to refer to the quality of teaching; in addition, the model features self-regulation, because students likely need sufficient self-regulation to improve their academic performance. The effect of self-regulated learning depends on
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The levels, and the optimal level varies from year to year. For example, it is unlikely that first-year students can self-regulate their learning as fourth-year students would. However, the different levels of self-regulated learning are beyond the scope of this study.

Instead, we propose the conceptual model illustrated in Figure 4.1, which anticipates that IE methods have both direct and indirect effects on students’ performance. Specifically, IE methods should have a positive effect on motivation, which in turn exerts a positive effect on time spent on the task and self-regulation and thus leads to improved academic achievement.

Figure 4.1: Conceptual model

The theory underlying this proposed model states that a high level of IE improves academic performance. However, for IE methods to be effective, students need to exhibit sufficient levels of motivation (self-efficacy and task value), spend time on the task, and engage in self-regulation. Therefore, this study features challenging, motivating, achievable activities, required of students who have been equipped with the skills to carry out the activities. As a result, they should be sufficiently confident in their ability to complete the activities. In addition, students received encouragement to construct their own understanding of the content in discussions. These activities and discussions prompted students to self-regulate, because they had to prepare in advance to participate actively in the discussions. Furthermore, students had enough time in class to engage in
these activities and discussions. Thus, the mediating variables, which we discuss next, should reveal the effectiveness of IE methods for improving academic performance.

4.2.1 Motivation
Motivation may best explain individual performance in a learning process (Radovan, 2011), such that it also likely leads to the attainment of improved academic performance. Students invest effort in accordance with their beliefs, attitudes, and assessments of their own skills and ability to complete the task (Bandura, 1997; Clark & Sugrue, 1990; Keller, 1987). Clark and Sugrue (1990) propose three motivational concerns that students consider before they are willing to continue with a task. First, is the task interesting enough for students to engage with it? For this study, we designed challenging but achievable tasks that connected the content to students’ likely future work situations, such as the following: ‘The energy capacity of your specimen can be estimated from the area under force-elongation and stress-strain curves. Devise graphical and numerical methods for estimating these areas’. Although this activity relates to both the coursework and potential work situations, students still might not value the task if it is not interesting enough for them to like it.

Second, what skills do students need to carry out the task? For this study, the student participants should have had the skills to perform the assigned activities, because the content has already been discussed in class, and they had frequent opportunities to ask questions. Thus, students should have known what was expected of them to complete the activity.

Third, with regard to students’ personal estimates of competence, even when students know what they are supposed to do, do they feel competent to perform the activity? Self-efficacy beliefs affect the level and type of goals students adopt, which in turn affects their performance. Challenging goals increase motivation and goal attainment (Locke & Latham, 2002), and people with high self-efficacy tend to remain committed to highly challenging goals (de Ridder & de Wit, 2008). Self-efficacy even may have a stronger effect on academic performance than other motivational beliefs (Pintrich & De Groot, 1990; Wang & Wu, 2008). For this study, we sought to instil confidence in students by establishing positive expectancies for their success. The focal lecturer also acknowledged students’ efforts to perform the task by offering substantial feedback, which helped the
students realise that the activities were worth doing. They then continued to study to complete the next activities, which ultimately should lead to academic achievement.

4.2.2 Self-regulation

Baumeister and Vohs (2007) define self-regulation as a process of changing behaviour to pursue certain goals. They argue that effective self-regulation requires a clear, well-defined standard. For this study, we set definitive standards for students to represent their academic achievement. In particular, monitoring in the form of self-assessment activities, discussions and formal tests verified that students conformed with the stated standards. Yet even with such monitoring, students may fail to self-regulate if they lack the motivation to reach their goal (Baumeister & Kathleen, 2007). That is, motivation is critical to self-regulation, because it influences variables that come into play as students strive to regulate their behaviours (de Ridder & de Wit, 2008). As a result, students with an optimal level of self-regulation and high levels of self-efficacy should be more confident in their abilities and more internally motivated (Pintrich et al., 1991; Radovan, 2011). In contrast, less motivated students are often reluctant to make self-regulatory efforts to improve their academic performance.

4.2.3 Time spent on task

Most students can improve their academic performance to a desirable level if given enough time (Carroll, 1963). Students thus need to feel competent to perform a task within an allocated time (Zimmerman, Bandura, & Martinezpons, 1992). However, poor time management may signal insufficient self-regulatory processes. According to Terry and Doolittle (2008), time management is a key strategy for successful academic performance; Zimmerman et al.’s (1992) argument implies that the combination of the following variables should exert additional positive effects on academic performance:

1. Sufficient time spent on task, combined with self-regulated learning;
2. Sufficient level of self-efficacy, combined with self-regulated learning; and
3. Sufficient time spent on task combined with self-efficacy.
Creemers and Kyriakides (2008) argue that spending time on learning tasks alone cannot satisfactorily explain academic performance. Realistically, spending time on both learning tasks and content should more convincingly explain students' performance. Therefore, the measure of time spent on tasks in this study included self-assessment activities, content material uploaded onto Blackboard, and class attendance. In accordance with prior literature, students with high academic performance likely exhibit higher class attendance (Cheung, 2009; Marburger, 2001; Moore, 2003). Ledman and Kamuche (2002) also indicate that students with better attendance performance demonstrate more knowledge of the course material.

Finally, gender may have an impact on academic performance in higher education. Therefore, gender appears as a covariate in the model (Figure 4.1).

On the basis of the theoretical framework, we propose the following main and interaction hypotheses:

H1. Interactive engagement (self-assessment activities and collaborative learning) has a direct, positive effect on students' academic performance.

H2. There is an interaction effect of time spent on task with self-regulation, such that the combination of sufficient self-regulation and sufficient time spent on the task results in higher academic performance levels.

H3. There is an interaction effect of self-efficacy with self-regulation, such that the combination of sufficient self-regulation with sufficient self-efficacy results in higher academic performance levels.

H4. There is an interaction effect of time on spent task with self-efficacy, such that the combination of sufficient time spent on task with sufficient self-efficacy results in higher academic performance levels.
4.3 Methods

4.3.1 Participants
This study involved 158 engineering students in their second semester at a higher learning institution in Gauteng, South Africa. Of the 158 students, 56% (N = 88) were male students and 44% (N = 70) were female students. Students completed the questionnaires at the beginning and the end of the study. They also completed and signed consent forms, as required by the university’s Ethics Committee.

4.3.2 Instruments and measurements
The data pertaining to the self-efficacy, task value (motivation), time spent on task, self-regulation (metacognitive strategies), and students’ test scores variables were collected from the students. Cronbach’s alpha values served to identify the internal consistency of the variables (see Table 4.1). The scales for motivation and metacognitive strategies exhibited good internal reliability. However, the reliability of the class test was lower, with an internal reliability of .62.

Table 4.1: Descriptive statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Number of Items</th>
<th>Number of Participants</th>
<th>Mean</th>
<th>SD</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-efficacy</td>
<td>8</td>
<td>153</td>
<td>29.54</td>
<td>3.71</td>
<td>.85</td>
</tr>
<tr>
<td>Task value</td>
<td>6</td>
<td>155</td>
<td>21.57</td>
<td>2.77</td>
<td>.80</td>
</tr>
<tr>
<td>Time spent on task</td>
<td>2</td>
<td>158</td>
<td>6.39</td>
<td>1.53</td>
<td>-</td>
</tr>
<tr>
<td>Self-regulation</td>
<td>12</td>
<td>156</td>
<td>41.80</td>
<td>4.38</td>
<td>.84</td>
</tr>
<tr>
<td>Class test for the three groups</td>
<td>6</td>
<td>158</td>
<td>55.87</td>
<td>11.01</td>
<td>.62</td>
</tr>
</tbody>
</table>

To measure motivation, we adopted two dimensions from the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al., 1991): self-efficacy and task value. The self-efficacy scale consists of eight items (e.g. ‘I expect to do well in this course’), whereas the task value scale consists of six items (e.g. ‘It is important for me to learn the course material’). To measure metacognitive strategies, we relied on the self-
regulation aspects of the MSLQ, with twelve items (e.g. ‘When I study for this course, I set goals for myself in order to direct my activities in each study period’). These ratings used seven-point Likert scales, on which 1 indicated ‘not at all true of me’ and 7 indicated ‘very true of me’.

The measure of the time spent on the task featured two questions. At the beginning of the study, students indicated the time they anticipated spending to study and complete assignments for this specific course and the number of lectures they would attend. At the end of the course, two open-ended questions asked students about the time they really did spend on the course: ‘On average, how many hours per week did you spend on studying and doing assignments for this course?’ and ‘How many lectures did you attend for the past six weeks?’ To measure academic performance, we used two tests (pre- and post-test); we present the mean scores subsequently, in Table 4.5.

4.4 Study design and procedure

The Physical Metallurgy semester II course is structured such that students attend lectures three times a week, for two hours each. In a special arrangement, 40 minutes of each class was devoted to this study, and the remaining time involved practical work. For this research, we split the students randomly into three groups: self-assessment, collaborative learning and the control group, and each group had a chance to attend a lecture once a week. Although all the groups received content material in Blackboard, during face-to-face lectures and in computer laboratories, they were restricted in some learning opportunities, as indicated by ‘0’ in Table 4.2.

Table 4.2: Students’ access to learning opportunities

<table>
<thead>
<tr>
<th>Learning opportunities</th>
<th>Blackboard</th>
<th>Collaborative learning</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group discussions</td>
<td>0</td>
<td>X</td>
<td>0</td>
</tr>
<tr>
<td>Self-assessment activities</td>
<td>X</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

4.4.1 Self-assessment group

In addition to content material on Blackboard, the self-assessment group participated in self-assessment activities for six weeks. That is, in addition to their regular assessments, ten self-assessment activities uploaded on Blackboard served as weekly homework,
released only to the self-assessment group. A discussion platform on Blackboard, which remained available throughout the intervention period, allowed students to seek help from the lecturer and their peers. A computer laboratory, booked daily from 15:00 to 17:00, ensured that students who did not have Internet access at home or lived in university residences had access to the site. Students confronted challenging narrative and multiple-choice questions that required them to create, explain and carry out calculations.

The lecturer used these self-assessment activities and scores to monitor and regulate students’ learning. After completing the self-assessment activities, students received immediate feedback from the system. They had to rework the problem until they got it right, before they could move on to the next problem. Then during classroom sessions, students received formal feedback related to each question; thereafter, all questions remained published on Blackboard for students’ review. From this feedback, students could become immediately aware of the extent to which they still needed help. If they successfully completed the task, they became more confident. Guidance from the lecturer continued but at decreasing levels.

4.4.2 Collaboration learning group

With this approach, students participated in discussions to gain a broad understanding of the activity and to learn from one another. Students often have difficulty concentrating for more than 20 minutes (Boyle & Nichol, 2003; d’Inverno et al., 2003; Masikunis et al., 2009; Mazur, 1997), so all discussions were interspersed with lecture content, as in Table 4.3.

Table 4.3: Time allocation for a 40-minute class session period

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Lesson presentation</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Discussions, including feedback</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Continuation of a lesson</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Another discussion (different question)</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Summary and conclusions (lecturer)</td>
<td>5 minutes</td>
</tr>
</tbody>
</table>
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The lecturer started each lesson with a review of the previous lesson, followed by the actual lesson for the day. After 10 minutes of lecturing, students had 5 minutes to solve a problem, share their responses and receive feedback from the lecturer. After providing feedback, the lecturer continued with the lesson for another 10 minutes, thus repeating the process until the end of the period. This group did not receive any homework. During the lesson, the lecturer served as facilitator, moving physically through the classrooms to visit each group, give guidance on their discussions and monitor which members did not participate, as recommended by Dillenbourg, (1999).

4.4.3 Control group
The control group attended a lecture once a week for 40 minutes, similar to the experimental groups, but received traditional instruction, with content provided through a PowerPoint presentation. Students had access to the computer laboratory and the content material on Blackboard; they also could ask questions during the lecture. Although they did not have access to the self-assessment activities, they received problem-solving explanations from the lecturer in class, during the lesson.

4.4.4 Analysis strategy
We conducted analyses of covariance (ANCOVA) to test for statistically significant associations between the independent variables and the dependent variable, taking the effects of the covariates into account. One of the strengths of ANCOVA is their ability to control for variables that are not part of the main experimental manipulation but still influence the dependent variable. We tested five different models: Model 0, to test for the significance of the difference between the experimental and control group, as well as the pre-test Model 1, covariate Model 2, content Model 3 and interaction effect Model 4.

4.5 Results
We present the ANCOVA results in Table 4.4, including both significant and insignificant effects. The overall model accounted for 83% of the variance in academic performance.
Table 4.4: Analysis model

<table>
<thead>
<tr>
<th>Model Number</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig</td>
<td>F</td>
<td>Sig</td>
<td>F</td>
</tr>
<tr>
<td>Model 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>61.740</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>35.651</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task value</td>
<td>7.598</td>
<td>.007</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time on task</td>
<td>24.794</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-regulation</td>
<td>1.477</td>
<td>.226</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-regulation X time on task</td>
<td>3.307</td>
<td>.071</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy X self-regulation</td>
<td>11.484</td>
<td>.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-efficacy X time on task</td>
<td>2.529</td>
<td>.114</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>18.934</td>
<td>.000</td>
<td>18.820</td>
<td>.000</td>
<td>26.086</td>
</tr>
</tbody>
</table>

Notes: Model 0: \( R^2 = .196 \) (adjusted \( R^2 = .186 \)), Model 1: \( R^2 = .197 \) (adjusted \( R^2 = .181 \)), Model 2: \( R^2 = .428 \) (adjusted \( R^2 = .413 \)), Model 3: \( R^2 = .805 \) (adjusted \( R^2 = .794 \)), Model 4: \( R^2 = .842 \) (adjusted \( R^2 = .829 \)).
4.5.1 Model 0
In the first step, we tested the hypothesis that there would be no performance difference between experimental groups and the control group. The results revealed a significant difference though (see Table 4, bottom row; \( F(2,155) = 18.93, p < .001 \)). The mean scores for each group on the pre- and post-tests appear in Table 4.5.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Number of Participants</th>
<th>Mean Pre-test</th>
<th>Mean Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-assessment</td>
<td>52</td>
<td>46.73</td>
<td>62.15</td>
</tr>
<tr>
<td>Collaborative group</td>
<td>53</td>
<td>43.45</td>
<td>55.30</td>
</tr>
<tr>
<td>Control group</td>
<td>53</td>
<td>45.04</td>
<td>50.26</td>
</tr>
</tbody>
</table>

A post-hoc Tukey's test provided a follow-up assessment of the significance of the differences between the means of the three groups. The post-test mean scores showed that the self-assessment group performed significantly better than the collaborative and the control groups, equally; the collaborative group also performed significantly better than the control group.

4.5.2 Pre-test Model 1
Adding the pre-test scores to the model enabled us to control for pre-treatment differences between the experimental and control groups. The information in Table 4.5 shows that pre-test differences between the experimental and control groups were not significant though (\( F(1,154) = .078, \) n.s.).

4.5.3 Covariate Model 2
When gender entered the model as a covariate, a significant difference emerged (\( F(1,153) = 61.74, p < .001 \)). Female students performed better than their male counterparts in all three groups.
4.5.4  Content Model 3
With this model, we tested the significance of the variables that should have had a positive effect on students' academic performance, namely, self-efficacy, task value, time spent on task and self-regulation. Self-efficacy was significant ($F(1,145) = 35.65, p < .001$), as was task value ($F(1,145) = 7.60, p < .007$) and time spent on task ($F(1,145) = 24.79, p < .001$). However, self-regulation was not significant ($F(1,145) = 1.48, 'n.s.'). The difference across groups remained significant even when moderated by the independent variables ($F(2, 145) = 4.81, p < .009$).

4.5.5  Interaction effect Model 4
To create the interaction variables, we multiplied sets of two variables that might yield additional positive effects on academic performance. The results indicated a significant interaction effect of self-efficacy and self-regulation ($F(1,142), 238.60 = p < .001$). Therefore, the extent to which students regulated their learning had different effects on their academic performance, depending on their level of self-efficacy. In addition, we found a weak but significant interaction effect of time spent on the task with self-regulation ($F(1,142) = 3.31, p = .1$). Thus, the level at which students regulated their learning had a slightly different effect on their academic performance, depending on the time these students spent attending lectures, studying and doing related activities. The interaction of self-efficacy and time on task did not appear significant ($F(1,142) = 2.53, n.s.$).

4.6  Discussion
This study has tested four hypotheses. The results reveal that interactive engagement (IE) has a positive effect on students' academic performance, in line with both the first hypothesis and Hake's (1998) finding that IE approaches are more effective than traditional methods for enhancing students' understanding and academic performance. Frequent uses of IE methods, especially including self-assessment activities in the learning process, oblige students to devote more effort to studying to understand the activities,
which ultimately contributes to their academic performance. Students in the self-assessment group in this study thus achieved a greater increase in their academic performance compared with the collaborative or control groups. The self-assessment group also had an opportunity to engage in two activities per day, which encouraged them to complete the task before the next lecture.

Self-efficacy, a motivational component, contributed most significantly to explaining students’ academic achievement, compared with the other model variables. These results confirm that motivation is the most important explanatory factor for individual performance in the learning process (Radovan, 2011). Time spent on the task offered the next most significant contribution. This predictor variable included three interrelated factors: hours of studying, time spent on the learning task and class attendance. In most cases, if students attend lectures regularly, their chances of missing important content information decrease, so they gain more information, which prompts inquisitive thoughts and encourages them to spend more time on studying and learning tasks.

Increased time spent on the task also improves academic achievement (Kember, Jamieson, Pomfret, & Wong, 1995; Reynolds & Walberg, 1992). The results indicate that students with higher performance scores also scored higher on attendance and hours spent on studying and learning tasks. Previous research (Moore, 2003; Naher, Brabazon, & Looney, 2008; Purcell, 2007), concurs that better lecture attendance improves academic achievement.

Surprisingly, task value was a third significant contributor to academic achievement. This finding implies that students value tasks differently. A challenging, interesting task for some students might not be interesting to other students, for various reasons. This result pertains to a question we asked previously: Do students value the task? Some activities clearly were not interesting enough to create value for students, which suggest the need to redesign these activities. The results also suggest that self-regulation contributed poorly to academic performance. As indicated previously, the effect of self-regulated learning depends on its levels, and the optimal level can vary from year to year. These participants were all first-year students, which may mean they still
needed guidance in how to self-regulate their learning. Further research might include fourth-year students as a comparison group, to determine if their (likely higher) self-regulation levels yield significant effects on academic performance.

The interaction hypotheses received some support. The significant interaction of self-efficacy and self-regulation suggested that the level at which students regulated their learning exerted different effects on academic performance, depending on students' self-efficacy. That is, at the same level of self-regulation, students with greater self-efficacy achieved better academic performance than those with low levels of self-efficacy. Thus, self-regulation was not a notable main effect in this study, but it had an impact in combination with self-efficacy. In addition, the results emphasised Schunk's (1989) assertion that students with the same level of intellectual capability differ in their performance because of their level of self-efficacy, which re-enforces the powerful impact of self-efficacy on academic performance.

The combination of self-regulation and time spent on the task revealed a weak but significant interaction, likely due to the sample size restriction. The time that students spend attending lectures, studying and doing related activities thus had a marginally different effect on their academic performance, depending on the level at which they regulated their learning. In contrast, the interaction of self-efficacy and time spent on the task was not significant. At the same level of self-efficacy, whether students devoted more or less time to attending lectures, studying and doing related activities did not matter for their academic performance. Furthermore, when we included the interaction effects, the main effect of time spent on task no longer explained a significant proportion of the variance in academic performance. We thus reason that time spent on a task does not work well in combination with other variables but functions predominantly as a main effect.

Regarding the role of gender in academic performance, Hyde and Kling (2001) argue that irrespective of the measure of success, women tend to outperform men in higher education. Kim, Rhoades, and Woodard (2003) find that gender is a powerful correlate of graduation at the individual level. The results of our study also suggest that
gender has an important effect for determining students’ academic performance, such that female students perform better than male students. However, correlation analyses indicated that male students spent more time on related activities than female students in this study, in line with previous research (van den Berg & Hofman, 2005). It appears that men spend more time on educational activities but spend their time less effectively. Therefore, gender differences in academic performance reflect of gender differences in study behaviours.

Along with these findings, this study offers some limitations. First, in the self-assessment group, the purpose of the discussion platform was specifically for students to use to seek help. Despite a clear explanation of this purpose, some students used the platform for social networking, which frustrated their peers. As a result, the lecturer occasionally had to remind students of the primary aim of the platform, which was to benefit all students through the questions and feedback posted within the system. Second, the collaborative group included a lot (10) of groups, which made some class discussions difficult, as the lecturer needed to attend to all 10 groups within a very limited time. Thus, the discussions often took longer than the allocated time.

Despite these limitations, this study makes a significant contribution with regard to the effectiveness of IE methods for students’ academic achievement. In particular, it suggests a ranking of factors that make significant contributions to explaining students’ academic achievement: self-efficacy ranks first, followed by time on task.

This study confirms that two levels from the comprehensive model of educational effectiveness (classroom and student) influence participating students’ academic achievement. For example, time on task (student level) depended notably on the time available for learning, which was determined by the lecturer (classroom level). These two factors in turn depended on the quality of the teaching method used to improve academic performance. Thus, both teaching methods used (self-assessment and collaborative learning) appear to have been effective. In addition, students had an opportunity to spend more time learning, which led to improved academic achievement. Therefore, we demonstrate that academic performance depends on more than one level in the comprehensive model of educational effectiveness.
The impact of interactive engagement methods

In conclusion, IE methods improve students’ academic performance. Variables such as self-efficacy, task value and time spent on the task strengthen this influence. Students and lecturers have important roles to play if they hope to achieve students’ academic performance. The cognitive view of motivation emphasises the stimulation of curiosity as a means to motivate students to learn new information (Brennen, 2006; P. R. Pintrich & Schunk, 1996). Lecturers must meet the challenge of designing activities that will inspire students’ inquisitiveness, develop their sense of capability and give them opportunities to share their ideas with other students through group discussions. They also should ensure that students have enough time to spend on the tasks. Equally, students need to play their part by improving their level of self-efficacy and self-regulation, which will lead to their improved academic performance.