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Enhancing Student Performance in Managerial Accounting: A Laptop-Based Active Learning Approach

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Abstract

The main purpose of this study is to examine empirically the effect of a learning approach that combines active learning activities with educational technology tools. This study was conducted in a Middle-Eastern country where English is the second language. Data was collected relating to student performance. The performance of a group of students who were taught using a range of innovative methods was compared with the performance of a control group who were taught using only traditional methods. The experimental group was given a pre-test and a post-test, while the control group had only a post-test. The experiments employed three different learning environments: the traditional approach (TL), the cooperative learning approach (CL), and the Laptop-Based Active Learning approach (LAL). The study concludes that the LAL approach appears to have a significant positive effect on students' performance compared with the other two approaches.

Introduction

For many years the methods used to educate students in accounting have been criticized. There have been repeated calls to incorporate real-life work skills rather than emphasizing the memorization of technical rules (Elliott, 1991; Institute of Management Accountants, 1999; Maher, 2000; Boer, 2000; Burnett, 2003; Dillon, 2004; Kiger, 2004). In response to these criticisms, accounting education researchers have carried out action research to test alternative approaches to the accounting curriculum. For summaries of this research trend see, for example, Herring *et al*., 1989; Watson *et al*., 2003; Paisey and Paisey, 2004.

The majority of studies have investigated separately the effects of two factors on student performance and perceptions: (a) various Active Learning (AL) techniques and (b) the use of modern educational technologies. These studies rarely tested and examined the effect of a combination of these two factors when used simultaneously. The majority of studies reported the application of AL techniques within parts of accounting courses rather than adopting a comprehensive AL approach to the teaching techniques used throughout a course. Research in non-accounting contexts provides ample evidence on the benefits of using AL methods in teaching (Caprariis *et al*., 2001; Dowling *et al*., 2003; Wharton and Parry, 2003). Research also indicates that using technology does not detract from student performance (Becker and Haugen, 2004;Sherrod *et al*., 2000; Moss *et al*., 2003) and that students' reactions to it are positive (Efaw *et al*., 2004).

The present study was conducted in a Middle Eastern country where students speak English as a second language. The experiential teaching methodology described in this paper was applied in a second year foundation course, "Fundamentals of Cost and Managerial Accounting". Normally students taking this course as part of a structured program in accountancy, although some of the students on this course are not majoring in accounting. The students who are not enrolled as accounting majors take the course out of sequence. This delay in taking the management accounting course causes difficulties in learning because of course *sequencing effects* (Bower, 2002). A considerable part of the student population in this course may therefore have a low level of interest and motivation in the course -

which is not a favorable teaching environment. This constituted another reason to look for ways of promoting student enthusiasm towards accounting courses.

The main purpose of this study is to examine empirically the effect of a teaching approach that combines active learning activities with the use of modern educational technology (such as Blackboard and laptop computers) on student performance. We believe that combining various AL techniques with the available educational technology to teach management accounting courses in a more coherent manner will provide students with a better opportunity to acquire and retain the accounting knowledge, and gain the analytical and problem solving skills expected from accounting graduates. In this study we examined the effects of such a teaching approach on student performance. The authors call this comprehensive teaching approach "The Laptop-Based Active Learning" (LAL) approach.

To the authors' knowledge, no previous study has examined the relative effectiveness of the traditional learning approach (TL), the cooperative learning approach (CL), and the laptop-based active learning (LAL) approach on student performance. This study should therefore provide a better understanding of the effect of teaching methods on student performance. Although this study has specific relevance to the environment in the United Arab Emirates (UAE), other countries with similar problems and needs may benefit from the results of this study.

The remainder of this paper is structured in five sections. Section 2 summarizes the related literature on educational technology, the integration of AL with technology, and hands-on techniques. Section 3 describes the model and the learning activities used. Section 4 explains the background of the experiment and experimental design. Results and discussion of the statistical analysis are reported in Section 5. Finally, conclusions, limitations, and suggestions for future work are presented in Section 6.

Literature Review

Studies of active/cooperative learning techniques

Accounting education researchers have examined and reported the use of many AL techniques. Paisey and Paisey (2004) presented a comprehensive analysis of accounting education research published between 1992 and 2001. They concluded that more attention should be paid to the effect of instructional strategies, and the specific educational context within which those strategies were implemented, on learning outcomes. Sharma (1997) concluded that altering accounting students' learning approaches would require altering the learning context to one that encourages understanding rather than reproduction of information.

Leveson (1999), and Lancaster and Strand (2001) experimented with forms of the cooperative learning format in teaching accounting courses and reported positive student responses, but no significant difference in student performance. Possible explanations of these results included deficiencies in the method of performance assessment, the special nature of the accounting courses, and lack of instructor training in using AL techniques.

Studies of the impact of technology on learning

Regarding the impact of educational technology on accounting students' performance, Watson *et al*. (2003) argued that the use of technology in the assessment of student learning remains important area for future accounting education research. Results from experiments with the use of various forms of educational technology in teaching accounting courses seem to indicate that accounting students have a positive attitude towards the use of technology and that using computer technology, at the minimum, will not harm their academic performance (Basile and D'Aquila, 2002; Dowling *et .al*., 2003; De Lange *et. al*., 2003; Fry and Love, 2004; and Kalbers and Rosner, 2003). However, there is a need for the accounting instructors to reflect on their teaching strategies when using a Virtual Learning Environment (VLE) if the benefits expected are to be realized (Fry and Love, 2004). In addition, the real benefits of integrating modern technology in teaching may not be easy to measure over the short term (Kalbers and Rosner, 2003). On the integration of AL techniques with technology, Rainsbury and Malcolm's (2003) analysis revealed that students' reactions were positive. They also reported that students with a non-English background participated more when using an electronic discussion board. Boland *et al*. (2004) pointed out that students who speak English as a second language prefer a computer-assisted learning environment.

Studies of hands-on in teaching accounting

Experiential learning that involves real hands-on experience has been used in teaching business courses (Wharton and Parry, 2003). In accounting, three examples, all in management accounting courses, can be cited where hands-on methods have been used. Lovata (1986), Lightbody (1997), and Kern (2002) each devised a hands-on project for teaching a management accounting topic. All reported a positive response and positive attitudes on the part of

students. Lovata (1986, p. 152) commented that, "Educationally, and most importantly, the project enables the students to visualize the production process, which makes costing easier." Lightbody (1997) found that her students achieved a higher level of comprehension and enthusiasm, while Kern (2002) reported higher student problem-solving skills after using this technique. Nonetheless, Kern found no evidence that the use of such a model enhances conceptual recall over that attained in a lecture-oriented environment.

Studies on other aspects of the learning context

Lucas (2001, p.181) suggested that, "The design of modes of assessment should be reviewed so that students cannot benefit unduly from the adoption of format approaches to learning and are encouraged to adopt a relating approach to learning". Leveson (1999) mentioned that student performance could be affected by assessment grades and the culture shock of the first university year. Other factors such as the grading policy, the assessment tool, and the sequence of the course can all have effects on the measured student performance. Marriott (2002) stated that students change to a deep learning style when given the reason and the opportunity. Thus, it can be seen from the literature that the context of learning and the instructional strategy adopted are two very influential factors that need to be given more attention when new technology elements are introduced into the learning environment. The design of LAL model introduced in this study is based on the previous studies discussed in this section.

The LAL Model

This section introduces the LAL teaching strategy and describes the learning activities used. This section is divided into ten subsections which cover all the major activities used in the course of this experiment.

Theme

The basic idea incorporated into this model is the constructivist learning philosophy. The methodology involves using one or more elements of different teaching, learning, and assessment tools (both technology-based and non-technology-based) and in-class activities with the intention of engaging the students at all times. Engagement here is based on Shulman's definition of "pedagogies of engagement", which means, “Pedagogies that not only *grabbed* students' interest, but ones that also *held* it, pedagogies that led to deep learning" (Rhem, 2002, emphases in the original). In the experimental model for this study, Shulman's (2002) taxonomy was used. The following sections describe the various in-class learning activities.

In-class Factory: Hands-on with Clay

This is a variation and extension of the hands-on models mentioned earlier in Section 2. The instructor brings to class cubes of colored clay. The class is divided into groups of 4-5 students, each simulating a factory that manufactures colorful airplanes and dolls. The instructor plays two roles: the storekeeper for raw materials and the shop floor supervisor. A PowerPoint slide is projected showing the detailed basic data for the manufacturing and costing of the two products. Each group is given a job order to manufacture a number of units of the final product and allocates the manufacturing tasks to its members. Students download and use Excel templates of a material requisition form and a worker time card form from the Blackboard platform. All students are told that this simulated work day is the last day of the accounting period.

Manufactured parts flow from one student to the next, each one keeping a record on their laptop of the time and materials used. The instructor calls an end to the working day and the students deliver the completed units to the storekeeper. Approximately 40-45 minutes of class time is needed for this exercise. The instructor then asks questions and leads the discussion. Topics covered include the number of units produced and the possible application of the just-in-time approach to ordering material. Each section of the discussion is followed by a pause for 2-3 minutes for students to internalize the concept, conduct intra-group discussion, or write notes. When all the questions have been discussed (which may require another class session) students are asked to finalize their solutions and write a summary of their understanding of the concepts and calculations involved.

The educational technology available (e.g. Blackboard, laptop, and Excel) play an important role in this exercise. The laptop provides flexibility in doing fast calculations, especially for the "what if" questions. Also, the e-forms are used again in other activities. From an instructional perspective, this exercise was a time-saver. Many concepts were introduced in an integrated manner. Students' experience with this exercise was recalled and used in other areas of the syllabus. The exercise should help in developing critical thinking, problem solving, teamwork, and computer skills.

Real Product Data: Problem Solving

The actual production process, basic physical production factors requirements, and cost data for two real life products (paper binders and floor cement tiles) were presented by the instructors. PowerPoint slides described in pictures, not words, the production process of each product. Samples of the two products were taken into class for the students to examine. Students were then given the real data in a semi-structured format in an Excel file and were asked to prepare classified cost statements. The same data was used with some modifications for a job-order and process costing systems and decision making situations. Educational technology brought a visual simulation of the manufacturing process into the class to increase students' understanding of cost flows. Although building the animated slides is time consuming, it is an investment that produces a reusable learning tool in subsequent semesters.

Electronic Simulation and Excel
Active Models electronic simulation was used for the presentation of Cost-Volume-Profit analysis classes. The tool allows students to manipulate "what if" questions with a visual experience that should enhance their concept development, deductive reasoning and critical thinking with hands-on experience. For cost behavior analysis, problem solving techniques were used in class, supported by Excel. Classes for both topics start with 15-20 minutes of mini-lecture using traditional PowerPoint technology. Then students use their computers for simulation and problem solving while working in pairs to allow for peer teaching.

In-Class Summary Writing
Several pauses are used in most classes regardless of the teaching technique used. During those pauses, each student was asked to write either a question about the class subject, or a short summary of what was understood from the material just completed. Students' questions were discussed in class and some student summaries were read to the class. This served as a tool for improving reading/writing communication skills, reflection on and internalization of concepts learned, and a chance for the instructor to see where misunderstanding existed.

Animated PowerPoint
For crucial concepts that required an explanation of relationships and levels of analysis, a small number of animated PowerPoint slides was developed. The slides were designed to be used in class discussions as an oral jigsaw or electronic tutorial where parts appear on the screen after students answer a critical thinking question requiring them to use their inventory of knowledge to extract a new piece of information, discover a link between concepts, or a step in a method of calculation. This tool served as a critical thinking exercise for cost flow, cost behavior concepts, and cost statements.

Intra-term Group Projects
Each group of students was asked to choose a real life product; anything was acceptable, from soft drinks to aircraft. Each group was required to:

- Discover and then describe the process for manufacturing the product.
- List all resources required.
- Translate resource requirements into classified cost figures. Students may use fictitious but realistic estimates.
- Try to apply at least one of the concepts studied to this product (Cost-Volume-Profit, job-order accounts, pricing decisions, etc).
- Write a final report and prepare a class presentation on the product.

Students normally used the internet and the e-form templates downloaded previously (see Section 3.2). The laptop had to be used in preparing their presentations. The availability of continuous communication between students through the Blackboard e-mail and digital drop box facilitated group work. The group project served as an important cooperative learning tool for developing students' research writing and critical thinking skills.

Web Search
Students were asked to search the web for specific sites or information during class. This internet exercise introduced students to accounting related web sites and to real life information about various firms and products. Without the availability of the laptop and internet access in the classroom, this activity would not have been possible.

Discussion Board
A discussion board is normally considered an asynchronous learning activity. However, it was also used in the classroom. On Blackboard, a forum for each chapter was created in which a new thread, including critical thinking question(s), was added and students were asked to submit answers. This method allows students to see all the submitted answers. To maximize the benefit, a few answers were randomly selected, and the students were asked to brief the class about his/her idea(s). This required students to be well prepared and ready for discussion.

Games
A game was adapted to the course materials to improve students' knowledge, critical thinking, and communication. The game, "who is the best," was conducted at a class group level with marks awarded to the winning group. The two rounds of the game included two types of questions. One required recall of concepts, methods, and processes. The second related to the use of abstractions in particular and concrete situations such as technical principles, ideas, and theories. Answering all questions correctly in the first round allowed the group(s) to move to the second (final) round where the winning group(s) was (were) determined. Students played this game with enthusiasm and found it very useful.

Research Methodology

Background
The college is laptop-based and uses a VLE (Blackboard), with all classrooms equipped with wireless internet. All students have laptop computers. The student population consists of an overwhelming majority of students who speak English as a second language with a small minority of international students. The teaching and assessment in all courses is in English. Class duration is 80 minutes, twice a week. The two instructors taught the course several times before implementing this experiential approach. Both have long teaching experience and have attended several training workshops for AL techniques provided by prominent AL experts.

In order to avoid the problems that Leveson (1999) mentioned in relation to the use of assessment grades, the grading policy for this experiment was designed to test and motivate AL activities. In addition we accepted Michaelson and Black's (1994) suggestion to distribute course grades over the major performance areas. Therefore, the course grading was distributed as follows:

- 20% for on-going term projects that included a field project with written and oral presentation (10% for teamwork and 10% for individual contribution)
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- 30% for other class work including quizzes, participation in discussions, in-class problem solving, discussion board participation, games, etc. (10% for individual, 10% for team, and 10% for individual contributions).
- 20% for the Mid-term exam (individual)
- 30% for the Final exam (individual)

The learning environment model was designed to change the students' learning style and encourage a deeper style of learning. The intention was to make it clear to the students that surface learning was not enough to pass the course and that the teaching methodology would be different. This was achieved by communicating the redistribution of grades to the students, coupled with a variety of in-class learning activities.

The Experimental Design
The experimental design involved a treatment group and a control group which were selected randomly from the 2004 academic year. The groups were similar in terms of the mean class size, student GPA, gender, and English language skills. The control group received the TL approach only, while the treatment group received the TL, the LAL, and the CL approaches. Table 1 summarizes the three approaches which were used as follows:

- The TL involved one way instructor-centered teaching. This learning environment was used with the treatment group (for course material No. 1, Chapter 1) and with the control group (for all course materials).
- The CL involved non-IT group activities only. This learning environment was used with only the treatment group (for course material No. 3 only, Chapter 3).
- The LAL combined various active learning activities with the use of modern educational technology. This learning environment was used for the treatment group only (for course material No. 2[1], Chapter 2).

Data was collected that indicated student performance (i.e., test results). The class tests, marked out of 10, were used as indicators of student performance throughout the experiment (see Table 1). The test results of each test for the treatment group and control group were collected separately and then used in the statistical analysis. For example, the test result for Material 2 was used to compare the student performance under LAL and TL. Similarly, Material 3 was used to compare student performance under CL and TL.

The performance of the group of students who were taught using a range of innovative methods was compared with the performance of a control group who were taught using only traditional methods. The experimental group was given a pre-test and a post-test, while the control group had only a post-test. The experiments employed three different learning environments: the traditional approach (TL), the cooperative learning approach (CL), and the Laptop-Based Active Learning approach (LAL). The effects of different timing and materials were tested and controlled. The tests conducted are summarized in Table 2 and explained as follows:

(1) Homogeneity among the treatment and control groups of students was checked using a Mann-Whitney test on one performance measurement (the test score on course material No. 1[2]) using the TL approach in both groups. The purpose of this test is to make sure that the results of the experiments are not affected by any significant differences in the prior knowledge level of the treatment and control groups.

(2) A Mann-Whitney test was used to compare the performance measurement (test score on course material No. 2[3]) of the control group (TL) with that of the treatment group (LAL).

(3) A Mann-Whitney test was used to compare the performance measurement (test score on course material No. 3) of the control group (TL) with that of the treatment group (CL).

(4) A Friedman test was used within the treatment group to compare their performance (test scores on course materials 1, 2, and 3) under the three different learning environments at different times. To adjust for the effect of differences in materials tested and timing, relative values of the test scores were used. For each student in the treatment group, the value used was the difference between the test score under the TL approach and the mean score of the control group (TL) for the same course material. The same process was implemented for the LAL approach (course material No. 2) and the CL approach (course material No. 3). The relative values for the TL, LAL and CL were compared to see the effect of these learning approaches on student performance.

(5) A Wilcoxon test was used to compare the effect of the two learning approaches (TL and LAL) on student performance, using the relative values of the test scores of the treatment group. The same technique was used to compare the effect of the LAL and CL approaches on student performance, and also to compare the TL and CL approaches.

Results and Discussion of the Comparative Analysis

[1] The various learning activities used are described in Section 3. The results of the test on Material 2 were used to measure the student performance under LAL. However, all the other materials (apart from 1 and 3) were taught using an LAL approach but not included in the experimental tests.

[2] Chapter 1 is an introduction to the course, therefore; it was suitable for testing the students' prior knowledge (homogeneity) between the two groups.

[3] Materials 2 and 3 require almost the same skills and have similar levels of difficulty. The three learning approaches can be used to teach these materials.

This section reports and evaluates the results obtained from a comparative analysis of the three teaching approaches. The objective here is to analyze and discuss the effects of the traditional learning (TL), cooperative learning (CL), and comprehensive laptop active learning (LAL) on student performance.

Homogeneity among the treatment and control groups

A Mann-Whitney test was used to ensure homogeneity and assess the level of the groups' prior knowledge. Table 3 presents the results for the performance of the treatment and control groups using the same learning environments (TL) before conducting any experiments. The result shows no significant differences ($p = 0.278$) between the mean scores of the two groups. This indicates that homogeneity in prior knowledge existed between the two groups.

The effect of teaching methods on student performance

Part A of Table 4 reports the results of a Mann-Whitney test for the performance of the two groups using the two different learning environments: the TL approach (control group) and the LAL approach (treatment group), using Course Materials 2. Results of the LAL approach appear to be significantly better ($p = 0.000$) than those of TL. One explanation for this result is that moving from the traditional approach to a more interactive approach motivates students to interact, thus improving their performance. The results agree with the findings of Dowling *et al.* (2003) that students scored higher marks on their midterm and final exams when a hybrid, flexible approach was used compared with a traditional face-to-face approach. In addition, because the LAL approach involves extensive use of technology, these results may also be considered to be in agreement with the conclusion of Moss *et al*. (2003) that the use technology improves the learning environment and results in enhancing student performance. These results are also consistent with those of Lovata (1986), Lightbody (1997), and Kern (2002) regarding hands-on techniques. The comprehensive application of the LAL approach seems to have increased overall student comprehension and their ability to retain and recall knowledge.

Part B of Table 4 reports a Mann-Whitney test was conducted to examine the performance of the two groups employing the TL (control) approach and the CL (treatment) approach, using Course Material 3. The result reveals no significant difference ($p = 0.161$). This is probably because the CL approach is used in isolation from all other active learning techniques. Therefore, it is expected that the integration of the various techniques and their comprehensive overall application (i.e., the LAL approach) would result in a significant difference in student performance (as shown in the next subsection).

The effect of different learning approaches on the treatment group's performance

Table 5 reports a Friedman test that was employed to determine the differences, if any, between the performance score of the treatment group under the three learning approaches (TL, LAL and CL). The computed scores were adjusted for the level effect of the different materials and timing differences, as explained in subsection 4-2. The results suggest that student performance differs significantly ($p < .01$) between the TL approach (1.64), the CL approach (1.65), and the LAL approach (2.77). Examining the mean ranks of the three learning approaches reveals that students have the highest test score under the LAL approach, whereas the students under the TL approach have the lowest. This suggests that the LAL approach is the most effective learning approach in enhancing the student performance.

To determine the specific differences in performance between pairs of learning environments – LAL vs. TL, LAL vs. CL, and CL vs. TL – a Wilcoxon test was used, and the results are presented in Table 6. This analysis used the relative values of the performance score of the treatment group for the TL and LAL. Table 6 reveals that the two scores under the LAL approach (3.02) and the TL approach (-0.45) are significantly different ($p < .01$). However, the results in Table 6 indicate no significant difference ($p > .05$) in the scores under the CL and TL approaches. Table 6 highlights the significant difference ($p < .01$) in the test scores between the LAL and CL approaches. The result shows that the score under the LAL approach (3.02) was higher than the score under the CL approach (-0.22). It can be concluded that LAL can significantly improve student performance and that student performance under CL is not significantly better than their performance under TL.

Conclusions

This study compared the effect of three different teaching approaches on student performance. The intention of the study was to examine the different effects resulting from applying the LAL approach in teaching compared with the TL and CL approaches. Student performance was measured in the Fundamentals of Cost and Managerial Accounting course taught in English to students who spoke English as a second language. Some courses, including the course used in this study, require various computer and non-computer-related skills, and high levels of student-

student and student-instructor interaction. In the experiments conducted for this study, the student performance appears to have been much better when the instructors adopted the LAL approach that comprehensively redesigns the teaching strategy and integrates the use of technological tools, hands-on exercises, grading policy changes, and group-based class activities. The results of this study suggest that the group-based approach, when used alone, will not have a significant effect on student performance compared with the LAL effect.

Limitations in the learning tools provided by the TL and CL approaches appear to reduce the opportunities that students have to perform well in such courses. The results revealed that the LAL approach had a significant and positive effect on the students performance, compared with the TL and CL approaches. Thus, we believe that teaching methodology matters, and that finding the appropriate methods that enhance student performance is the real challenge. Hence, we support the arguments advanced on the basis of previous research (for example: Becker and Haugen, 2004; Efaw *et al*, 2004; Leveson, 1999; and Fry and Love, 2004) that when introducing technology into the teaching of accounting, instructors need to reflect comprehensively on their teaching strategies.

One limitation of this study is that examining the treatment group in the three learning environments for different materials and at different times could raise some questions about the internal validity of the procedure. Nevertheless, controlling for the effect of different material and differences in timing (as explained in subsection 4-2) makes it possible to arrive at sensible conclusions about the effect of the three learning approaches on student performance in the treatment group. Future research may extend the present study by increasing the number of groups examined. In addition, further research should include student workloads, the effects of class timing and personal circumstances of the students.

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Table 1

The performance measurement for the treatment and control groups

PERFORMANCE MEASUREMENT	THE CONTROL GROUP	THE TREATMENT GROUP	DESCRIPTIONS
Test 1	TL	TL	Material 1
Test 2	TL	LAL	Material 2
Test 3	TL	CL	Material 3

Table 2

The experimental test designs for the treatment and control groups

PURPOSE	THE CONTROL GROUP	THE TREATMENT GROUP	PERFORMANCE MEASYRENT	TEST TYPE
To control for homogeneity	TL	TL	Test 1	Mann-Whitney test
To compare the performance between the two groups	TL	LAL	Test 2	Mann-Whitney test
To compare the performance between the two groups	TL	CL	Test 3	Mann-Whitney test
To compare the performance of the treatment group under the three leaning approaches	-	TL/LAL/CL	Test 1, Test 2, Test 3	Friedman test
To compare the performance of the treatment group under the two learning approaches	-	TL/LAL	Test 1 and Test 2	Wilcoxon test

Table 3

Homogeneity between the treatment and the control groups

THE CONTROL GROUP	THE TREATMENT GROUP	D E S C R I P T I O N S
5.85	5.40	Mean
1.85	3.13	Standard deviation
1	1	Minimum
9	10	Maximum
0.278		Nonparametric p-value[a]
45	47	Count

[a] The nonparametric p-value is a Mann-Whitney test

Table 4

Comparing the effect of teaching methods on student performance in treatment and control groups

(B) COMPARING CL AND TL		(A) COMPARING LAL AND TL		DESCRIPTIONS
CONTROL GROUP (TL)	TREATMENT GROUP (CL)	CONTROL GROUP (TL)	TREATMENT GROUP(LAL)	
7.35	7.13	5.7	8.72	Mean
2.24	0.95	2.01	1.87	Standard deviation
2	5	0	2.5	Minimum
10	10	9	10	Maximum
0.161		0.000		Nonparametric p-value[a]
44	47	45	47	Count

Table 5

Comparison between the effect on the student performance of implementing the TL, LAL and CL approaches for the treatment group

MAXIMUM	MINIMUM	STANDARD DEVIATION	MEAN RANK	MEAN	TIME
4.15	-4.85	3.13	1.60	-0.45[a]	Time 1- TL
4.3	-3.20	1.87	2.77	3.02[b]	Time 2- LAL
2.65	-2.35	0.95	1.64	-0.22[c]	Time 3- CL
		0.000			Nonparametric p-value[d]
		47			Count

[a] Computed as the difference between the score of the test for the treatment group (under TL) and the mean of the test score for the control group (under TL) using the same course material.

[b] Computed as the difference between the score of the test for the treatment group (under LAL) and the mean of the test score for the control group (under TL) using the same course material.

[c] Computed as the difference between the score of the test for the treatment group (under CL) and the mean of the test score for the control group (under TL) using the same course material.

[d] The nonparametric *p*-value is a Friedman Test**.**

Table 6

Compariso, S. n between the effect on the student performance of implementing LAL, TL and CL

Comparing CL and TL		Comparing LAL and CL		Comparing LAL and TL		DESCRIPTIONS
TL APPROACH	CL APPROACH	CL APPROACH	LAL APPROACH	TL APPROACH	LAL APPROACH	
-0.44[b]	-0.22[c]	-0.22[c]	3.02[a]	-0.44[b]	3.02[a]	Mean[a]
3.13	0.95	0.95	I.87	3.13	I.87	Standard deviation
-4.85	-2.35	-2.35	-3.2	-4.85	-3.2	Minimum
4.15	2.65	2.65	4.3	4.15	4.3	Maximum
0.53		0.000		0.000		Nonparametric p-valuec[d]
47	47	47	47	47	47	Count

[a] Computed as the difference between the score of the test for the treatment group (under LAL) and the mean of the test score for the control group (under TL) using the same course materials.

[b] Computed as the difference between the score of the test for the treatment group (under TL) and the mean of the test score for the control group (under TL) using the same course material.

[c] Computed as the difference between the score of the test for the treatment group (under CL) and the mean of the test score for the control group (under TL) using the same material.

[d] The nonparametric p-value is a Wilcoxon Test**.**