# Factors Affecting STOU Student Achievement in Subjects with Computation Contents

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**ABSTRACT**

*This paper presents a research aimed at studying students' achievements in courses involving computations. The sample included 1,237 undergraduate and certificate students enrolled in 29 courses involving computations in the second semester of 2005 and the first semester of 2006 as well as 19 chairs of course management or test development committees. The research instruments were survey questionnaires and a recording log. The multilevel analysis of student achievement was performed through HLM, where student-level variables included age, prior knowledge, socio-economic status, problems in computations, learning style in distance learning, readiness for exams, academic planning, attitudes towards courses and self-discipline. Course-level variables included test difficulty, test reliability, scores on course assignments, number of units involving computations, number of items involving computations, quality of educational materials and students' achievement. Findings indicated that student-level variables which had positive effects on students' achievement included prior knowledge, attitudes towards courses and self-discipline while learning problems had a negative effect on students' achievement. Course-level variables which had positive effects on the course mean included test reliability and number of units involving computations. However, the number of items involving computations had a negative effect on the course mean.*

## INTRODUCTION

Sukhothai Thammathirat Open University (STOU) is an open university which uses distance learning in higher education to facilitate students and instructors who are far from each other. The students learn from the materials provided by the university. This distance learning system, therefore, is different from conventional instruction. The requirements for students who would like to get admission to STOU are that they must have studied up to at least Grade 9 and have five years of working experience or that they have studied up to Grade 12, vocational diploma, higher vocational diploma, bachelor's degree or higher. To conclude, the applicants to STOU vary in their qualifications and skills background.

Previous research on the learning achievements of students in this distance learning system found that age, background knowledge, economic status, distance learning, preparation for examination, study plans, learning goals and self-discipline were all factors affecting achievement (Meesaplak, S., 1997; Poolsanguan, J., 1996; Chindanurak, T., 1995, Prommapan, B. et al., 1995). These variables were in the characteristics of the students. Apart from this, results from other research revealed that other variables which affected their success in passing examinations concerned the tests such as test difficulty, score on course assignments, number of items involving computations, number of units involving computations, quality of educational materials and type of course (Angsuchoti, S. and Wipassilapa, S., 2006; Keaowwan, P. et al., 1999; Prommapan, B. et al., 1995).

For this reason, the researchers wanted to study the factors which influenced the learning achievement of the students in the distance learning system of STOU who used educational materials which involved computation. The factors which interested the researchers had two levels of structure. These were student level (characteristics of students) and course level (variables related to the tests and the type of course). The data for this study came from two sources of hierarchical data, whereby the level of the students was under the level of the course. The variable to predict and the variables according to the level of the students at the low level were related and influenced by the variable to predict, which was at a high level. The researchers used multi-level analysis to comply with the structure of the data. The results of this research would help make information technology which is beneficial for planning the development of students. The data is also useful for those involved in developing the course in various aspects like instruction materials and the quality of the tests. As a result, there will be an approach in increasing the effectiveness of the instruction in higher education in the future.

## RESEARCH OBJECTIVES

The research was carried out to achieve three objectives, which were to study the relationship between student-level and course-level variables and the achievement of students, the results from the effects of student-level and course-level predictors on their achievement, and the predictions of their achievement in courses involving computations.

## RESEARCH METHODOLOGY

The research methodology in this study was as follows:

### Population and Sample Group

The population in this research contained two groups. The first group comprised 30,310 undergraduate students and certificate degree students who enrolled in 29 courses which involved computations during the second semester of 2005 and the first semester of 2006. The second group consisted of 29 chairs of course management or test development committees for the courses who were responsible for examinations.

There were two sample groups in this research. For the first sample group, undergraduate students and certificate students from all 29 courses which involved computations in the second semester of 2005 and in the first semester of 2006 were randomly selected by computer to pick 100 persons in each course. There were 25 courses with a sample group of 100 persons. For seven of the courses, fewer than 100 persons were enrolled so all of them were included in the sampling group. The second sample group comprised the chairs of course management or test development committees for the courses who were responsible for examinations in the second semester of 2005 and in the first semester of 2006. The data came from 19 courses only, so the analysis was done with 19 persons.

### Research Tools

The tools used in this research consisted of a questionnaire for the students, a questionnaire for the chairs of course management or test development committees and a recording log.

### Data Collection

The researchers sent 3,000 copies of the questionnaire to the students by post and indicated the research title, benefits of filling the questionnaire and how to return it to the researchers. There were 1,237 copies returned or 41.23% of the total distributed. The researchers sent copies of the questionnaire to the chairs of course management or test development committees. Out of the total distributed, 19 copies were returned, or 65.52%. The researchers asked the Office of Computer Services to provide data on the learning achievements of the students in all 29 courses. The researchers asked the Office of Registration, Record and Evaluation to provide data on the test difficulty and test reliability of all 29 courses.

## DATA ANALYSIS AND STATISTICAL TOOLS

The data from the first section of the questionnaire for the students was about status and general information. It was in multiple choice format and analyzed through frequency and percentage. As for the items to be filled, these were analyzed through mean and standard deviation.

The second section of the questionnaire for the students provided their opinion of the courses which involved computations as well as their aptitude. The third section was about the level of practice with the courses which involved computations. The data was analyzed through mean and standard deviation. The findings from the open-ended part of the questionnaire for the students was analyzed in terms of the contents.

The data from the questionnaire for the chairs of course management or test development committees was analyzed in terms of the contents and frequency as well as percentage. The recording log data was analyzed in terms of the contents and calculated through frequency and percentage.

The data about the variable to predict and the results from the learning achievement with the courses involving computations was analyzed in terms of relationship. The level for nominal scale was based on the tetracolic relationship. The analysis of the relationship when the data was in interval was based on Pearson product moment. The

data about the variable to predict the influence on the learning achievement of STOU students for the courses involving computations was analyzed in multilevel by HLM program.

## RESEARCH RESULTS

The results from the research were the model for prediction of the courses involving computations as follows:

- The model for the prediction of the learning achievement of the students for the courses involving computations, which could be explained by the variable at the first level (student level) and had statistical significance, could be classified into the two following cases:

  1. In case there is no variable at the second level involved, the prediction equation is: Students' achievement = 39.489** + 1.601**(Prior knowledge) - 2.490**(Learning problems) + 0.952* (Attitudes towards course) + 2.260**(Self-discipline)
  2. In case the variable at the second level is involved, the prediction equation for the predictive variable at the first level only is:
     Students' achievement = 39.785** + 1.683**(Prior knowledge) - 2.490**(Learning problems) + 0.878*(Attitudes towards course) + 2.710**(Self-discipline)

- The model for the prediction of the learning achievement of the students for the courses involving computations from the variable at the second level (the course level) could be classified as:

  1. The equation to predict the mean score of the learning achievement at the course level (intercept), which could be explained from the variable to predict the course level and had statistical significance, is:
     Mean learning achievement of course = 39.785** + 25.744*(Test reliability) + 0.620*(Number of units involving computations) - 0.167**(Number of items involving computations)
  2. The equation to predict the regression coefficient (slope) from the variable at the first level, which could be explained from the course level predictive variable and had statistical significance, is:
     Influence of distance learning = 0.239**(Test difficulty) + 0.069* (Number of items involving computations)
     Influence of self-discipline = 2.710**–0.243**(Test difficulty) + 34.057* (Test reliability)

Findings indicated that student-level variables which had positive effects on students' achievement included prior knowledge, attitudes towards the course, and self-discipline; but the learning problems had a negative effect on students' achievement. Course-level variables that had positive effects on the course mean included test reliability and the

number of units involving computations. However, the number of items involving computations had a negative effect on the course mean.

*Note. * p < .05, **p< .01*

## DISCUSSION

This research can be discussed in the following aspects.
The factors which influence the learning achievement of STOU students for the courses involving computations at the student level consisted of four variables: prior knowledge, learning problems, attitudes towards the course and self-discipline. Here is the discussion:

- Prior knowledge is a variable to predict which has positive relationship and is the factor which influences learning achievement for the courses involving computations. The regression coefficient is 1.601, that is to say, when prior knowledge increases by one unit, the score of the students will increase by 1.601 times. This complies with the research work related to the relationship between prior knowledge and the learning achievement which shows that there is correlation (Sasai, L., 2007; Sirirongpan, C., 2007; Meesaplak, S., 1997; Chindanurak, T., 1995).

- Learning problem is the variable with negative relationship with learning achievement and the factor which influences learning achievement for the courses involving computations. The regression coefficient is -2.490, that is to say, when the value for study problem increases by one unit, the score of the students will decrease by 2.490 times. This is relevant with the research by Muadthaisong, N., (2000) in that anxiety or problems about learning computations is related to the learning achievement for studying mathematics.

- Attitudes towards courses involving computations is the variable to predict with positive relationship and the factor which influences learning achievement for the courses involving computations. The regression coefficient is 0.878. When the value for the attitudes increases by one unit, the score of the students will increase 0.878 times. This is in compliance with past research works in that attitudes had an effect on the learning achievement of the students (Kanjanapa, D., 1997; Sirirongpan, C. , 1997).

- Self-discipline is the variable to predict with positive relationship and the factor which influences learning achievement for the courses involving computations. The regression coefficient is 2.260. When the value for self-discipline increases by one unit, the score of the students will increase by 2.260 times. This is relevant to past research in that self-discipline affects the learning achievement of the students (Sirirongpan, C., 2007; Meesaplak, S., 1997; Chindanurak, T., 1995).

Factors at the course level which influence learning achievement for the courses involving computations of STOU students consisted of three factors: test reliability, number of items involving computations and number of units involving computations. Moreover, the number of items involving computations, test reliability and test difficulty

influence the learning achievement for the courses involving computations through the factors at student level because of influence over the level at course level which affects the student level factors. In other words, test difficulty and number of items involving computations influence the regression coefficient value (rate of change) of distance learning. Test difficulty and test reliability influence the regression coefficient value (rate of change) of self-discipline. Here is the discussion:

- Test reliability from this research was found to have influence on learning achievement for the courses involving computations and to show positive value to the average score (beginning score) of the learning achievement in each subject. It also affects the student variable, which is the self-discipline of the students. This is because the model to measure test reliability for multiple choice has two values: one point when the students choose the correct answer and zero point when the students cannot answer correctly. The ratio of students who choose the correct answer for each question, or the difficulty of the test question and standard deviation of the total score of the examiner will be calculated to find out the test reliability. Therefore, it can be seen that the difficulty in each question has a relationship with the test accuracy. The test accuracy is, therefore, the factor which influences learning achievement for the courses involving computations.

- The number of items involving computations in this research shows that it is the factor which influences learning achievement for the courses involving computations with a positive result. It affects the student level variable, which is the distance learning approach. It gives a negative result to the mean score of the learning achievement for such courses because the number of items involving computations require many skills such as analysis, interpretation of the question, formula usage, the accuracy of the value representation along with the accuracy of the computations. Therefore, the more computations test questions, the more time the students spend on studying. The variable about the number of items involving computations, therefore, has a positive effect on distance learning. Furthermore, the course with more computations test questions is considered more difficult, resulting in a negative effect on the mean score of such courses.

- The number of units involving computations from this research shows that it is the factor which influences the learning achievement for the courses involving computations with positive effect on the mean (beginning score) of learning achievement in each subject. Besides, the course with more computations learning units is usually intended for students whose major is related to mathematics. The students are normally good at computations or applications. The contents will be arranged in an order. The course with a few computations learning units is normally composed of essential concepts related to the computations in such course. Therefore, the students thought that the course which was not their major course but had more computations learning units was too difficult. For this reason, the number of units involving computations is the factor which affects the learning achievement for the computations.

- Test difficulty from this research shows that it is the factor without direct influence on the courses involving computations. However, it directly affects the learning achievement of the students for the courses involving computations through the student level variable. In other words, test difficulty affects the student-level variables – distance learning and self-discipline. This is because the difficulty of the test is the ratio of the persons who choose the correct answer in such items. If the number is low, that means the test is difficult. The lower the value is, the more difficult the test is. The courses involving computations are normally different from the general courses because they require a lot of skills: understanding, analysis, interpretation and computation accuracy. Therefore, for the test which comes from difficult contents (the mean scores of the test were low), the students need more self-discipline. Test difficulty, thus, affects self-discipline negatively. The distance learning in the courses involving computations is similar because it requires the ability to analyze and calculate. Test difficulty influences the distance learning in the same direction; therefore, it results in positive value. This complies with the research work about STOU students' opinions towards the difficulty (Keaowwan, P. et al., 1999) in that most students think that STOU tests are quite difficult.

## SUGGESTIONS

**Suggestions for the university:**

- There should be additional tutoring sessions for courses involving computations. The university should promote additional tutoring sessions through the Internet and additional classroom sessions through video conference. At present, the university has done this for some subjects. It should increase or provide students with intensive instructions or additional classes. Moreover, this should be announced so that the students can have more options to choose from.

- In cases where students have only a small amount of prior knowledge, the university should provide them with tests to estimate their background individually so that the data can be used for planning the materials for each student. The university should prepare the readiness of the students systematically.

- There should be various forms of materials for the courses involving computations. The university should promote more materials for such courses. For example, it could provide a summary in the form of a compact disc so that students can review it any time. In other cases, CAI about the courses involving computations can be made as a part of the instruction or e-learning with multimedia in the instruction.

- Permission to use a calculator. The university should consider this, especially for the courses involving computations. Where the calculator is not allowed, the instructor who set up the test should test the principles and the understanding instead of the computations in a complicated manner. In addition, the test must comply with the contents and objectives of the courses.

**Suggestions for the instructors:**

- As for the production of the learning materials, the committee for the development and revision of the courses should consider the presentation of the contents in an appropriate way for self-study at undergraduate level. Moreover, it should match the skills of all groups of students because the students in each course are diverse.
- As for the quality of the test, test development committees for each course should be aware of the test quality, especially the difficulty and reliability. According to this research result, the quality of the test in terms of test difficulty and test reliability are factors which influence learning achievement for the courses involving computations.

**Suggestions for the students:**

- According to the research results, prior knowledge is the factor which affects learning achievement of the courses involving computations. The policy of the university is to develop a test to examine the prior knowledge of STOU students so that each student knows their basic level in Thai language, analytical thinking and mathematics. Afterwards, the university will report to each student. For this reason, students should participate in this activity.
- Learning problems in this research show that it is the factor which influences learning achievement for the courses involving computations. When self-reports of the students were considered, it was found that most students had problems at a middle level and at a critical level in similar ratio. The students should consider their own study problems and understand the causes and how to solve them. If the students cannot solve the study problems, they will have problems in future instruction.
- Attitudes towards the course in this research show that most students had attitudes at a middle level towards the courses involving computations. When the details were considered, it was found that most students felt anxious about the courses involving computations and realized that computations was the basis of other subjects. Therefore, if students have a good attitude towards the subject, they will show good results in the test.
- Self-discipline in this research shows that most students had self-discipline at a middle level. When the details were considered, it was found that the students had a high level of self-discipline. Although they could see others' answers, they still tried to find the answers themselves. They also reviewed the contents before examination. These two behaviours show the good ethics of the students. Therefore, self-discipline is a factor which affects the courses involving computations. If the students have more self-discipline, they will have good learning achievement for the courses involving computations.

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