Asia Pacific Education Review
2005, Vol. 6, No. 1, 28-40.

Critical Trial Use of TIMS* as an Alternative Instructional Delivery Tool

Chin Uy
University of Santo Tomas
Philippines

This quantitative-qualitative study seeks to determine the effectiveness of TIMS (Thomasian Interactive Multimedia Software) in teaching the introductory topics in Trigonometry. The acceptability of the software to the student respondents was established using the content, design, interface, and effectiveness of the media used as the evaluation criteria. The critical trial use of the software involving a small group of students was employed to elicit the needed information. It aims to provide meaningful report which includes the strengths and weaknesses of the software, the recurring problems, and constraints during its implementation, and a critique of the software as to how it should be improved for future use.

Key Words: Critical trial use, TIMS, Software

In the late 90's, a survey of more than 600 higher-education institutions in the United States indicated that 15 per cent of the courses delivered by faculty members used CD-ROM based materials, 25 per cent used multimedia technology, and around 33.33 per cent used Internet resources (Murray, 1999; Green, Campus Computing Survey, cited in TLTC Handbook, 2000). Apparently, more and more teachers are utilizing technology to enhance their delivery of the course content.

Considering the trend in the use of technology in the teaching-learning process, several studies have been conducted to assess how its use invigorates teaching. Moreover, there is a need to ascertain the progress of students who have been exposed to IT-driven instruction (Rosow, 2001).

In the Philippines, though institutions have ventured into IT integration via the production of in-house courseware, there is an urgent need to conduct assessment and evaluation studies for purposes of generating feedback on the overall effectiveness of courseware vis-à-vis students' academic performance. Hence, this preliminary study is an attempt to describe how TIMS, an alternative instructional delivery tool developed by the University of Santo Tomas (UST), a time-tested institution, underwent the process of critical trialling.

The Present Study

This study aimed to determine the effectiveness of TIMS in teaching the introductory topics in Trigonometry by comparing the performance of students exposed to the use of TIMS and those taught in the traditional lecture discussion method. Using the content, design, interface, and effectiveness of the media used as the evaluation criteria, the acceptability of the software to the student respondents was established.

The software TIMS proposes the use of the facilities installed in the multimedia rooms of the University in teaching selected topics in trigonometry. If proven to be effective, the software can be used in colleges with the same course offering.

Chin Uy, faculty researcher, Center for Educational Research and Development, University of Santo Tomas, and Professor, College of Commerce.
Correspondence concerning this article should be addressed to Dr. Chin Uy, UST Center for Educational Research and Development Room 201 Thomas Aquinas Research Complex, España, Manila Philippines (1008). Electronic mail may be sent to doc_cuy@ yahoo.com. Telefax: +632-7315709.

The Thomasian Interactive Multimedia Software (TIMS*)

The Thomasian Interactive Multimedia Software (TIMS) is CD-ROM based material created by an instructional design team from the Educational Technology (EDTECH) Center, in coordination with a faculty researcher. The authoring software used was Authorware version 6.0. Video and animation were done using Adobe Premiere 5.1, Avid Express DV 3.0, and Adobe After Effects. Graphics were constructed using Photoshop 6.0, while sounds were created and edited through Vegas Pro 2.0 and Sound Forge 6.0. Font Creator Program 3.0 was utilized to create fonts that are not available in the keyboard.

The software consists of nine (9) bits. A bit is a lesson to be delivered through the computer using the system in the multimedia classroom for each 1-hour class period. The 60-minute class period is allocated to the different components as follows:

1. Concept building	5 to 6 minutes
2. Preparatory exercise	10 to 12 minutes
3. Application	17 to 20 minutes
3.1 Introduction of concepts	
3.2 Manipulation of concepts	
4. Valuing	4 to 5 minutes
5. Generalization	2 to 3 minutes
6. Evaluation	10 to 11 minutes
7. Provision for reinforcement	2 to 3 minutes

The nine bits as enumerated below are the introductory topics of Math 102 (Trigonometry), using the course offering at the UST Faculty of Pharmacy as reference. They were the topics chosen since the foundation of learning trigonometry lies in the understanding of these basic concepts.

Bit 1 Six trigonometric ratios of an angle
Bit 2 Six trigonometric ratios of an angle (continuation)
Bit 3 Trigonometric ratios of special angles
Bit 4 Trigonometric ratios (co-functions)
Bit 5 Arc measure and arc length
Bit 6 Arc length
Bit 7 Solution of right triangle
Bit 8 Applications of solutions of right triangles
Bit 9 Applications of solutions of right triangles (continuation)

The instructional package consists of a multimedia-complement lesson plan with its corresponding concept map for the use of the teacher. The concept map presents a flowchart-like delivery of the learning content. Generally, the lesson plan contains the learning objectives, learning content, materials to be used, learning experiences, generalization, value statement, evaluation and assignment. The learning experiences consist of preparatory exercises, motivation or review, lesson proper, and application.

For the student's use, the support materials prepared were the note sheets, the assignment sheets, and the evaluation sheets. While exploring the software, the students have the evaluation sheet on hand. It contains questions and exercises corresponding to the bit they are viewing. The note sheets, which contain the learning content, are to be distributed at the end of the class period. The assignment sheets, distributed also at the end of the class period, prepare the students for the next bit or lesson.

The interactive CD requires a class username and password to keep track of the bits completed by the class. It has a main navigational interface and the lesson interface. The main navigational interface features introduction buttons and bit buttons. It secures student's access in going from one bit to another; thus, a student will not be allowed to log on to the second bit without completing the tasks required by the first.

The lesson navigational interface includes the different boards in the system; they are the chalk board, the note board, the video board, the graphing board, the formula board, the calculator board, and the equation editor board. The chalk board is where the learning contents are discussed. It acts as the typical blackboard in a classroom. The note board is where important concepts discussed can be pasted. The video board displays the supplemental video that is useful in learning a specific content. The graphing board contains the rectangular coordinate system. It is where graphs are displayed. The formula board contains formula discussed. This board is not accessible while the students are doing the exercises. The calculator board functions like a typical scientific calculator. The equation editor board supplies symbols not found on the keyboard of the computer.

The use of TIMS is anchored on the principles of individualization, cooperation and collaboration, thus creating a highly interactive learning atmosphere. The teacher plays the role of a facilitator; he monitors the progress and behavior of students. The students explore the software as a group. They could have group discussion in class or even before or after class to develop mastery of the materials to be learned. Cooperative learning is hence encouraged. The use of the software is viewed as a cheaper alternative to the computer-assisted learning approach that requires individualized computer facilities.

Methodology

Subjects

Two sections in Trigonometry at the Faculty of Pharmacy of the University of Santo Tomas for the second semester of the academic year 2002-2003 were selected; one as the control, and the other, as the experimental group. To eliminate bias due to differences in the teaching style and methodology, the two were chosen out of the three sections handled by the instructor assigned to test the effectiveness of the software. Other aspects such as content and time interval were well equated.

The two groups of respondents were compared using the results of the entrance examinations, which consists of an IQ test, English, Mathematics, and Science examinations and the overall percentile ranking of the achievement tests. Since the two sections chosen were handled by the same instructor in College Algebra, (which is a pre-requisite for Trigonometry), and considering the major examinations were departmentalized, their final raw scores in that course were also compared to establish that they are parallel groups.

The following tables show the t-test for each of the components of the entrance examinations:

Table 1 shows that the control group has better IQ scores than the experimental group. The mean IQ of the respondents in the control group (110.02) is 4.65 points higher than that of the respondents in the experimental group (105.37).

The same table shows that in each of the three content areas of the entrance examinations, the respondents in the control group fared better than the respondents in the experimental group. The mean of the first group in the different subject areas ranges from 83.45 to 86.98, while that of the experimental group ranges from 75.07 to 78.35.

Similarly, the mean in the over-all scores of the respondents in the control group is 86.93 compared to that of the experimental group which is 77.53. The computed value of the t-stat is higher in each of the five items than the critical value. Hence, it is safe to conclude that the control group is better than the experimental group. Apparently, the two groups of respondents were not equal at entry point, with the control group performing better than the experimental group in all aspects. Thus, the control group may perform better academically compared to the experimental group.

Table 2 shows that when comparing the raw scores of the respondents in College Algebra, the computed value of the t-stat is less than the critical value; hence, it is safe to conclude that relative to their performance in the course, the two groups of respondents are not significantly different. Hence, they can be expected to have more or less the same performance in the next mathematics course.

Table 2. *Comparison of Raw Score in College Algebra of the Control and Experimental Groups*

	Control	Experimental
Mean	84.75000	83.06977
Variance	35.21512	37.39978
Observations	44	43
Hypothesized Mean Difference	0	
Df	85	
t Stat	1.300162	
P (T<=t) one tail	0.098530	
t critical one-tail	1.662979	

Table 1. *Comparison of Results in Different Components in the University Entrance Examinations of the Control and Experimental Groups*

Items	Control Group			Experimental Group			Comp	At .01	Decision
	X	SD	N	X	SD	N	t-test		
IQ	110.02	5.83	44	105.37	7.49	43	3.22	1.66	Reject Ho
Math	83.45	15.18	44	75.07	17.56	43	2.38	1.66	Reject Ho
English	86.98	14.88	44	78.35	19.80	43	2.29	1.66	Reject Ho
Science	85.36	17.45	44	75.49	20.62	43	2.41	1.66	Reject Ho
Over-all	86.93	13.26	44	77.53	16.84	43	2.89	1.66	Reject Ho

Data Gathering Methodology

The research utilized two methodological approaches. The first, which is the quantitative approach, used the descriptive-comparative and experimental methods. The software TIMS was pilot-tested during the second semester of Academic Year 2002-2003. Two groups of respondents were chosen to be the control and the experimental groups. Both were given the same pre and post tests which were used as the measuring instruments. Students in the experimental group were taught using the software. The group discussion strategy was employed to facilitate students' exploration of the software. Observations of their behavior were done. To treat the gathered data in depth, the following statistical tools were used: T-test for correlated samples and T-test for independent samples. A Likert-type questionnaire was used to inquire about the ratings of the respondents on the use of the software and the different criteria relative to the software, as well as the different support materials used.

The second approach involves the use of interviews to give more information about the software, and the environment relative to the use of the software.

The phases of this study are illustrated in the figure below.

Results and Discussion

Quantitative Results

The questions in the pre and post tests were grouped into six (6) topics and each topic has 5 items for a total of 30 items.

Using the T-test for correlated samples, it was established that at 0.01 level of significance and 43 degrees of freedom, there is a significant difference between the means of the pre and the post-test results of the control group. This implies that the traditional or lecture-discussion method is a good method of instruction. However, when the results of the two tests were grouped according to topics, the difference of the two tests in topics III and V are not significant. This implies that the gain of the respondents in the topics "angle measure" and "solutions of right triangles" is very minimal.

This reaffirms the earlier findings that the lecture-discussion method is still a good method of instruction and it can be used alternately with other instructional modality (Uy et al, 2002; De Castro, 2000; Domingo, 1998; Houghton, 1997).

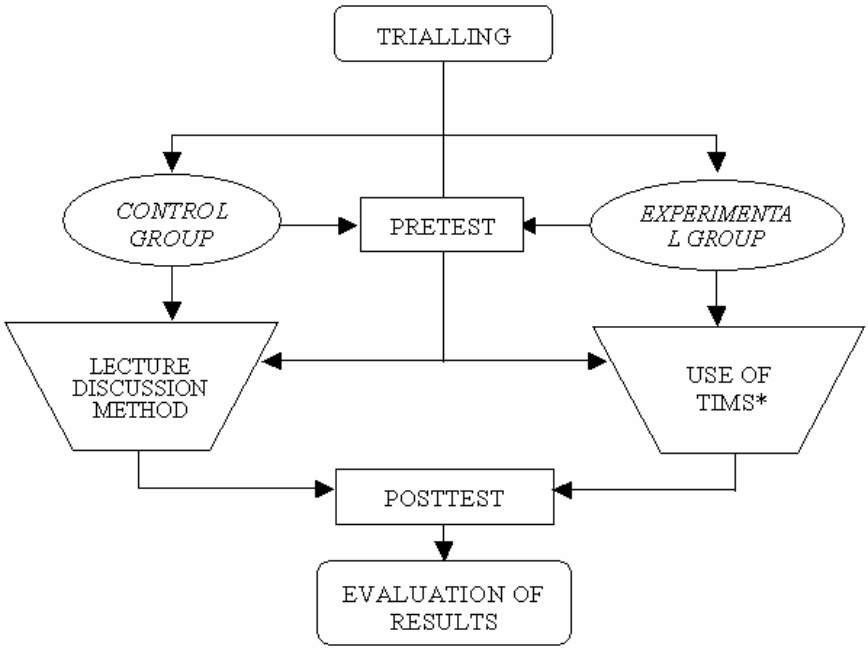

Figure 1. (Adapted from *"Development and Validation of a Computer-Assisted Instructional Material in Differential Calculus"* by Asuncion P. Bagarino, 1998).

Table 3. *Comparison Between Pre and Post-test Results of the Control Group*

Topic	Items	Pre Test			Post Test			Comp.	At .01	Decision
		X	SD	N	X	SD	N	t-test		
I	5	3.61	1.50	44	3.91	0.92	44	2.05	1.68	Reject Ho
II	5	2.52	2.26	44	3.39	1.68	44	3.81	1.68	Reject Ho
III	5	3.59	1.83	44	3.73	0.67	44	0.68	1.68	Accept Ho
IV	5	1.70	1.10	44	3.68	1.80	44	9.02	1.68	Reject Ho
V	5	2.68	0.78	44	2.48	0.49	44	1.18	1.68	Accept Ho
VI	5	2.14	2.31	44	2.57	2.07	44	1.99	1.68	Reject Ho
Total	30	16.25	24.47	44	19.75	17.26	44	6.42	1.68	Reject Ho

I – Trigonometric ratios of acute angles, II – Trigonometric ratios of special angles, III – Angle measure, IV – Arc Length
V – Solutions of right triangles, VI – Solution of word problems

Table 4. *Comparison of Between Pre and Post-test Results of the Experimental Group*

Topic	Items	Pre Test			Post Test			Comp.	At .01	Decision
		X	SD	N	X	SD	N	t-test		
I	5	2.44	2.25	43	4.42	0.53	43	8.53	1.68	Reject Ho
II	5	1.70	1.36	43	2.56	2.30	43	3.60	1.68	Reject Ho
III	5	2.63	2.52	43	3.53	0.87	43	3.52	1.68	Reject Ho
IV	5	1.58	1.53	43	3.26	1.72	43	7.07	1.68	Reject Ho
V	5	2.14	0.69	43	2.12	0.68	43	0.15	1.68	Accept Ho
VI	5	1.30	1.36	43	2.33	1.46	43	4.96	1.68	Reject Ho
Total	30	11.79	18.50	43	18.21	17.60	43	10.34	1.68	Reject Ho

Using the same T-test for correlated samples, it was established that at 0.01 level of significance and 42 degrees of freedom, there is a significant difference between the means of the pre and the post-test results of the experimental group. This implies that the use of the multimedia approach through the software TIMS provides a pedagogically sound mode of instruction.

On the other hand, table 4 also shows that when the results of the two tests were grouped according to topics, the difference of the two tests in topic V (Solutions of right triangles) is not significant implying a minimal gain among the respondents. On the other hand, significant gains were noted in all other topics as the pre and post rest results indicate.

Using T-test for independent samples, it was shown in Table 5 that at 0.01 level for significance and at 85 degrees of freedom, the computed value of t-test for Topic IV (Arc length) is lower than the tabular value. Thus, we conclude that for that topic, there is no significant difference between the results of the pre-tests of the control and experimental groups. For all other topics, as well as for the over-all result of the pre-test, there are significant differences between the performances of the two groups in favor of the control group. That is, the control group seems to do better than the experimental group in the pre-test given. This coincides with the conclusion derived from the data in Table 1.

Table 5. *Comparison of Pre-test Results of the Control and Experimental Groups*

Topic	Items	Control			Experimental			Comp.	At .01	Decision
		X	SD	N	X	SD	N	t-test		
I	5	3.61	1.50	44	2.44	2.25	43	3.99	1.66	Reject Ho
II	5	2.52	2.26	44	1.70	1.36	43	2.87	1.66	Reject Ho
III	5	3.59	1.83	44	2.63	2.52	43	3.04	1.66	Reject Ho
IV	5	1.70	1.10	44	1.58	1.53	43	0.50	1.66	Accept Ho
V	5	2.68	0.78	44	2.14	0.69	43	2.95	1.66	Reject Ho
VI	5	2.14	2.31	44	1.30	1.36	43	2.88	1.66	Reject Ho
Total	30	16.25	24.47	44	11.79	18.50	43	4.49	1.66	Reject Ho

Table 6. *Comparison of Post-test Results of the Control and Experimental Groups*

Topic	Items	Control			Experimental			Comp.	At .01	Decision
		X	SD	N	X	SD	N	t-test		
I	5	3.91	0.92	44	4.42	0.53	43	-2.79	1.66	Reject Ho
II	5	3.39	1.68	44	2.56	2.30	43	2.73	1.66	Reject Ho
III	5	3.73	0.67	44	3.53	0.87	43	1.02	1.66	Accept Ho
IV	5	3.68	1.80	44	3.26	1.72	43	1.50	1.66	Accept Ho
V	5	2.48	0.49	44	2.12	0.68	43	2.20	1.66	Reject Ho
VI	5	2.57	2.07	44	2.33	1.46	43	0.85	1.66	Accept Ho
Total	30	19.75	17.26	44	18.21	17.60	43	1.72	1.66	Reject Ho

I – Trigonometric ratios of acute angles, II – Trigonometric ratios of special angles, III – Angle measure, IV – Arc Length
V – Solutions of right triangles, VI – Solution of word problems

Table 6 shows that for topics III, IV and VI, no significant differences were noted between the performance of the two groups. For topic I, there is a significant difference between the performance of the two groups in favor of the experimental group, while for topics II and V, there is a significant difference between the performance of the two groups in favor of the control group. When the over-all results were compared, there is a significant difference between the performances of the two groups in favor of the control group; that is, the control group presumably learned more than the experimental group.

The results of the entrance examinations showed that the control group is better than the experimental group. Thus, the control group was expected to do better in both the pre and post-tests. However, Table 6 shows that the difference between the post-tests result of the two groups of respondents is significant only for three out of six topics. Hence, the difference between the pre and post-tests of each student of the two groups was made and a comparison was done on these differences. A positive difference means that there was an increase in the score obtained in the post-test compared with the result of the pre-test, while a negative difference means that the there was a decrease in the score obtained in the post-test compared with the result of the pre-test.

Table 7 shows that there is a significant difference between the said difference of scores in favor of the experimental group. This implies that although both groups performed better in the post-test, the experimental group showed a more significant gain.

This further implies that although both methods of instruction are good for delivering the introductory topics in trigonometry, there seemed to be more retention of concepts discussed using the multimedia approach. This could be due to the use of kinesthetic method of teaching as compared to the traditional lecture-discussion method. Thus, students in the experimental group apparently gained more knowledge and skills.

Table 8 shows the ratings of the student respondents on the software TIMS. Given the highest rating was the item on screen design, display and use of graphics, followed by the item on organization of topics. Given the lowest ratings was the item sound. This was due to the fact that the sound system in the different multimedia rooms used was not functioning well. Also rated less than 2.50 were the items on pacing of lesson and voice over. This is due to the fact that the topics included in the software were taken by most of the

Table 7. *Comparison of Differences between the Pre and Post Tests of the Control and Experimental Groups*

	Control	Experimental
Mean	3.500000	6.418605
Variance	13.09302	16.5825
Observations	44	43
Hypothesized Mean Difference	0	
Df	83	
t Stat	-3.531008	
P (T<=t) one tail	0.000339	
t critical one-tail	1.66342	

Table 8. *Respondents' Rating on Software TIMS*

	1	2	3	4	Mean	
Content	1	12	28	4	2.78	S
Instructions/directions	4	4	31	6	2.87	S
Examples	1	10	31	3	2.80	S
Exercises	1	10	32	2	2.78	S
Screen	0	7	22	16	3.20	S
Organization of topics	1	5	31	8	3.02	S
Pacing of lesson	4	19	21	1	2.42	US
Sound	5	21	16	3	2.38	US
Voice over	6	17	19	3	2.42	US
Style	2	13	22	8	2.80	S
Average					2.75	S

4 – Very Satisfactory (VS) 3.50-4.00, 3 – Satisfactory (S) 2.50-3.49
2 – Unsatisfactory (US) 1.50-2.49, 1 – Very Unsatisfactory (VU) 1.00-1.49

respondents in the secondary level; hence, they found the pacing too slow. Because of the defects in the sound system, the voice over cannot be heard clearly; thus, the low rating in the said item.

The other items on the delivery of the lesson, such as content, exercises, examples, and instructions, were rated between 2.78 and 2.87 which means that the respondents were satisfied. They were also satisfied with the style used. Similarly, the average rating of 2.75 means that the student respondents are fairly satisfied with the software TIMS.

Table 9 shows the rating of the student respondents on the different support materials. Given the highest rating was the note sheet that outlined the content of the lesson taken up in the particular bit. The ratings given to the evaluation sheet and the assignment sheet were more or less the same. The over-all rating of 3.03 shows that the student respondents were satisfied with the support materials.

The questionnaire included the ten statements outlined in Table 10. The student respondents were asked to rate on a scale of 1 to 4 on whether they "strongly agree" to "strongly disagree" with the statement. The student respondents mostly agree with the statement that the "Room is properly ventilated." They tend to disagree with the statements that "Use of multimedia sustains student's interest", "Use of multimedia allows students to maximize the class period", "The software is easy to use", and that "Students were able to learn more using TIMS." They fairly agree with the first five statements related to the software such as suitability of software, appropriateness of discussion, sufficiency of examples, and appropriateness and accuracy of graphics used.

Table 9. *Respondents' Rating on Support Materials*

	1	2	3	4	Mean	
Evaluation sheet	0	8	30	7	2.98	S
Note sheet	0	6	26	13	3.16	S
Assignment sheet	2	5	31	7	2.96	S
Average					3.03	S

4 – Very Satisfactory (VS), 3 – Satisfactory (S), 2 – Unsatisfactory (UN), 1 – Very Unsatisfactory (VU)

Table 10. *Respondents Perception of Usefulness of TIMS*

	1	2	3	4	Mean	
Contents are suitable and useful for students.	3	11	28	3	2.69	A
Discussions are appropriate to level of students.	4	14	22	5	2.62	A
Examples are sufficient and easy to understand.	4	10	27	4	2.69	A
Use of graphics and sounds is appropriate.	4	16	22	3	2.53	A
Graphics are pertinent, accurate and visually interesting.	3	18	19	5	2.58	A
Use of multimedia sustains students' interest.	7	18	18	2	2.33	DA
Use of multimedia allows students to maximize class period.	13	12	15	5	2.27	DA
Software is easy to use.	9	14	18	4	2.38	DA
Room is properly ventilated.	2	2	24	17	3.24	A
Students were able to learn more using TIMS.	12	19	14	0	2.04	DA
Average					2.54	A

4 – Strongly agree (SA), 3 – Agree (A), 2 – Disagree (DA), 1 – Strongly disagree (SD)

The average rating of 2.54 shows that the student respondents basically agree with the different statements on the usefulness of TIMS and its effect on the teaching-learning process.

Qualitative Results

Eight randomly selected students were invited to participate in the one-to-one interview and their statements were coded ST 1 – ST 8. Each of the interview lasted for a minimum of thirty minutes to a maximum of two hours. The interview questions were in English, but the responses were either in English or in Filipino according to the personal preference of the students. The interview questions focused on the student's actual experience in using the CD TIMS. The following questions provided the basis for the interviews:

- What were your expectations when told of the use of multimedia approach in learning the introductory topics in trigonometry?
- Have you used CDs in learning a particular topic before? How did you find the materials in available CDs?
- How do you think TIMS could harmonize with the teaching activity? How do you compare it with the traditional chalk and talk approach?
- How do you find the different support materials given?
- What are the good points in the software used? The weak points?
- What were the difficulties encountered?
- Were you able to work as a group in exploring TIMS? How did you find the experience?
- How would you rate TIMS?

All the interviews were done in the morning before the start of the first class period of the students, and were audio-recorded and transcribed. These interviews were analyzed for data categorization. The information gathered were culled and principal findings deduced as follows:

Use of CDs

Students were asked to share their expectations and experiences in the use of CD, especially in doing research. Most of the respondents find it user-friendly. There is no need for special instructions and the CD can easily be accessed. They find it helpful in doing research since they don't have to read the whole text anymore, thus learning was optimized. They find it accessible since one can bring the CD anywhere. However, ST 4 who came from the province claims:

"*Not much ang use ko ng CD. Wala akong computer. Sa library namin, restricted iyung paggamit ng CD, napaka valuable sa kanila."*
(Not much use of CD. I don't have a computer at home. The use of computer in our high school library is very restricted, because it is valuable to them)

The respondents have differing perceptions as to the completeness of information gathered from CD. ST 1 says: "*colorful, detailed information; to prepare a report, you just have to cut and paste"*, while ST 2 says: "*limited information, not as concise and detailed as the book."* On the other hand, ST 5 did not comment on its completeness but says: "*accurate and precise information; may website pa* (there is a website) *for further information."*

All the students interviewed never had the experience of using CDs in the classroom. They were amazed at how the CD on TIMS was developed and the amount of time and resources invested in it.

Concepts and Expectations from the Use of Multimedia Approach

To the average college student, the use of a multimedia approach in teaching means only one thing, the use of a computer. To cite ST 2, "*Computer na ang magtuturo sa amin, si ma'am, magsusupervise lang"* (The computer is the one that teaches us, the teacher simply supervises). They do not expect teachers to be using acetates and OHPs anymore, but instead, it should be LCD projectors, computers and CDs. Additionally, they expect to see powerpoint presentations.

Some unfortunately equated the use of a multimedia approach with a better learning environment. This could be due to the fact that some of the classrooms in the college are not air-conditioned. So says ST 2, "*aircon daw, malamig"* (airconditioned room, cold). ST 4 says: "*malamig, sobrang comfortable, iyung iba hindi na lang nakikinig"* (cold, very comfortable, some are not listening anymore). ST 3 even says that *"inaantok sila sa lamig"* (sleepy because its cold). They said they hope to learn more because of the use of visuals. Most of them expected moving objects, and interaction with the program. The students were excited that for the first time they will be taught mathematics using software.

Experience with TIMS

"High tech" was the term used by the students to describe the new learning modality they were exposed to.

Most of them were excited that they were chosen for the experiment. *"kakaiba ang pagtuturo"* (ST 2), *"Bagong way ng pagtuturo, enjoy and quite interesting"* (ST 3) (different way of teaching).

They were able to relate easily because of the use of Mr. Tomasino, a well-known caricature in the University. They were surprised that the development of the lesson, as well as the examples and exercises, were incorporated in the software. They were not used to the environment where the teacher simply guided them in exploring the software.

Students found the discussion on the software sufficient in that it has *"more concrete diagrams of problems"* (ST 4). They found the examples and exercises good, but not very sufficient. They said the software was not very user-friendly, because it accepts only a specific response for a particular question. ST 3 complained that he had difficulty placing the graphics properly. He even said

> *"Napaka-perfectionista nung software. Yung gusto lang niyang sagot ang tinatanggap, no alternative."*
> (The software is very perfectionist. It only accepts answers that it likes)

A common complaint of students was related to the sound effects. The sound systems in some rooms were not functioning well. In many instances, the sound was very irritating. They found it *"masakit sa tenga"* (ST 2) (painful on the ear). They also found *"problem in the voice over"* (ST 5). ST 2 says "*masama ang voice-over*" (voice-over is bad). ST 4 found *"the person making the voice-over cute, but the voice-over is very bad."* He observed that *"yung sound ng character, matagal bago lumabas*" (It takes time for the sound to come out).

All the respondents shared the view that it was very difficult to start TIMS. A lot of time was wasted for activating the software, unlike when they were using CDs in their research work. Some of the computers were not functioning properly. There was an instance where the mouse cannot be used since the mouse ball was missing. They cannot understand whether the problem was the hardware used, the software, or a combination of the two. Due to this limitation, some students gave up participating. ST 2 even asked himself once: *"Ang tagal naman, makikinig pa ba ako?"* (It is taking so much time, am I still going to listen?)

Due to these problems, the class had to extend beyond the official time. As voiced out by ST 1, *"parating nago-overtime"* (always extend the time). ST 2 says: *"nauubos ang oras sa pag-aayos ng computer"* (time is wasted fixing the computer). Also, the time allocated for these lessons was extended by a few weeks. Thus, the teacher had a hard time coping with the syllabus provided by the Office of the Dean.

With regards to the different instructional materials given, most of the respondents find the note sheets suitable. It takes away from the student the need to take down notes, and makes them concentrate on the software instead. The negative effect of it is that some students were not listening anymore to the discussion, *"because they were provided with materials, without which they would take down notes"* (ST 1). Hence, some students simply answered the evaluation sheet while the class was exploring the software.

The students found the exercises in the evaluation sheets too simple compared to the quizzes given by the teacher. They said that these were similar to the examples in the software, while the teacher gave very difficult problems in the quizzes.

Most of the student respondents were not familiar with the use of the assignment sheet. Instead of looking at it as a reading assignment in preparation for the next day's lesson, they looked at it as something which they have to master before coming to class. Hence, they complained that they were not able to answer the assignment sheets due to lack of background.

Most of the students complained about the difficulty of making reservations for the use of a multimedia room. First, there is the procedure of getting signatures (class president and teacher of the class assigned to the multimedia room to be borrowed, class president and teacher of the borrowing class, the math/computer coordinator, and the representative from the Office of the Dean). Students had to go from one place to another to get the signatures. Even after all that, most of the time, they were required to leave the form and go back for a single signature. At times, several classes were queuing for the use of the multimedia rooms. These sentiments of the students which were voiced were as follows:

> ST 1:
> **"***nagpapapirma sa teachers, dean* (have to get the signatures of the teachers and the dean)
> *difficult process just to get the room on that time, date maraming nasasayang na oras* (much time wasted)
> *mahirap kausap yung prof., may specification pa, kailangan aircon din ang room na kapalit"* (difficult to talk to the prof., there are specifications like the room to be given to them should also be airconditioned)
> ST 2:
> *"mahirap sa panghihiram ng multi-media, paunahan* (difficult to borrow multimedia room, first come-first served)

kailangan lumipat ng room (have to change room)
kailangan maaga kang manghiram" (have to reserve early)
ST 3:
"minsan mahirap manghiram, nagkasabay-sabay sa panghihiram" (at times, difficult to borrow room, several sections are queuing for reservation)
ST 5:
"I really had difficulty in borrowing the multimedia room."

As a result, there were class hours wasted because the class was not able to secure a reservation for a multimedia room. The teacher, on the other hand, was not able to prepare a contingency plan due to communication problems.

All things considered, students found the experience worthwhile. They commended the University for embarking on the project. They found the software useful for beginners in Trigonometry. They like the concept of using CDs in teaching and learning a particular topic, since learning is enhanced by moving objects, voice over and real life-like illustrations.

Finally, on a scale of 1 to 10, with 10 as the highest, ST 2 rated the software 7; ST 3 rated it 4; ST 4, 6; and ST 5, 6.5. ST 1 is non-committal, insisting that learning can take place only if the students are interested in the course.

Cooperative Learning vis-à-vis the Use of TIMS

In using TIMS, students were grouped and told to learn the lessons together. They were supposed to explore the software, discuss the lessons, and do the exercises as a group.

When asked how they handled the arrangement, some students who were assigned as leaders complained that their class mates waited for them to solve the exercises, and then they simply copied the solutions. *"They expect one person to do all the job, tumatamad ang ibang estudyante"* (ST 1) (the other students are becoming lazy). There were some groups though, that stuck together and learned the subject matter as a group. They exchanged ideas and even tried to find time either before or after class to discuss the lessons. Some group leaders divided the work and arranged group study sessions. "*Tinuturuan kami ng leader para makuha ang lesson"* (ST 2) (Our leader teaches us so that we could understand the lesson). There were also groups that just stuck together, but since they were not close to each other, it was still each to his own. *"Hindi kami nagtatanungan"*, so says ST 3 (We do not help each other).

Looking to the Future

Most of the suggestions focused on how the software could be enhanced. Students want more examples and exercises, and they want them to vary in degrees of difficulty. ST 3 suggested "more in-depth discussion since *this is a course in college and kulang ang content"* (the content is not sufficient). He suggested putting *"one lesson in one bit"*, rather than dividing the lesson into two bits for the purpose of continuity of thought. ST 4 suggested that "*yung drawing kung kaya, i-relate sa everyday life"* (relate the drawing to everyday life). The students suggested that the software be properly *"written on CD"*, so that the program will work properly even without "*uploading it to the computer"* (ST 5).

Everybody agreed that the procedure implemented in the College for the reservation of multimedia rooms should be reviewed. With the hectic schedule of the students, it becomes very inconvenient to seek the signatures of several people, considering that the two offices that give the final approval are situated on different floors of the building that can only be accessed through the ground floor.

Students also suggested the proper upkeep and maintenance of the computers and its peripheral in the multimedia rooms. They also requested one-and-a-half hour class sessions for the use of technology in classroom so as not to be limited by time.

To encourage cooperative learning, students suggested providing exercises that would require group work. ST 1 suggested "*allowing students to choose their own group mates*" so that they could work with their friends.

Most students still think that there is no substitute for having a teacher. Although it is good to use technology in the classroom, they want "*elaboration and guidance from the teacher"* (ST 1, ST 3). Somehow, they feel that "the teacher can answer questions that may arise *na hindi ma-answer ng program"* (ST 4, ST 5) (the teacher can answer questions that may arise that could not be answered). There were some who think that the teacher is very important in the classroom, "*hindi pwedeng mawala"* (ST 2) (we cannot do without her). They feel that "TIMS *should be used hand-in-hand with the professor, not really use TIMS as the professor itself"* (ST 5).

Finally, they suggested that after the software is enhanced, it should be evaluated again before actual implementation. Additionally, ST 5 suggested that *students be allowed to access TIMS on-line*, although he raised the issue of added cost that may arise due to the use of technology. He suggested that *if material is to be used on-line, then let it be optional on the part of the students so as not*

to burden them financially.

Conclusions

TIMS is one of the first, if not the first, attempts on the part of the University to develop instructional material in mathematics that can be delivered in the multimedia classroom. Apparently, in spite of its limitations, students acquired knowledge and skills after using the software. The amount of learning that took place is comparable, and could be more than that of the class that used the traditional lecture-discussion method. This affirms the survey of Russell (1999, cited by Rost 2001) that there are no significant differences in learning by using the different approaches in teaching.

The student respondents generally agree that the software TIMS is useful for learning the introductory topics in Trigonometry. They are satisfied to some extent with the software, but they are satisfied with the different support materials provided. They suggested that more examples and exercises be provided in the software and that these be of different levels of difficulty.

The software itself has to go through a process of enhancement and testing. Feedback should be sought in every enhancement done to fine tune the software according to students' needs. The software should include group activities so that students are given the opportunity to learn as a team, thereby deepening their understanding of the lesson (Chickering and Gamson, 1987).

The need to look into guidelines and procedures in the borrowing and use of multimedia rooms in the different faculties/colleges, as well as the proper upkeep and maintenance of physical facilities is deemed important. There should be proper coordination among the different departments and offices to ensure that resources are utilized to the maximum extent so as to provide a better learning environment for the students.

As institutions move forward towards the use of technology in teaching, the fact still remains that there is no better substitute for the teacher who incarnates not only conceptual understanding in the classroom but sound universal values as well. While the teacher is the one that inspires and stimulates the students, technology simply enriches teaching (Murray, 1999). Technology, in effect, cannot replace the teacher in the teaching-learning process (Institute for Higher Education Policy, 1999 cited by Rost, 2001).

Though results yielded in this study were pedagogically interesting, there is a need to subject the developed courseware to a larger sampling for more generalized results. The software under discussion can be further tested in a multi-disciplinary setting and may involve expert validation.

Reference

Alcroft, J. (2002). Illuminative Evaluation for Design Educators using Critical Trialling. Retrieved June 26, 2003, from http://www.lancs.ac.uk/palatine/s-v-presentations/alcroftpaper.htm

Bagarino, A. P. (1998). Development and Validation of a Computer-Assisted Instructional Material in Differential Calculus. Unpublished Dissertation, Manila: Centro Escolar University.

Chickering, A. & Gamson, Z. (1987). The Seven Principles for Good Practice in Undergraduate Education. Retrieved June 28, 2003 from http:// www.tltgroup. org/programs/seven.html

De Castro, B. V. (2000). Modular Approach in Teaching Linear Equations and Inequalities. Unpublished Master's Thesis, Manila: UST Graduate School.

Domingo, L.R. (1998). A Proposed Instructional Material in Math IV Specifically Exponential and Logarithmic Functions at Sauyo High School. Unpublished Master's Thesis, Manila: EARIST Graduate School.

Houghton, P. M. (1997). Relativity of the Modular Mathematics Delivery System to the Successful Completion of the Next Sequential Mathematics Course. Unpublished Dissertation, Michigan: Walden University.

Murray, B. (1999). Technology invigorates teaching, but what is the pazzazz worth the price? Retrieved December 2, 2003 from http://www.apa.org/monitor/apr99/faculty.html

Reed, M. W., Burton, J. K., Liu, M. L. (1994). Multimedia and Megachange: New Roles for Educational Computing. New York: The Haworth Press Inc.

Rosow, L.V. (2001). Technology in Education: Equity and Theory are Key. *Tech Trends*: 45(4), 31-39.

Rost, T. L. (2001). Paper presented at the SEB Annual Main Meeting 2001 at the Innovative Teaching Workshop. Retrieved December 2, 2003, from http://www. sebiology.org/Bulletin/Oct2001/article2.htm

Teaching, Learning & Technology Center Handbook for Faculty, Chapter 2 Technology for Teaching and Learning (n.d.). Retrieved July 2, 2003 from Teaching, Learning & Technology Center Website: http:// tltcdev.shu.edu/handbook/chapter2/Index.htm

Uy, C. & De Castro, B. V. (2002). Effectiveness and Acceptance of the Modular Approach in Teaching

Selected Topics in Algebra. Paper presented in the International Conference on “Higher Education for the 21st Century”, Curtin University of Technology Sarawak Campus, Miri, Sarawak, Malaysia on September 24-26, 2002.

Received March 18, 2004
Revision received January 10, 2005
Accepted February 15, 2005