Technology Package for Student Learning Empowerment:

PC Tablet Math Lesson Courseware Development

Final Report

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Introduction

The Philippines lags behind many other countries in terms of math (and science) expertise, as shown by our students' dismal scores in international and national surveys; for instance, in the Trends in International Math and Sciences Study (TIMSS) since the mid-1990s. Student scores have increased slightly from 2006 to 2009, according to Department of Education (Dep Ed) data, but the plethora of remedial classes in schools and colleges may belie this claim.

At the same time, global information technologies have been growing at a fast pace, from gigantic ponderous machines in the 1940s to the sleek miniature powerful phones and tablets that can fit in the palm of our hands. Along with rapid advances in hardware have appeared numerous software applications, initially for military and academic purposes (such as electronic mail) to ubiquitous social media used primarily for pleasure and contact by the general public (such as Facebook and Twitter).

Inevitably, hardware and software have also been retrofitted to fit the needs of education, from open-source codes to open universities; from Powerpoint in presentations to iPads in the classroom. Commercial software, including games, have burgeoned, from well-trusted pioneers such as JumpStart and Reader Rabbit, to----right now---practically every Juan and Juana who wants to cash in on the urgent need of parents to equip their kids with the most up-to-date educational techniques; the pressing requirements of schools who perennially lack well-trained and well-qualified teachers; the intense hunger of students for lessons that are presented not just in a proper way, but also in an entertaining manner.

Many psychologists and educators have warned against what they deem as the increasing computerization of learning, but then again, several experts say that children (particularly those who do not respond to traditional methods of instruction) learn concepts better with the aid of technology. Studies exist for both sides, and after years of research (and conducting my own studies), I have come to realize that moderation, again, is key: learning cannot all be relegated to the computer, but neither can we ignore the possible positive effects of well-designed educational software, given our pressing need to ensure that our students learn math (and science) in as many meaningful ways as possible.

Aims

Department of Science and Technology (DOST) Secretary Mario Montejo recognizes this need, thus he has tasked a Working Group to do math courseware (done by Filipinos), and to pilot the material, to see if it can make an impact on student learning.

Specifically, the aims of the project are:

1. To develop material to supplement math teaching and learning in the classroom, based on the concepts in the Dep Ed's Basic Education curriculum (which was in place when we started the project; but we also made sure it would be compatible with the proposed Kindergarten to Year 12 curriculum);
2. To test lesson material with various public school students across the country, revise whatever needs correction, and do recommendations in that regard;
3. To train teachers, as needed, to utilize the courseware to maximize its instructional potential;
4. To distribute the courseware (with corresponding hardware units) all over the country, if and once everything is deemed satisfactory.
5. To recommend further steps for future directions based on the results of the project.

Cooperation among Units

Because of the multi-faceted nature of the project, several units need to come together: Science Education Institute (SEI) that financed and oversaw the project; the Advanced Science and Technology Institute (ASTI) that provided the hardware and software production skills needed for the project; Dep Ed that made possible the pilot testing of the material in the various schools.

With DOST Undersecretary Fortunato de la Pena and Dep Ed Undersecretary Yolanda Quijano, I was made co-chair of the Steering Committee. I immediately took on board the invaluable services of the National Institute for Science and Math Education (NISMED) that wrote the lesson scripts.

The project has multiple phases: (1) design and development of the lessons for the courseware; (2) digitization of the learning material; (3) training of teachers on the use of the courseware, and; (4) pre-pilot testing of the courseware using tablet PCs; (5) pilot testing of the courseware using tablet PCs.

Because of time and personnel constraints, we decided to start with and focus on Grade One Math. Table 1 shows the subject topics we agreed were most important, based on student needs and competencies, as seen in surveys and our own experiences as math educators.

Table 1: Lesson Topics and Corresponding Activities for Grade One Courseware

Main Topic	Lesson	Title	Activity
Whole Numbers	1	Classifying Objects	Activity 1: How are the objects classified?
			Activity 2: Classifying objects according to a given condition
	2	Comparing Sets of Objects and Numbers	Activity 1: Forming sets of objects
			Activity 2: How many more or fewer do I have?
	3	Ordering Sets of Objects and Numbers	Activity: Which comes first?
	4	Searching for Number Patterns	Activity: What shapes or numbers are missing?
	5	Adding Whole Numbers	Activity 1: Expressing a number as a sum of two numbers
			Activity 2: Finding the missing addends or sum
	6	Subtracting Whole Numbers	Activity 1: How much money is left?
			Activity 2: Searching for the missing digits
Fractions	7	Partitioning Regions into Halves	Activity 1: Exploring ways of representing one-half
			Activity 2: Finding the whole
	8	Partitioning Regions into Fourths	Activity: Representing one-fourth in different ways
	9	Finding the Whole Region or Set, Given ¼ of It	Activity: Complete me!
Measurement	10	Measuring Length Using Nonstandard Units	Activity 1: Estimating the length of an object
			Activity 2: Which object has this length?

I edited and revised the scripts, and after I gave my go-ahead, the NISMED team would discuss with the ASTI team how to best provide animation to make the scripts come alive. The Steering Committee held meetings to finalize the ideas.

Each script starts with two or more of four Filipino students, named Ed, Dan, Tessa, Aida, who are playing or studying in real life, and then encountering a situation that is best solved by math. Animation is done, with voice-overs (actors hired by ASTI).

Students then do the "Activity" (most lessons have 2 activities, while others have one), and then go to the section on "Fixing Skills" to increase mastery of the concept.

Together with the scripts for students was the development of Teaching Support Material, teachers' guides on how to use the courseware effectively in class. Each guide, based on each lesson, has 3 parts:

- Curriculum Entry Point – indicates the major unit where the lesson is found and the competencies addressed based on the Basic Education Curriculum (would be formatted to suit K to 12 Curriculum)

- Activities – includes brief introduction of the activity and the skills it intends to develop, the objectives of the activity, the prerequisite concepts/skills needed for the activity, and teaching guide

- Vocabulary – defines important ideas or words used in the activity

Technical bugs had to be ironed out, but in July 2011, the team presented a promotional teaser during the National Science and Technology Week (NSTW) at SM MOA Convention Center. The project was well-received by the media, and we realized the hunger of educators for such programs.

In the meantime, the schools for pilot testing have been identified. We decided on ten schools scattered around the country (to ease logistics, two schools in each region), which Dep Ed feels are easy to work with, and which have enough facilities (electricity, existing computers) to support the pilot testing. The final schools are shown in Table 2:

Table 2: Pilot Schools and their Regions

Region	School
I – Ilocos region	San Nicolas Elementary School, San Nicolas, IlocosNorte
	Pasuquin Central School, Pasuquin, IlocosNorte
IVA – Calabarzon	Tanauan North Central School, Tanauan, Batangas
	Lores Elementary School, Antipolo City
NCR – National Capital Region	Fourth Estate Elementary School, Sucat, Paranaque
	San Agustin Elementary School, Moonwalk, Paranaque
VIII – Eastern Visayas	Cong. A. T. Aguja Memorial Central School, Carigara, Leyte
	Cassidy Elementary School, Carigara, Leyte
X – Northern Mindanao	Jasaan Central School, Jasaan, Misamis Oriental
	Kimaya Elementary School, Jasaan, Misamis Oriental

All the schools consented to the testing (on the promise that afterwards, 50 tablet computers with the courseware would be given to them). Afterwards, their Grade One math teachers came to NISMED to be trained on the software and PC tablet by NISMED and ASTI. Training took two days, and the teachers themselves were also given pretests and posttests. Results of the posttests looked promising, but the sample was too small to generalize well.

Things were set, but the biggest hurdle was something out of our hands: on the hardware end. To make things transparent, ASTI had to comply with bidding and auction laws, but first they had to ensure that enough funding was available to entice companies to bid. This delay in procurement of funds caused us some months, but finally, when things were expedited, the project flowed steadily.

Pre-Pilot Testing

Since the PC tablets were not yet available (fund procurement and bidding took months), we decided to do a pre-pilot phase on the courseware, using laptop computers instead, which were provided by SEI. The objective was to identify possible problems in the testing, and iron these out to make the actual pilot testing smoother.

From November 2011 to March 2012, pre-pilot testing was done on the 10 schools. All the lessons were pre-piloted in the various schools, starting from Lesson 1 in Jasaan (November 2011) and ending with Lesson 10 in Fourth Estate (March 2012). In this way, all the lessons in the courseware were tested.

Lesson 1 is "Classifying Objects." Activity 1 is "How are objects classified?" and Activity 2 is "Classifying objects according to a given condition."This lesson, and both activities, were used in the Practice Sessions for the pre-pilot phase in all schools, except for those in Region Ten, which used other lessons for practice.

Lesson 1 is composed of two activities on whole numbers, and asks students to classify sets using common objects according to color, size (length, height, thickness, width, etc.) and shape.

Activities on classifying objects usually involve putting objects together based on a given attribute such as color, shape, or size. In Activity 1, the pupils have to do the opposite. They are given sets of objects that have been classified according to a certain attribute. Their task is to identify the basis used for classifying them. The attributes considered in this activity are color, size, shape, number, and whether the objects have corners or none.

Activity 2 makes pupils classify objects according to a given condition. It serves as an enhancement to what they have already learned about classifying objects in their previous lessons. Furthermore, the exercises in this activity develop among pupils not only skills in classifying, but also observing, recognizing, and identifying attributes.

Upon arrival at the school, the monitoring team made a courtesy call to the regional supervisor/ division superintendent and principal. They were informed on what will transpire during the visit. They were invited to observe the implementation of the lesson/s. In addition, the principal was asked to answer two questionnaires: *Principal's Questionnaire* and the *Principal and the School Profile Questionnaire*.

The two teachers from each school who had been trained earlier chose two intact Grade One classes. One class was assigned as the experimental group, while the other class as the control group. The experimental group would use the computers; the control group not.

A pretest was given to both experimental and control groups at the same time. The posttest was administered after the implementation of the last activity. After the administration of the pretest, the staff of DOST ASTI assisted by the staff of DOST SEI, UP NISMED, and DepED familiarized pupils in the experimental group with the features and operation of a laptop computer. They also gave the pupils a chance to try out some activities in the courseware.

The planning session was conducted by UP NISMED staff with the two teachers. The teachers were informed that except for the use of the computers, the experimental and the control groups will be subjected to the same conditions: lesson, teacher, and evaluation. Moreover, they were told that only one of them will implement the lesson/s while the other one will assist during the implementation.

Teachers with the guidance of UP NISMED staff, planned the implementation of the activity, from the Activity Proper to the Fixing Skills and finally, the Evaluation. Materials to be used were provided by UP NISMED staff. Additional materials were made as a result of teachers' ideas on how to go about the implementation more effectively. After the planning, the implementation followed, first in the control group then in the experimental group. The monitoring team, who were sometimes joined by the instructional leaders and administrators, observed the implementation of the activity. They sometimes answered pupils' questions. In some cases, immediate feedback was given to the teacher during the implementation of the lesson, like shortening the preparatory activity. After the post activity discussion, selected pupils were interviewed to get feedback about the courseware, like the part they liked most or they found difficult. After the implementation, the team and other observers together with the teachers sat down for a post activity discussion. When all activities have been implemented, the posttest was administered.

After the posttest was done, other teachers were given an opportunity to experience using the courseware and were asked to give feedbacks. Likewise, the pupils in the control group were given a chance to use the courseware.

After statistical analysis, there seemed to be a significant difference between the scores of the experimental and control groups (with the former having higher scores). This means that possibly, the courseware was instrumental in making them attain higher scores in the posttest.

But I was personally not satisfied with the samples and the conditions. For instance, too many pupils were absent in either the pretest or the posttest for the results to be extremely valid. Also, because the two groups were not comparable at the start, the statistical test of ANCOVA was used instead of a more appropriate one---difference of two means.

These two shortcomings would be addressed in the actual pilot testing phase.

Pilot Testing

The information on pilot testing is generally taken from NISMED's final pilot testing report of September 26, 2012. For other details, see their report.

The official pilot testing of the Grade One lessons 2 to 4 was done from July to September 2012 (interrupted for a bit by the August 2012 Habagat). The problems encountered in the earlier pretest was dealt with, primarily the high absentee rate of the students. This time, the principals of the schools ensured that their students were present for the entire testing period.

We also agreed that the pilot testing will be done for Lessons 2 (Activity 2), 3, or 4, in line with public school students' math lessons in those months. Lesson 1 and Lesson 2 (Activity 1) were used for the practice sessions.

Lesson Two is "Comparing Sets of Objects or Numbers." Activity 1 is "Forming Sets of Objects" and Activity 2 is "How many more or fewer do I have?"

Lesson 2 includes two activities. Activity 1 aims to develop student skills in comparing the number of objects in two sets. They construct a set of objects that are fewer than, as many as, or more than a given set. Afterwards they determine the number of objects in the resulting set.

Activity 2 aims to enhance pupils' skills in recognizing, identifying, comparing, and applying conceptual understanding to sets. Pupils compare two sets using the expressions "fewer than," "more than," or "equal to." They determine how many more or fewer objects a set has than another set.

This lesson is generally taken before that on operations on whole numbers. So one strategy that can be helpful is to match the objects of the two sets. The set having an extra element/s without any corresponding counterpart in the other set is the bigger set.

However, it is possible that some pupils may already have previous knowledge on numbers, so they can use the "count-on" strategy to determine how many more objects are needed for two sets to be equal. Evidently, the number of objects needed to make the two sets equal is the same number by which one set is more or fewer than the other.

This activity can also serve as an introduction to the concept of subtraction.

Lesson Three is "Ordering Sets of Objects or Numbers," and the Activity tested for the lesson is: "Which comes first?"

This activity enhances skills such as recognizing, identifying, comparing, and applying conceptual understanding on numbers and sets.

After students have learned to compare sets, they are ready to order or arrange three or more sets of objects or numbers, according to a certain condition or criterion. Pupils order or arrange sets of objects or numbers from least to greatest (and vice versa), and arrange distances from farthest to nearest (and vice versa). Pupils also choose from among several sets the one with the most or the fewest number of objects.

Lesson Four is "Searching for Number Patterns" and the Activity tested for the lesson is "What shapes or numbers are missing?"

This activity involves recognizing patterns involving shapes or numbers. Students arrange objects according to some characteristic/s, order things in a repeated sequence, and use and extend patterns. From the observed patterns, they should be able to make generalizations about the sets or numbers.

Patterns help students develop number sense, ordering, counting, and sequencing skills. Very young children first develop patterns with objects, and eventually with numbers.

Sample Size

812 Grade One pupils participated in the study, but only 747 were included in the analysis of data, practically 92%, a good enough number to make data valid. Table 3shows the actual percentages of each school:

Table 3: Sample Size vis-à-vis Total Number of Pupils

School	Total Number of Pupils	Number of Pupils Included in Analysis	Percentage of Total
Jasaan Central School	81	69	79%
Kimaya Elementary School	93	87	94%
Cong. A. T. Aguja Memorial Central School	87	87	100%
Cassidy Elementary School	87	77	79%
Fourth Estate Elementary School	78	69	88%
San Agustin Elementary School	89	70	78 %
San Nicolas Elementary School	82	82	100%
Pasuquin Central School	51	51	100%
Tanauan North Central School	80	79	99%
Lores Elementary School	84	76	79%
TOTAL	812	747	92 %

We wanted to ensure that only pupils who were present for the duration of the testing (three to four days) for both experimental and control groups were counted in the study. Pupils who missed at least two end-of-activity evaluations were also dropped from the analysis.

We note that pilot testing was done during the rainy season (a particularly vicious one in 2012), and some pupils were absent because of the heavy rains or floods. In Jasaan Central School and Kimaya Elementary School, some pupils had to cross a spillway to school, which became impassable during rains. (Kimaya though, still had a whopping 94% student inclusion rate.)

We need to keep these constraints in mind when conducting future pilot studies on courseware for upper grades.

The experimental group was composed of pupils who used the lesson courseware in the tablet; the control group did not. The other variables were kept as constant as possible: the same teachers taught both groups, the grade levels were the same, the composition of the classes were heterogenous (mixed-ability); the classrooms were practically the same, etc.

We wanted to isolate the effect of only one variable: the use of the courseware in the PC tablet.

Findings

Pretests and posttests (on the math lessons 2, 3, 4) were given to both experimental and control groups, and afterwards, their scores on each were calculated. The differences in average (mean) gain scores were calculated, and using the statistical software SPSS, with the usual difference-of-means tests (Z test for big samples), the probability values (p-values) difference in the mean gain scores of the two groups were gotten.

The important thing to note is what the probability values imply for statistical significance. The mean gain scores for all the schools (except for Pasuquin Elementary School) were significant at the 0.01 level, which means that there is a 99% degree of confidence that the difference in scores is genuine, not a statistical fluke.

In short, we are (very) 99% confident that the difference in scores (the experimental groups all had higher scores) may be due to the students' use of the courseware in the PC tablet.

Pasuquin Elementary School did not do badly, either. Their mean gain score was significant at the 0.05 level, which means there is a 95% degree of confidence that the difference in scores may be due to the student use of the courseware. Statistically, 95% degree of confidence is considered more than acceptable.

Table 4 shows the detailed statistics results in mean gain of scores.

Table 4: Probability Values, Significance Levels, Degree of Confidence

School	p-value	Significance Level	Degree of Confidence
Jasaan Central School	0.000	Significant at 0.01	99% confident
Kimaya Elementary School	0.000	Significant at 0.01	99% confident
Cong. A. T. Aguja Memorial Central School	0.000	Significant at 0.01	99% confident
Cassidy Elementary School	0.000	Significant at 0.01	99% confident
Fourth Estate Elementary School	0.000	Significant at 0.01	99% confident
San Agustin Elementary School	0.000	Significant at 0.01	99% confident
San Nicolas Elementary School	0.000	Significant at 0.01	99% confident
Pasuquin Central School	0.022	Significant at 0.05	95% confident
Tanauan North Central School	0.000	Significant at 0.01	99% confident
Lores Elementary School	0.000	Significant at 0.01	99% confident

When the students' posttest scores were correlated to their total score in the end-of-activity evaluations, the Pearson r correlation test showed that there is again a highly significant (at 0.01 level) relationship between them. The higher the end-of-activity evaluation score, the higher the score in the posttest, and vice-versa. This means that we are 99% confident that that the activities in the courseware may have accounted for the student posttest scores, and indirectly, for the students' increase in performance.

Table 5 shows the correlations between courseware activity evaluations and student posttest scores.

Table 5: Pearson Correlations, Significance Level, Degree of Confidence

School	Pearson r value	Significance Level	Degree of Confidence
Jasaan Central School	0.534	Significant at 0.01	99% confident
Kimaya Elementary School	0.436	Significant at 0.01	99% confident
Cong. A. T. Aguja Memorial Central School	0.573	Significant at 0.01	99% confident
Cassidy Elementary School	0.570	Significant at 0.01	99% confident
Fourth Estate Elementary School	0.738	Significant at 0.01	99% confident
San Agustin Elementary School	0.615	Significant at 0.01	99% confident
San Nicolas Elementary School	0.616	Significant at 0.01	99% confident
Pasuquin Central School	0.405	Significant at 0.01	99% confident
Tanauan North Central School	0.452	Significant at 0.01	99% confident
Lores Elementary School	0.593	Significant at 0.01	99% confident

Observations and Recommendations

1. Most of the Grade One students can neither understand oral English nor read written English, which is the language used in the courseware. We had decided on English because most textbooks are written in English, and most teachers teach in English (as per Dep Ed observations).

But starting this school year 2012 – 2013, the use of the Mother Tongue in the early years (including Grade One) has been mandated. Thus, pupils are not yet exposed to English, accounting for their difficulties. (English would also be taught in the third quarter of every school year, a consideration to keep in mind once pilot testing of future courseware would be done for the upper grades.)

A good solution to this problem is the teacher. Recall that all teachers have undergone training (done by ASTI and NISMED) months earlier in NISMED itself in preparation for using the courseware. Thus, the teachers understood what the courseware was imparting, and thus, they were able to translate the questions or explain instructions to the students in their native tongue.

When this was done, pupils were able to answer the activities. This implies that the animation and the numbers were easily understood (even by young kids with little knowledge of English). The discussions that followed after the students had done the Activity, Fixing Skills, and Evaluation, were all conducted in their native tongue.

Recommendation: Translate the courseware into different dialects for the students to understand the lessons better. If the cost is too prohibitive (since the script was done by actors in English), then subtitles in native tongue can be added on every image.

Teacher should continue updating their skills in information technology (through seminars or workshops) so they can feel more confident about using digital learning aids. If possible, include in the research or training team an expert who can speak in the Mother Tongue of a particular region.

2. The courseware was originally created to support the existing curriculum, under its constraints, with a time allotment of 70 minutes each for math in Grade One. When the K to 12 curriculum took effect this year, math class was cut down to 50 minutes, a loss of 20 minutes. Thus, during the pilot testing, the implementation of the some activities invariably went beyond 50 minutes, particularly in the experimental groups, where the setting up of the tablet PC took some time.

Recommendation: For future courseware, keep in mind Dep Ed constraints. Make activities and lesson plans suitable for 50, instead of 70, minutes, (unless for some reason, K to 12 plans are revised).

For the current courseware, teachers need to be flexible. Perhaps they can choose which activities or parts of the lesson to use in class, or even do the lesson in two sessions instead of one.

3. Students were very excited to using tablet PCs. While instructions were given out on how to properly use them, they were attentive, but a bit distracted by the sight of the tablet in front of them. Some students were energized, while others were more hesitant. But practically everyone was eager to use the tablet PC.

Also when viewing the courseware, some students unconsciously placed their figure on their mouth or nose, afterwards using their fingers to tap the screen, smudging it and making the equipment tedious to clean afterwards. If tablets do not respond, they keep on tapping (a natural reaction), but this could cause the equipment to hang.

Recommendation: Students should be given more time (possibly an introductory lesson or two, in just using the tablet PCs, before any formal lesson is done. Afterwards, since the PC is intuitive (and the students, being young, absorb technology easily), they can explore by themselves (or with the teacher's help) the various features of the PC and the courseware.

Teachers should learn better classroom management, especially how to handle students and call their attention to the task at hand. Workshops on classroom management (including classroom discipline) are recommended.

4. Interaction between pupils was kept to a minimum, because each student was provided with his or her own tablet PC to use. Several concepts in math are retained better through cooperative learning or pair work, and individual PC tablets tend to foster individual learning, without the benefits of exchange of ideas.

To make matters worse, some students who had finished answering a question would tap their seatmates' tablet PC when the latter had not yet figured out the answer.

Recommendation: Instead of one student per tablet, have two students share a tablet, especially when doing the Activity or Fixing Skills portions. This makes them interact to solve a problem, and minimizes intrusion of faster learners upon the pace of slower ones.

5. Despite meetings between NISMED and ASTI to correct technical problems, some problems still remained, such as when the tablet PCs hanged or the screen did not reset. Mostly these were bugs, but

sometimes these happened when pupils were so excited that they could not wait for the voice over to finish before tapping the tablets or because they dragged several objects at the same time. More major errors would be marking correct answers wrong or wrong scores on the board on screen. These problems had already been communicated to the hardware team before the pilot testing. But because of lack of manpower and faulty equipment, not all technical issues could be addressed well.

Recommendation: Hire more personnel for ASTI to animate future courseware in the upper grades, which means setting aside early on, government funding for this purpose. For the public bidding of tablets, cost should not be the sole consideration, quality should also be kept in mind. We can always get cheap tablets, but will they last? (taking into consideration the inevitable spills, falls, accidents children are prone to do when handling hardware)

6. Many schools did not have a ready secure storage area and charging station for the tablet PCs, so the monitoring team had to improvise. The problem is compounded by the number of tablets given to each school: 50 tablets, a significant number.

Recommendation: Aside from the Grade One math teachers, schools need to assign personnel to ensure that the tablet PCs are safe and ready for use. Schools also need to designate a secure storage space safe from theft or calamities, plus a charging area for the computers.

Since we intend to have two (and not just one) student per tablet in the future, we recommend giving to the schools not 50, but 25, tablets.

Future Directions

At first, we had wanted to include more schools in the pilot study, especially those located in the NCR, which most likely would be the schools most equipped and thereby most ready to use the courseware once it becomes publicly available.

The following schools were identified by Dep Ed as possible pilot sites: Aurora Quezon Elementary School (Manila), P. Gomez Elementary School (Manila), NemesioYabut Elementary School (Makati), Pio del Pilar Elementary School (Makati), Marikina Elementary School (Marikina), J. Sumulong Elementary School (Pasay), T. Paez Elementary School (Pasay), Sto. Cristo Elementary School (Quezon City), Lagro Elementary School (Quezon City), and Taguig Elementary School (Taguig).

When ASTI and SEI inspected the computer capabilities of the schools, they found that even though the courseware would run with existing computers, only one school had enough computers with speakers. Most schools did not have earphones or headsets needed to pilot the courseware.

Moreover, the results with the original 10 schools were already significant enough that this added test was scrapped.

The team plans to create courseware for Grades 2 to 6, this time focusing on the topics most urgently needed by the students, and those which they find most difficult (according to surveys and our

own educators' experiences from previous research): fractions, proportionality, geometry, charts and data interpretation, statistics.

We plan to schedule creation of courseware based on topics first, starting with fractions, and piloting them for Grades 2 to 6 across the board for the next year. We recommend that the 10 NCR schools just mentioned be included as pilot schools. Funding should be made available for more hardware and the hiring of personnel to do the software.

As for the hardware, we recommend the use of laptops rather than tablets for young students. Laptops are more resistant to mishandling, and cost-wise, are the same price or even slightly less than tablets. They are also easier to handle in case keyboarding (not just tapping screens) is warranted.

In the meantime, once the bugs of the Grade One courseware are fixed, we recommend the rolling out of the courseware to schools across the Philippines, in line with innovations pushed by K to 12.

On a personal note: despite the delays, it has been a pleasure for me to work with several government teams at once (I am the only non-government person in the project), and in a relatively short time, we were able to accomplish something significant. The team works well together, and I look forward to working with them again.

Acknowledgements / References

The findings on the testing phases were generally taken from NISMED's reports to SEI.

NISMED. "Report on the Pre-Pilot Testing of the Interactive Courseware for Grade 1 Mathematics." April 2012.

NISMED. "Report on the Pilot Testing of the Interactive Courseware for Grade 1 Mathematics." September 2012.

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