A Three Day Versus a Five Day Graphing Handheld Professional Development Program; and, Its Attitudinal Effect On Teachers of Mathematics

Gail M. Gallitano and Kathleen Jackson
Department of Mathematics
West Chester University
West Chester, PA 19383
USA
ggallitano@wcupa.edu; kjackson@wcupa.edu; http://www.wcupa.edu

Abstract: - Professional development for all educators, including mathematics educators, is an important facet of their profession. It helps them to stay current and proficient. Under the aegis of The West Chester University Teachers Teaching with Technology In-service/Pre-service Professional Development Program a study was conducted using two different workshop formats to determine if one format over the other had a more significantly positive attitudinal impact on the educators. In addition, this study also showed that teacher in-service training significantly affects, in a positive direction, teachers’ attitudes toward the use of graphing handhelds and other technologies in the mathematics classroom. Both five day and three day graphing calculator institutes were held. The same attitudinal survey was done both before each workshop and again at the conclusion of each workshop. The study was conducted at West Chester University of Pennsylvania and it included 63 educators, mostly mathematics teachers. This study showed that a five day institute is more effective than a three day institute and that graphing calculator institutes have a positive attitudinal affect on teachers of mathematics.

Key-Words: - Professional development; attitudinal; graphing handhelds; educators; mathematics education

1 Introduction

Professional development is a continual process. There are both content and pedagogical areas that teachers must be kept abreast of; and, there are new issues today and new pedagogical methods that are preferred over the time-honored ones (Koolbreeze, 2009). Veteran teachers need ongoing and regular opportunities to learn from one another. Professional development should be ongoing, experiential, collaborative, and connected to and derived from working with students and understanding their culture. Research shows that an inspiring and informed teacher is the most important school-related factor influencing student achievement (Edutopia Staff, 2008). Undoubtedly, great effort and sufficient resources should be put into professional development programs for educators.

In addition to needing professional development, mathematics teachers also need to embrace technology in the mathematics classroom. For example calculators, when used appropriately, can be a learning tool for mathematics. "Appropriate use of calculators is a way of increasing the amount and the quality of learning afforded students during the course of their mathematics education” (Pomerantz, 1997). Calculators are a valuable educational tool and help to alleviate monotonous tasks and assist with the conceptual development of higher mathematical concepts. The major mathematical organizations NCTM, AMATYC, and MAA have developed standards which provide guidelines for mathematics instruction in grades K-12 and in some areas of the undergraduate mathematics curriculum (Gallitano et al., 2009). Reform efforts in mathematics instruction emphasize the “Rule of Three: every mathematical topic should be presented from the symbolic, algebraic, and graphic approach” (Clutter, 1999). It’s important that mathematics transferors of knowledge educate our students and prepare them for a society that is highly technological oriented.

2 Statement of the Problem

For mathematics teachers both professional development and embracing technology in the classroom is essential for excellence. Any improvement in education must start with improvement of the teachers already in the classroom (Wu, 1999). Professional development helps mathematics teachers to enrich and remediate their knowledge. Therefore, the more effective the professional development program the more advantageous it will be for both the teacher and the students. Attributes of meaningful professional development programs include format, curriculum, comradeship, instructors, facilities, and more.

"Research from over 100 studies indicates that the use of calculators (a) promotes achievement, (b) improves problem-solving skills, and (c) increases understanding of mathematical ideas” (Suydam, 1987). In addition, "students using calculators possess a better attitude toward mathematics and an especially better self-concept in mathematics than non-calculator students. This statement applies across all grades and ability levels" (Hembree and
Dessart, 1986). There is a strong need for meaningful professional development in the area of the use of technology in the mathematics classroom.

3 Methodology

The West Chester University Teachers Teaching with Technology In-service/Pre-service Professional Development Program was founded in 1995. Under the aegis of the program all day week long graphing handheld institutes or three day graphing handheld institutes are hosted for mathematics teachers. During the school year two or three day follow up institutes are also offered. These institutes are instructed by Texas Instruments professionals who are well trained in graphing handheld methodology and technology. The institute’s curriculum is written by mathematicians and mathematics educators who are well versed in the integration of the graphing handheld into the mathematics curriculum. The graphing handhleds used are one of the TI models, such as the TI-84 Plus Silver Edition, the TI-89 Titanium, the new touchpad TI-Nspire, the Voyage 200, or the new touchpad TI-Nspire (CAS). The institute’s instructors also use many other types of technology during the institutes, including the CBR, the CBL2, the computer, TI-interactive software, and so forth.

During the summer 2009, the Program’s director collected data from the participants in both the three day and five day institutes using an attitudinal survey which is filled out by the participants both at the beginning and at the end of the institute. The survey questions deal with graphing handheld usage in the mathematics classroom and also with the teacher’s attitudes concerning graphing handheld usage in the mathematics classroom. The purpose of the graphing handheld institutes is not only to provide in-service/pre-service training for mathematics teacher but also to enhance their attitudes toward graphing handheld usage in the mathematics classroom so as to encourage them to appropriately use the graphing handheld in their classroom instruction.

4 The Results

Questionnaires were evaluated from 63 participants to evaluate their attitudes toward handheld technology in the classroom. Among these 63 participants, 23 of them attended a three day-long workshop and 40 of them attended a week-long workshop; Ninety two percent of them were between 20 and 60 years of age; About half of them were male (44%); The years of teaching experience were relatively evenly distributed from “5 years or less” to “21 years or more;" Around half of them earned a bachelors degree or masters degree and half of them earned a post masters degree. Most of the participants are senior high school mathematics teachers (79%).

Participants’ attitudes toward the use of graphing handheld technology in the classroom were assessed before commencing the workshop and after completing the workshop to determine the attitudinal effect of the workshop. Each participants’ attitude was measured as an ordinal variable on a 5-point Likert Scale, ranging from 1 = Strongly Agree to 5 = Strongly Disagree.

Paired t-tests were used to test whether there was a statistically significant attitude response score change before and after the workshop. Paired t-tests, rather than independent two sample t-tests, were used because each participant was measured twice. Among the total 22 attitude questions, nine of them found statistically significant attitude response score differences before and after the workshop for the 63 pooled participants (40 week-long workshop and 23 three day-long workshop) (Table 2 and Figure 1). This shows the effectiveness of the workshop in changing participant’s attitudes toward graphing handheld technology.

For the nine significant attitude questions above, they were all significant for the 40 participants in the week-long workshop group. Besides these nine attitude questions, there were three more attitudes that significantly changed before and after the workshop for the 63 pooled participants (40 week-long workshop and 23 three day-long workshop) (Table 2 and Figure 1). This shows that the week-long workshop was more effective in changing participant’s attitudes toward graphing handheld technology than the three day-long workshop.

Table 2: The mean, standard deviation and p-value for the ATTITUDE question response score that significantly changed before commencing the workshop vs. after completing the workshop based on paired t-test (α=0.05)

<table>
<thead>
<tr>
<th>Question #</th>
<th>Question</th>
<th>Pre-Mean +/-Std Dev</th>
<th>Post-Mean +/-Std Dev</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Students should be introduced to graphing calculators at the algebra I level.</td>
<td>1.76+/-0.98</td>
<td>1.54+/-0.84</td>
<td>0.0468</td>
</tr>
<tr>
<td>2</td>
<td>Graphing calculators allow for algebra classes to cover additional algebraic material (topics) not covered in classed that are not using graphing calculators.</td>
<td>2.11+/-0.84</td>
<td>1.75+/-0.82</td>
<td>0.0025</td>
</tr>
<tr>
<td>3</td>
<td>Graphing calculators allow for greater detail and/or difficulty of</td>
<td>1.87+/-0.71</td>
<td>1.62+/-0.66</td>
<td>0.0051</td>
</tr>
</tbody>
</table>
algebra topics
than in classes
that are not
using graphing
calculators.

4 Graphing
calculators
allow for
omission or de-
emphasis of
certain
algebraic topics.

5 The graphing
calculator is
motivational.

6 Students should
not be allowed
to use graphing
calculators until
they have
mastered the
concepts or
procedures.

7 Graphing
calculators
should be used
only to check
work once the
problem has
been worked
out on paper.

8 Using graphing
calculators will
make students
try harder.

9 I know ways I
can use
graphing
calculators
effectively in my
classroom.

10* More interesting
algebra
problems can
be done when
students have
access to
graphing
calculators.

11* Graphing
calculators
should be
required of all
algebra
students
assuming that
they would be
made available
to those who
could not afford
one.

12* I am proficient
at using
graphing
calculators.

* The 40 week-long workshop participants group

**Fig. 1:** Participants’ attitude toward the use of graphing calculators for nine significantly changed questions for the 63 pooled participants and for an additional three significantly changed questions for the week-long workshop group of 40 participants.
**Attitude 0:** I know ways I can use GC effectively in my classroom.
Mean: 2.15, 1.62; STD: 1.08, 52; Paired t-test P-value: <0.0001

**Attitude 1:** GC is motivational.
Mean: 2.16, 1.81; STD: 0.5, 86; Paired t-test P-value: .0011

**Attitude 3:** Students should not be allowed to use GC until they have mastered the concepts or procedures.
Mean: 3.10, 3.46; STD: 1.03, 96; Paired t-test P-value: .011

**Attitude 6:** GC should be used only to check work once the problems have worked out on paper.
Mean: 3.40, 3.71; STD: 0.46, 81; Paired t-test P-value: .018

**Attitude 7:** I am proficient at using GC.
Mean: 2.33, 2.98; STD: 1.23, 86; Paired t-test P-value: .024

**Attitude 8:** Using GC will make students try harder.
Mean: 2.79, 2.55; STD: 86, 84; Paired t-test P-value: .0123

**Attitude 10:** More interesting algebra problems can be done when students have access to GC.
Mean: 1.98, 1.55; STD: 0.83, 60; Paired t-test P-value: .028

**Attitude 11:** GC should be required of all algebra students assuming that they would be made available to those who could not afford one.
Mean: 1.95, 1.60; STD: 1.04, 71; Paired t-test P-value: .021

* 40 week-long workshop participant group.*
Independent two sample t-tests were used to test the attitude response score change (before workshop score minus after workshop score) difference between the week-long workshop group and the three day-long workshop group. Among 22 attitude questions, six of them were found to be significantly different.

(Table 3 and Figure 2). For example, for questions 3, "Graphing calculators allow for greater detail and/or difficulty of algebra topics than in classes that are not using graphing calculators," the mean attitude response score change before commencing the workshop and after completing the workshop is 0.43 for the week-long group and -0.04 for the three day-long group. We are 99% confident (1.00-p value) that there is a difference between these two changes.

Table 3: The independent two sample t-test results for testing the ATTITUDE question response score change (Pre-workshop –Post-workshop) difference between the week-long workshop group and the three day-long workshop group

<table>
<thead>
<tr>
<th>Question #</th>
<th>Group</th>
<th>N</th>
<th>Mean (pre-post)</th>
<th>Std Err</th>
<th>T-test Method</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Week-long (0)</td>
<td>40</td>
<td>0.43</td>
<td>0.11</td>
<td>Pooled</td>
<td>0.0089</td>
</tr>
<tr>
<td></td>
<td>Three day-long (1)</td>
<td>23</td>
<td>-0.04</td>
<td>0.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Difference(0-1)</td>
<td></td>
<td>0.47</td>
<td>0.17</td>
<td>Pool ed</td>
<td>0.0009</td>
</tr>
<tr>
<td>4</td>
<td>Week-long(0)</td>
<td>40</td>
<td>0.50</td>
<td>0.13</td>
<td>Pooled</td>
<td>0.0098</td>
</tr>
<tr>
<td></td>
<td>Three day-long(1)</td>
<td>23</td>
<td>-0.04</td>
<td>0.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Difference(0-1)</td>
<td></td>
<td>0.54</td>
<td>0.20</td>
<td>Pool ed</td>
<td>0.0075</td>
</tr>
<tr>
<td>5</td>
<td>Week-long(0)</td>
<td>40</td>
<td>0.53</td>
<td>0.14</td>
<td>Pool ed</td>
<td>0.0007</td>
</tr>
<tr>
<td></td>
<td>Three day-long(1)</td>
<td>23</td>
<td>0.04</td>
<td>0.10</td>
<td>Satter wait e</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Difference(0-1)</td>
<td></td>
<td>0.48</td>
<td>0.20</td>
<td>Satter wait e</td>
<td>0.0075</td>
</tr>
<tr>
<td>10</td>
<td>Week-long(0)</td>
<td>40</td>
<td>0.43</td>
<td>0.13</td>
<td>Pooled</td>
<td>0.0027</td>
</tr>
<tr>
<td></td>
<td>Three day-long(1)</td>
<td>23</td>
<td>-0.22</td>
<td>0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Difference(0-1)</td>
<td></td>
<td>0.64</td>
<td>0.21</td>
<td>Pool ed</td>
<td>0.0027</td>
</tr>
<tr>
<td>11</td>
<td>Week-long(0)</td>
<td>40</td>
<td>0.35</td>
<td>0.15</td>
<td>Pooled</td>
<td>0.0187</td>
</tr>
<tr>
<td></td>
<td>Three day-long(1)</td>
<td>23</td>
<td>-0.09</td>
<td>0.11</td>
<td>Satter wait e</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Difference(0-1)</td>
<td></td>
<td>0.44</td>
<td>0.21</td>
<td>Satter wait e</td>
<td>0.0187</td>
</tr>
<tr>
<td>12</td>
<td>Week-long(0)</td>
<td>40</td>
<td>0.35</td>
<td>0.15</td>
<td>Pooled</td>
<td>0.0430</td>
</tr>
<tr>
<td></td>
<td>Three day-long(1)</td>
<td>23</td>
<td>-0.04</td>
<td>0.12</td>
<td>Satter wait e</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Difference(0-1)</td>
<td></td>
<td>0.39</td>
<td>0.22</td>
<td>Satter wait e</td>
<td>0.0430</td>
</tr>
</tbody>
</table>

Note: For the actual question please refer to Table 1 according to the question #.

Fig. 2: The ATTITUDE question response score change (Pre-workshop –Post-workshop) difference between the week-long workshop group and the three day-long workshop group.

5 Additional Findings

On average, a 5 year increase of participant’s algebra class size is associated with 0.32 increase of attitude score change (pre – post) on the question "Students should be permitted to use the newest graphing calculators (like the TI-92 –an algebraic symbolic manipulator) in algebra classes."

On average, a 5 year increase of teaching experience is associated with 0.23 increase of attitude score change (pre – post) on the question "When students work with graphing calculators, they do not need to show their work on paper."

On average, GC-using group’s attitude score change (pre-post) for the question "Students understand algebra better if they solve problems using paper and pencil" is 0.81 smaller than Non-GC-using group.

On average, the GC-using group’s attitude score change (pre-post) for question "I know ways I can use graphing calculators effectively in my classroom" is 1.01 smaller than Non-GC-using group.

6 Conclusion

Professional development is essential for teachers not only to stay current and enhance their teaching, but also to positively enhance their attitudes toward various aspects of their teaching. This study
shows that the format of the teachers' professional development is as important an aspect of the professional development as is the topic itself. A week long workshop may be just enough time to immerse oneself into the workshop whereas a three day workshop may leave a teacher feeling a little more shallow. Why a week long professional development program was significantly more influential than a three day professional development program is not completely clear. However, since it was statistically shown that a week long program is more effective than a three day program more research in this area is encouraged.

References: