



# TEACHERS' AND LEARNERS' ATTITUDES AND OPINIONS TOWARDS TABLET COMPUTERS FOR TEACHING MATHEMATICS

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**ABSTRACT**–In this study, the attitudes and the opinions of grade 11 learners in one of the pilot schools within the Hewlett-Packard National Education Technology Assessment (HP NETA) project were assessed regarding tablet computers after one year of a pilot plan that included the distribution of tablet computers to learners for learning science and mathematics. This present research attempts to answer the research question on whether the use of tablet computers in a mathematics class has a positive effect on the learners' attitude and opinions towards learning mathematics. We also investigated whether there is meaningful difference between male and female learners' usage of tablet computers on their attitudes toward using tablet computers for learning mathematics. Quantitative and qualitative data collection tools were used in the research. The Attitude to Learning Mathematics with Tablets Questionnaire was developed for the purpose of this research which was used in evaluating the learners' attitudes towards using tablet computers for learning mathematics. All the learners were also given an opportunity to express their opinions about using tablet technology for teaching and learning purposes through an open ended question through email. We also conducted interviews with science and mathematics teachers in order to investigate their expectations concerning the integration of tablet computers into their classes. We analysed both positive and negative dimensions of integrating tablet computers into the classroom. The findings indicate that learners have a positive attitude toward using tablet computer and using it for learning mathematics. However, there was no significant difference between male and female learners' attitudes towards using tablet computers. Learners' and teachers' opinions about using tablet computers for teaching and learning as well as the positive and negative aspects of using tablet computers were discussed in this paper.

**Keywords:** Computer attitudes, Gender differences, Mathematics, Tablet computers, Teaching and learning

## 1. INTRODUCTION

Recently, there has been a growing interest on the use of tablet computers as a tool for enhancing teaching and learning at all levels of education as noted by Hashemzadeh & Wilson (2007) who reported an increase in the way both university and college teachers had integrated technology into their classroom instructions. Tablet computers are wireless, portable personal computers with a touch screen interface which is typically smaller than a notebook computer but larger than a smartphone. According to Banister (2010), tablet computers create an environment that facilitates learners' learning processes as well as an interactive classroom with real-time feedback. A number of recent reports on the integration of ICT tools into the classroom indicated that the use of portable devices such as tablet computers in the classroom is more effective than the traditional format of teacher-centered teaching (Bonds-Raacke & Raacke, 2008; Bayliss, Connel & Farmer, 2012). This integration has a positive effect on the development of students' mathematical concepts (Bonds-Raacke & Raacke, 2008; Bayliss, Connel & Farmer, 2012).

According to Shuler (2009), the use of applications mobile devices like tablet computers for teaching and learning has the potential to become new means of delivering educational content to learners. The study emphasised that mobile technologies play an increasingly prominent role in the lives of learners worldwide and educational stakeholders are experimenting with the use of these mobile devices in the classroom in order to enhance learners' conceptual understanding of various subjects.

In another study, Pegrum, Oakley & Faulkner (2013) reported that tablet computers had been widely adopted in educational settings around the world especially in the developed world; although its usage is still very much at the experimental phase. Furthermore, a number of tertiary institutions in the developed world have adopted pilot projects to study the efficacy of tablet computers for teaching and learning purposes (Wachsmuth, 2003; Clark, 2004). For example, Clark (2004) reported that Notre Dame and Seton Hall University provided their faculties with tablet computers to use as teaching tools in the classroom. Bentley College in the USA also distributed tablet computers to students for learning purposes (Weitz, Wachsmuth, & Mirliss, 2006). The intervention allowed lecturers to deliver instructions from tablet computers which communicated wirelessly with a server connected to a data projector. With the use of tablet computers in the classroom, lecturers were able to roam freely about the classroom and allow students to post comments that are accessible to everyone in the class. The findings from all these pilot studies and others suggest that the use of tablet computers in teaching allows greater collaboration and active learning within the classroom.

Previous studies have also shown that teaching mathematics is becoming more difficult for learners at all levels (Zaranis, 2011; Audi & Gouia-Zarad, 2013). For instance, Zaranis (2011) investigated the effect of computer based teaching and mathematical thematic teaching methods on young learners' performance. The result of the study revealed that computer-assisted learning significantly enhanced the development of mathematical skills and the cultivation of a deeper perceptual ability for the pupils (Zaranis, 2011). Similarly, Audi & Gouia-Zarad (2013) conducted a study which showed that the integration of tablet computers in teaching introductory mathematics courses has a positive impact on the performance of average students in the class. It also showed that the use of tablet computers increases the interaction between teachers and learners thereby rendering the class more dynamic and tailored in real time to learners' needs. The study also reported that learners were more engaged and motivated during the learning activities as they concentrated on the learning process throughout the lesson. Meanwhile, the main challenge of the mathematics classroom is to direct learners' attention and interest to the understanding of mathematical concepts in order to improve on their academic performance (Pai & Borba, 2012; Jelemenská & Pavel, 2012). This, however, necessitates that teachers should incorporate new technologies such as tablet computers into their teaching strategies (Pai & Borba, 2012; Jelemenská & Pavel, 2012).

In the developing countries like South Africa, learners in schools with limited resources have continuously underachieved in the gateway subjects like Mathematics and Science (Nokulunga & Donovan, 2012). The government is advocating seriously that teachers should use modern technology to strengthen their teaching and learning processes. Teachers are expected to integrate these new technologies in an innovative way; but at the moment they are not well equipped to do so. In embracing the phenomenon of integrating ICT tools like tablet computers into teaching and learning, we embarked on this study which involves giving learners' a formal opportunity to express their opinions on learning mathematics using different forms of delivery methods. We understood very well that the method of delivery of a subject could have a profound effect on the learners' attitude as well as on their learning performance.

Furthermore, various studies had confirmed gender as the leading factor that determines learners' attitudes toward using technology for their learning (Robertson, Calder, Fung & O'Shea 1995; Kickmeier-Rust, Holzinger, Wassertheurer, Hessinger, & Albert, 2007; Meelissen & Drent, 2008). According to Meelissen & Drent (2008), male students have more positive attitudes towards computers than female students. Robertson, *et al.* (1995) established the reason why female learners have negative attitudes to computer compared to that of male learners in the sense that female learners have less interest in using computers, they think that computers are less useful.

Therefore, in this study we aimed to uncover learners' attitude and opinion towards the use of tablet computers for learning mathematics. Specifically we describe a study conducted at a South African school on HP NETA project with grade 11 learners' regarding their attitude and opinions towards using tablet computer for learning mathematics. In order to achieve these goals, our overarching research question is: *How does the use of tablet computers for learning affect learners' attitudes and opinions towards learning mathematics?*

## **2. METHODOLOGY**

### **2.1. Research Design**

This study adopted sequential exploratory mixed method approach. Mixed methods research is a methodology for conducting research that combines the quantitative and qualitative approaches in the research methodology of a single or multiphase study (Tashakkori & Teddlie, 1998). Using a mixed method approach in data collection and data analysis offers educational researchers a path toward a deeper understanding of experimental results (Igo, Kiewra & Bruning, 2008). A sequential exploratory mixed method study enabled us to explore the impact and nuances of tablet computers usage on learners' attitudes towards learning mathematics. Furthermore, succeeding the quantitative data collection and analysis with qualitative data collection and analysis assisted us to obtain a richer account of learner's views about using tablet computers in learning mathematics. Bird & Hammersley (2006) are of the opinion that the use of several methods to explore an issue greatly increases the chances of accuracy. Therefore, employing both quantitative and qualitative methodological tools for this research has led to more valid, reliable and diverse construction of realities resulting in more trustworthy results.

### **2.2. Participants**

The participants of this study were grade 11 learners in a South African high school the school is in research collaboration with HP National Education Technology Assessment (HP NETA) and the University of Johannesburg. The South Africa pilot school is a secondary, co-educational public schools dedicated to learners with an aptitude for mathematics and science. It is currently one of the top achieving schools in the Gauteng province of South Africa featuring amongst the top 5 in relation to grade 12 exit level examination results. The HP NETA pilot project is one of the programmes designed to assess the impact of technology-based interventions in schools across the globe. HP NETA initiative seeks to showcase how HP technology and support can help in transforming learning. Tablets computers were distributed to all the grade 11 learners and paper based questionnaires were also distributed to 98 learners. The sample size of this study consisted of 39 male (39.80%) and 59 female (60.20%) learners between the ages of 16 and 17. In addition, learners were also given an opportunity to express their opinions about the use of tablet technology for teaching and learning purposes through an open ended question via email. Seven science and mathematics teachers were also interviewed in order to investigate their expectations concerning the integration of tablet computers into their classes.

### **2.3. Instruments**

Both quantitative and qualitative data collection tools were used in this research. An Attitude to Learning Mathematics with Tablets Questionnaire was developed by the researchers for the purpose of this study for evaluating learners' attitudes and opinions about the impact of tablet computers use in their own learning. The questionnaire consisted of 26 items. The items were presented on a six-point Likert scale from Hardly Ever (1), Occasionally(2), About half the time(3), Usually(4), Nearly always(5) and I don't know(0) for the first four items while the remaining items had from Strongly Disagree(1), Disagree(2), Neither agree or disagree(3), Agree(4), Strongly Agree(5) and I don't know(0). Therefore, the potential scores from the questionnaire ranged from 26 for lowest to 130 for the highest. The Cronbach alpha reliability coefficient was found to be 0.79. Examples of items include: *I am good at using tablet computers; I like using tablet computers for Mathematics; Tablet*



*computers help me learn Mathematics better.* The questionnaire was analysed using descriptive statistics and t-test.

In addition, emails were used to gather learners' opinion about using tablet computers in learning mathematic. Their responses were collected via email. Similarly, seven participating science and mathematics teachers were also interviewed to share their ideas of how they could use tablet computers and other technologies to support conceptual understanding of learners in the classroom. The purpose of the interviews and emails were to obtain additional and richer data about teachers and learners' opinions about using tablet computers in the classroom. Both email text and interview text were added to the qualitative data set for analysis.

#### **2.4. Procedure**

The HP tablet computers were distributed to the South African learners when they were in grade 10 at the beginning of the third term in 2014 academic year. This research was conducted approximately 6 months after the students started using their tablet computers. Every student has the identical tablet computer. The distributed tablet computers have an Android operating system, 1024 \_ 600 screen resolutions, 7 inch screen size, touch screen and the capacity to open numerous electronic documents in many extensions (e.g., doc, docx, and pdf). Each tablet was assigned an email address in order to gain access to the Play Store to update various applications. The students have started using their tablet computers at school for mathematics and science subjects. Prior to this, the researchers organised training workshops on Saturdays for the learners to enable them master various features on the devices as well as the rules guiding its usage in the classroom.

In this study, learners were provided with information about the questionnaire and they were encouraged to answer all the items honestly. The data collection process took approximately 3 weeks, and the data were transformed to SPSS for analysis. Furthermore, the researchers organised a follow-up workshop for the learners which took place during school hours as learners were excused during the school assembly period. During this session, they learnt how to compose and send emails. Learners were asked to express their opinions about using tablet computers in the classroom and send it through email to the researchers. ATLAS.ti was used to organise the qualitative data and systematic thematic content analyses generated a list of codes that were grouped together resulting in emerging themes.

### **3. RESULTS**

In this section, we present the analysis of the study. The background information of the research participants are presented, the effects of gender on the learners' attitudes were also analysed.

#### **3.1. Influence of the use of tablet computers on learners' usage of desktop computers and internet for learning at home and school**

Prior to the commencement of the project, almost half of the learners (49%) have desktop computers without internet access at home while 48% have desktop computer with internet access at home.

It is pertinent to note that the period of twelve months ago was prior to the commencement of this study when learners had not been introduced to the usage of tablet computers while the period of three months ago was just about six months into commencement of this study when learners had been trained on the use of tablet computers for learning purposes. Meanwhile, the overall profile of the participants depicted in Table 1 shows that computer usage at home and school by the learners paralleled their usage of the Internet. It is interesting to note that more learners were using desktop computers and Internet at home and school in the last three months relative to the last twelve months. However, it is evident that more learners were using computers and Internet at home than

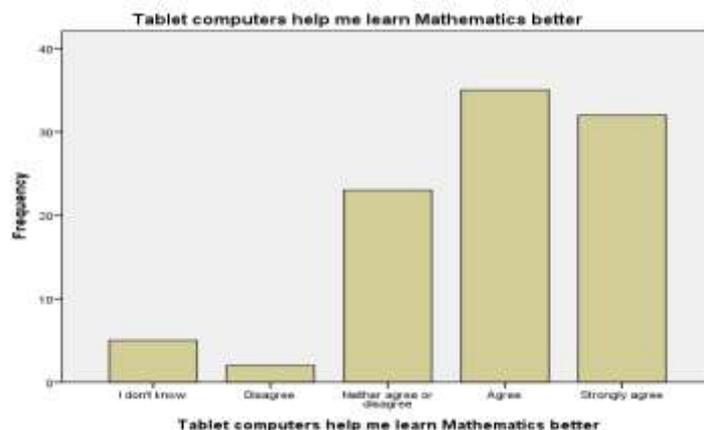
at school. Approximately 9 and 6% of the learners have not been using Internet and computer respectively at home over the last three months.

**Table 1: Learners' Profile**

Characteristics	f	%
Desktop Computer without internet access	48	49
Desktop Computer with internet access	47	48
<i>Frequency of desktop computer usage at home (Monthly)</i>		
In the last 3 months	90	91.
In the last 12 months	7	7.1
<i>Frequency of desktop computer usage at school (Monthly)</i>		
In the last 3 months	22	22.4
In the last 12 months	12	12.2
<i>Frequency of internet usage at home (Monthly)</i>		
In the last 3 months	92	93.9
In the last 12 months	3	3.1
<i>Frequency of internet usage at school (Monthly)</i>		
In the last 3 months	19	19.4
In the last 12 months	3	3.1

### 3.2. Learners' attitude and opinions towards learning mathematics using tablet computers

The mean values calculated for all the items on the attitude towards learning mathematics with tablet computers indicated that the participants are positive towards using the tablet computers in learning mathematics. The higher the variable's value, the more positive attitude learners have towards using tablet computers for learning mathematics. Figure 1 reveals that a significant majority of learners agreed and strongly agreed that using tablet computers for learning mathematics will improve their conceptual understanding of the mathematical concepts. For instance, 67 (68.40%) out of 97 respondents agreed or strongly with the statement "tablet computers help me learn mathematics better." However, only 2.0 % disagreed with the statement while 23.5% of the learners were unsure and could not decide whether to agree or disagree.



**Figure 1: Tablet computers help me learn Mathematics better**

Another interesting finding from the analysis reveals that 69 (70.5%) learners agreed and strongly agreed that using tablet computer to learn mathematics make the subject more interesting as shown in Figure 2.

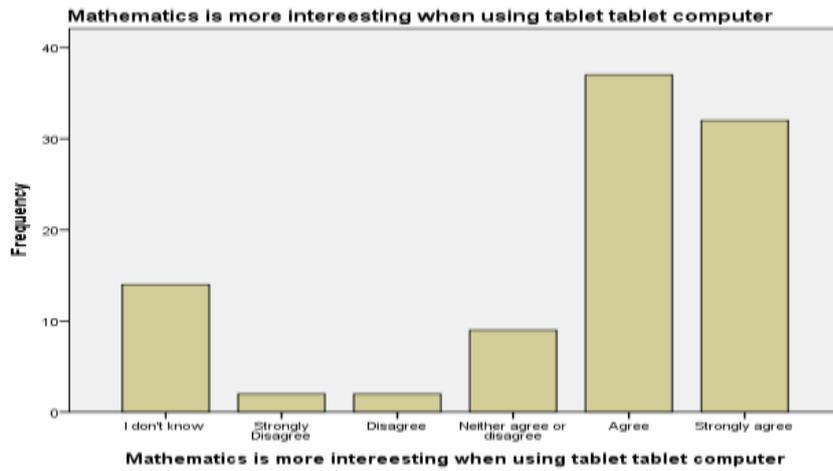


Figure 2: Mathematics is more interesting when using tablet computer

### 3.3. Gender differences in attitudes towards using tablet computers for learning mathematics

When the learners' average scores on the attitudes questionnaire were analysed, male and female learners had almost equal average scores as shown in Table 2. The t-test was applied to determine whether there was a meaningful difference between the attitude scores of the learners by gender.

Table 2: Independent t-test of learners' scores on attitudes scale by gender

Gender	N	Mean (SD)
Male	39	3.79 (1.06)
Female	59	3.78(1.08)

Table 2 shows the mean scores for male and female learners are 3.79 and 3.78 respectively ( $t(94) = 1.69; p > 0.05$ ). This result shows that there was no meaningful difference between the male and female learners ( $p > 0.05$ ). Hence, male and female learners have positive attitude towards using tablet computers for learning mathematics but there is no significant difference in their attitude.

### 3.4. Pertinent issues about using tablet computers for learning based on the opinions of participating learners and teachers

During the third learners' workshop, learners were asked to share their ideas of how they could use tablet computers and other technologies to stimulate effective conceptual understanding in It is pertinent to note that the period of twelve months ago was prior to the commencement of this study when learners had not been introduced to the usage of tablet computers while the period of three months ago was just about six months into commencement of this study when learners had been trained on the use of tablet computers for learning purposes. Meanwhile, the overall profile of the participants depicted in Table 1 shows that computer usage at home and school by the learners paralleled their usage of the Internet. It is interesting to note that more learners were using desktop computers and Internet at home and school in the last three months relative to the last twelve months. However, it is evident that more learners were using computers and Internet at home than at school. Approximately 9 and 6% of the learners have not been using Internet and computer respectively at home over the last three months. the classroom. Learners' responses were sent to the researchers via e-mail. These responses were analysed and the following themes emerged. Here are some of the creative suggestions as presented in Table 3:

**Table 3: Comments of learners about the use of tablet computer for learning**

Theme	Examples of learners' comments
Decreased disruption to the class.	<ul style="list-style-type: none"> <li>• <i>I can use the tablet to message my friends in class to ask them a question that I do not understand so as to lessen a disturbance when the teacher is talking.</i></li> <li>• <i>Communicating via chat service with our student teachers or fellow classmates to gain additional explanations or to understand it in a different way and cause less of a disruption.</i></li> <li>• <i>We can have a chat room where the class can discuss that day's topic in a quiet and controlled way so that the discussion does not get out of hand.</i></li> </ul>
Improved teacher-learner relationships	<ul style="list-style-type: none"> <li>• <i>Students should be able to interact with the teachers privately. The teachers can be relaxed while they explain. They can send each learner a specific thing, in regards to that learner alone and also focus specifically with a single learner and try and improve their marks.</i></li> <li>• <i>There will be less of a boundary between the teaching of teachers and the learning by students. We will be able to understand exactly what the teacher is teaching and relate on almost the same level.</i></li> </ul>
Desire for individual attention	<ul style="list-style-type: none"> <li>• <i>It would give the teachers and the learners an indirect one on one.</i></li> <li>• <i>If my teacher could see each of us working and correct each individual before they go too far into misunderstanding, it would be like each student is receiving individual attention.</i></li> </ul>
Increased learner Agency	<ul style="list-style-type: none"> <li>• <i>I would really appreciate it if we used technology a bit more so that instead of each and every one of us waiting for the teacher to answer our individual questions on how she or he got to the final answer and her to re-explain the work.</i></li> </ul>
Feeling better prepared for their future	<ul style="list-style-type: none"> <li>• <i>It will give us an edge when first being introduced to the world of work.</i></li> </ul>
Advantages of increased access	<ul style="list-style-type: none"> <li>• <i>There are many experiments in science and sometimes we do not do all of them so now we can watch videos and visualise them. I will also be able to search for dangerous experiments and observe what happens.</i></li> </ul>
Dynamic content	<ul style="list-style-type: none"> <li>• <i>Internet is constantly updated and the textbooks are constant.</i></li> </ul>
Increased pedagogical reach:	<ul style="list-style-type: none"> <li>• <i>it will show and explain the different methods using videos and animated examples to make understanding better and improve concentration in class</i></li> </ul>
Task simplification	<ul style="list-style-type: none"> <li>• <i>Ensures complete accuracy when working with tables, and helps improve concentration and simplifies difficulty</i></li> </ul>
Health implications	<ul style="list-style-type: none"> <li>• <i>In English class one would be able to read a book on our tablets instead of holding a book that has a thousand germs. It saves chalk which means no more sneezing.</i></li> <li>• <i>Have a textbook that doesn't have scratches in it.</i></li> <li>• <i>Our bags would be far lighter than it is now and would be efficient because we would have all our books with us instead of keeping them in our lockers.</i></li> </ul>

Seven participating teachers were also interviewed to share their ideas of how they could use tablet computers and other technologies to stimulate effective conceptual understanding by learners in the classroom. Teachers' responses were analysed. The interview was aimed at exploring the usage of tablet computers in classrooms, their positive and negative views about using tablet computers for teaching and learning. All the participating teachers concurred that the incorporation of tablet computers into teaching removes boredom by introducing entertainment into the classroom, enables teachers to elucidate concepts better by providing relevant examples and enhances learners' classroom concentration and motivation. Moreover, the incorporation of tablets into teaching also enabled the participating teachers to use class time more effectively and plan activities more efficiently.

Nevertheless, all the teachers also expressed their concerns about their lack of knowledge in creating exciting, engaging, and productive learning activities for their learners using tablet

computers. They were also concerned with the fact that students might be spending significant amounts of time on non-academic activities such as surfing the web, reading email, online shopping, and posting to social media. They were also worried about the amount of time that it would take to develop learning materials and resources suitable for teaching with tablets.

#### 4. DISCUSSION AND CONCLUSIONS

This study investigated learners' attitudes and opinions about using tablet computers for learning specifically for learning mathematics among grade 11 learners in a South Africa high school. Most of the learners who participated in this research already had personal computers at home. However, only few of the learners were using desktop computers at school and home for learning purposes prior to commencement of this study. It is however surprising that the introduction of learners to the usage of tablet computers had only produced a more noticeable positive effect on their usage of desktop computers and internet at home relative to the usage at school. Meanwhile, this may be elucidated by the fact that learners' accessibility to tablet computers in the classrooms did not allow them to use the desktop computers for learning while at school due to the portability of the technology. Most importantly, it must be noted that learners' usage of this technology at school might have motivated them to use desktop computers and internets for increased learning purposes at home.

The results also show that the ninety-eight learners who participated in this study had positive attitude towards using tablet computers to learn mathematical concepts. This is evident in Figures 1 and 2 where majority of the participants (67) agreed or strongly agreed that this technology enabled them to learn mathematics better or makes the learning of mathematics more interesting. Learners' comments under the themes on pedagogical reach and task simplification as presented in Table 2 also affirmed this finding. Teachers' opinion that *"the incorporation of tablet computers into teaching enables teachers to elucidate concepts better by providing relevant examples and enhances learners' classroom concentration and motivation"* in response to the question *"What was wow about the mathematics lesson using tablet computers?"* also corroborated this finding. This finding is in agreement with other studies Pai & Borba, (2012); Jelemenská & Pavel, (2012) who encouraged teachers to incorporate new technologies such as tablet computers into their teaching strategies in order to enhance learners' conceptual understand of their various subjects.

A critical search through the available literature reveals that the attitudes of male learners towards using tablet computers and other information communication technologies (ICT) for learning purposes are more positive than those of their female counterparts (Kickmeier-Rust, Holzinger, Wassertheurer, Hessinger, & Albert, 2007). However, the cited literature above did not highlight why there was gender difference in learners' attitude towards employing technological tools for learning. Hence, it is possible that differences in the social and economic status of these learners might be responsible for this disparity in attitude towards technological tools. In this study, it was established that there was no meaningful difference between the attitudes of male and female learners towards incorporating tablet computers into learning mathematics. This finding could be elucidated by the fact that the participating learners have the same background socially and economically. Therefore, the status of the high school used in this study is such that most of the participating learners had a computer at home.

According to learners, tablet computers and other technologies should be used more in their classrooms as it makes learning more meaningful and entertaining. Learners were of the opinion that using technology will enable them to have immediate feedback from their teachers. This finding is in agreement with other studies (Dündar & Akçayır, 2012). A number of learners also expressed that the use of tablet computers increased their interest in learning mathematics as the concept could be explained using different methods such as videos and animated which helps conceptual



understanding and improved concentration in the class room. However, few learners reported that using the technology in the class decreases their interest because the tablet computers did distracted them from concentrating very well.

Finally, this study shows that both learners and teachers have positive attitudes towards using tablet computers in the classroom. There were high expectations from both of them that using technology in the classroom will increase efficiency in education. This study increases the level of awareness of both teachers and learners on the need to cultivate 21st century skills in learners and recognition to devote more time to learning from each other. Although teachers are finding it difficult to carve out additional time required to adapt technology into their classroom, the researchers are still giving them all the supports necessary through adequate and ongoing training.

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