Acceptance factors: an iPad in Classroom Ecology

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Abstract—In this paper, we discuss a one-year-long pilot study introducing the iPad into classroom information ecology. In spite of much enthusiasm in the beginning of the study, interest for the iPad diminished significantly by the end of the study. Our primary interest was to observe the classroom information ecology and how the established networks and relations change with the introduction of a new mobile device over a longer period of time, thus eliminating the novelty effect. Our secondary interest was to identify factors contributing to decrease in both use of and interest for the device. Additionally, factors that may positively influence adoption are discussed.

Index Terms—iPad, mobile learning, education, technology acceptance.

I. INTRODUCTION

This paper describes a one-year-long pilot study focusing on the iPad’s adoption into an elementary school classroom. Through Cuban’s research [5] we see that, historically, many waves of new technology have passed through schools and classrooms, none leaving a lasting effect. Computers have been found to be unused or underused [6] in most schools. Factors contributing to this situation are many and well researched (example [19]). About the tablet, Cuban says [12]: “There is very little evidence that kids learn more, faster or better by using these machines. iPads are marvelous tools to engage kids, but then the novelty wears off and you get into hard-core issues of teaching and learning”. After a one-year-long study in the 5th grade at a provincial school, our research confirms Cuban’s words. Yet, thousands of schools worldwide are opting for adoption of this technology in the classroom. Part of the reason for this is that, unlike desktop technologies, mobile technologies have the potential to change the time and space for learning, with significant advantages, both pedagogically and technologically (see [14]). With the appearance of the iPad on the market, this potential for redefining what constitutes a learning space, how and when learners engage with learning activities, has been seen by many (see [4] as an example) as the real shift in the mobile learning paradigm.

Prior to the study presented in this paper, we conducted a similar pilot study at the university level, using the Technology Acceptance Model (TAM) approach to determine which factors influence the adoption of this new classroom technology. Our findings indicated that various forms of ownership played a prominent role in the acceptance of the tablet [7]. The iPad was not accepted, in spite of the enthusiasm among all stakeholders. However, while we could establish some of the factors that led to its non-acceptance, we could not draw any conclusions as to whether the iPad could be successfully integrated as a learning tool. Our results were in accordance with Barki and Benbasat’s observation in [2]: “…in the final analysis this approach (note: TAM) has basically provided explanations or antecedents for one set of belief perceptions via another set of belief perceptions, without also increasing our knowledge of what makes an IT useful.”

Thus, in the design of this second pilot study, the TAM approach in an educational setting (see [16]) and the classical approach of Davis [9,18], considering perceived ease of use and usefulness, we additionally applied Nardi and O’Day’s information ecology approach [15]. The purpose of the latter was to enable identification of a broader range of issues, as well as understanding of what could, potentially, make the iPad a successful addition to the classroom ecosystem. By taking the study into an elementary school classroom, we hoped that factors such as lack of time for exploration and device mastery, which were prominent in the university study, would be less significant. Furthermore, there were comparatively, a lot more applications in the App store that could support a 5th grader than those that could support a novice researcher in a geosciences field. Applications for pupils could also make use of learning through creative play and collaboration to a much higher degree.

The initial observations from this elementary school study were so distinct from the ones at the university level, that after one semester of use, we considered them to be very positive, in contrast to the first study [10]. However, as we allowed the novelty effect of the iPad to fade and the classroom to resume its life without the obvious presence of researchers, the results began to look a lot less glamorous than they did during the first period of the study. At the end of the year, in likeness with the university study, we could observe that the iPad was marginalized in the classroom information ecology, nearly threatened with complete extinction.

This paper thus discusses the factors contributing to the fact that the iPad did not meet the expectations as a learning paradigm shifter in this context, as well as which factors could potentially change this outcome.

The next section provides a description of the study, methodology and results. In section 3 we discuss the results using the TAM approach and in section 4 using the information ecology approach. Section 5 concludes the paper.
II. THE STUDY

Our pilot study spanned the whole of 2011. A Norwegian provincial school was chosen for the study. The school children were 4th graders at the start of the study, 5th graders from the fall of 2011. Their classroom before the study was also typical: rows of school benches seating two students each and facing the front of the classroom. Information technology (IT) was represented by a smart board, a laptop to connect to it and three desktop computers.

There was no wireless connection at the school. Wireless mobile broadband was installed for the purposes of the study. It could support only 6 iPads. The class had 26 children that were thus divided into 5 groups, receiving an iPad each, to use during the entire study. The sixth iPad was given to the teacher. The iPads came with chargers and protective covers. Multi-positional covers, styluses or external keyboards were not available. Children could take the iPads home, in order to allow for free play and exploration.

Norwegian schools usually provide textbooks. However, in this case, there were not enough books for each student. Black and white copies of relevant material supplemented books. Digitalized curriculum is not yet common. For the purpose of this study, we obtained access to free digitized curriculum for mathematics, science and religion studies from the academic publisher.

A. Methodology

As the pilot study was of an explorative character, during the spring semester (January-May) ethnographic methods were used to observe the use of the iPad in the classroom and identify the factors contributing to its adoption. Observations were carried out once a week during this period and information was collected using notes. In addition, audio, video and photography were used during workshops and interviews. The iPads were also collected periodically in order to view and document the content. Two workshops, interviews with two families (including students), as well as an interview with the teacher were conducted during the initial period of the study. Many informal conversations before the first class period and during the breaks with both students and the teacher provided invaluable input. Some quantitative data on reading preferences were collected through two short surveys. During the fall semester (August-December), we as researchers were much less visible and present in the classroom. The reason for the shift was a desire to create a use situation as close as possible to a normal school situation, trying to make students forget that there is an external interest in what they do with the iPads in the classroom. Regular contact was maintained with the teacher. At the end of the year, one workshop, a series of group interviews and an interview with the teacher were conducted. The interviews were analyzed using a sticky notes method to categorize issues that emerged during these interviews.

B. The first semester

The classroom, organized into 5 work areas, one of which is shown in Fig. 1, was the setting for our first hour-and-a-half long lesson on the basic use of the iPad, marking the official start of the study. The children learned how to log into their iTunes accounts and download apps. They learned how to search the App Store, in particular, how to find education and entertainment applications. "Planets", "IDCL", "Alice Light" and "The Little Red Riding Hood" were downloaded and tried.

They also learned how to place files into Dropbox. The children were clearly excited about the iPads, but also disciplined, waiting for the break to ask one million small questions and to tell about everyone they knew who had an iPad and everything they already knew how to do. The iPads were regarded as cool. It was also cool that they were the only class using them in their school.

During the first five weeks of use everyone learned how to capture screen images from the iPad and they tested various painting and drawing applications. Some iPads had hundreds of images stored on them: beautiful pictures of horses, berries, tigers, screen shots from games they played etc (Fig. 2). All of the iPads had many apps, entertainment apps dominating in numbers. The students learned how to group the apps and make categories. They developed sharing schedules and each group customized its iPad. The most interesting thing though, was a new behavior pattern that emerged: coming to school about 20 minutes early to share the iPad related experiences, again, mostly in games.

At the five weeks mark, some free apps with inappropriate advertisements showed up on the iPads. In cooperation with the children, the decision was made to remove such applications. It was agreed that they could keep two games of their choice, with no advertisements. The children themselves removed all other pure entertainment apps as agreed. Finally, the password to iTunes was changed, and only the teacher had access to it. Installation of new applications on the iPad had to be done by the teacher. A decrease in interest was expected.
However, no change in children’s behavior or interest was observed. The early morning meetings continued as usual. The discussion about games was simply replaced by discussing and using educational apps. The classroom seating, as depicted in Fig. 1 was kept throughout the semester.

C. Interviews

The first family interviewed consisted of parents, twins (in the class) aged 9, an older child aged 12 and a younger child aged 2. The mother got an iPad from her husband for Christmas. The iPad was considered by the whole family to be really cool. The twins expressed pride in being able to use the same piece of technology as their mother. At the time of the interview, their use of the iPad was much more complex than their mother’s (who used it to read her email and the news). The twins were reading a lot, enjoying their digital textbooks. One of them in particular, enjoyed the possibility to enlarge the text while reading. They did their homework and played on the iPad. They loved teaching their younger brother how to use some simple apps. However, the twins themselves had a decidedly different approach to the device. One of them was intensely curious and liked to try many different things, while the other stayed with something that interested her over an extended period of time. The rest of the family, the father and the older brother, also used the iPad. The father checked sports news and the older brother liked playing games. Sharing the iPad and experiences around it with the rest of the family was important to the twins.

The second family consisted of parents and two children aged 9 and 12. The youngest child, who was the student in the study, was happy and proud to show the iPad and her iPad skills, to the rest of the family. The older sibling was very interested in the iPad. The parents, at the time of the interview, were considering buying one of their own.

The teacher was positive to the iPad use in the classroom. When asked if her preparation for the class was more difficult now that she also needed to consider the iPad, she said: No! This is actually simplifying matters. I can ask them to use their iPads to check things online and they manage to do it by themselves. They have tools to do it by themselves (referring to Apps, Wikipedia or Google search). ... They are also better at reading from the screen. I skim-read, but they certainly get interested and immersed and they actually got things from one text we were reading that I did not get, as I did not read carefully enough.

When asked about the number of iPads they got and how that worked, she simply answered that it worked very well. She thought of the iPad as a tool complementing her teaching style well. She had the children look for and use Apps relevant for curriculum (e.g. Planets, where children could see the solar system in 3D) and gave them additional iPad assignments based on their interests (see Fig. 3). Children cooperated well on these assignments.

D. Workshops

The objective of the first workshop was to see if and how the children’s search strategies changed. Three boys and three girls participated. Every child had an iPad. The first task was to find an explanation for unknown words such as "biotechnology". Children used between five and nine minutes to complete such tasks. The children used a variety of search strategies. One used the App store, and found an expensive application, that he could not download, and thus needed an alternative approach. The participants tried Google, YouTube, Google videos, Wikipedia and Google images. We intended to have them work alone, but they spontaneously cooperated anyway and we chose to allow them to do so. The interesting observation here was that the search strategy with the iPad became broader and included searches in visual databases. On desktop computers, all the students started with a Google search. This showed indication that learning practices were changing, though at this time we did not do any study around the quality of the change.

The second task was to find information about how to tell a story, both as a very short introduction into the second workshop and to check if the search strategy would change since the scope of the question was different and allowed for different answers (possible answers could include a set of examples, storytelling strategies, genres etc. rather than a definition of storytelling from Wikipedia). This time they were allowed to cooperate. Children at once started by looking for an example, for a story itself. The boys were working together and they chose an epic poem, while the girls found a children’s classic. Nobody completed the actual task, within the time allocated for the workshop.

The second workshop engaged the children in storytelling using five different modalities. The objective was to see which ones they were most creative with. 25 students participated. Storytelling was part of the curriculum at the time of the workshop. Additionally, we had a well of literature on storytelling from various perspectives that we could use in the analysis later on (see [1], [3] and [8]).

Two of the chosen modalities involved the iPad and applications Puppet Pals and Animation HD. Those were designed for story making and making short animations, respectively. They were chosen because they offer different ways of telling a story on the iPad. Animations HD required free-hand drawing, while Puppet Pals used ready-made characters, shifting the students’ focus more onto the story itself. The remaining three ways of creating stories were not iPad related: one was based on paper with lots of colored pencils, one on 3D origami-like shapes that the children helped design, and the last one on the iPhone application StoryKit, designed for story making, see Fig. 4.

Fig. 3. The children using iPads in a science class.

![Image of children using iPads in a science class](image-url)
Fig. 4: The storytelling workshop with Animation HD, Puppet Pals and 3D paper objects in origami style.

Puppet Pals was a clear winner in terms of the children’s engagement and enthusiasm for making a story.

E. Surveys

A short survey was held after a month of the iPad use. Just before the survey, the students had a read-aloud session. Each child had to read a particular story from the iPad to the rest of the group. Afterwards, the students discussed the story. The survey was based on simple questions that were to be answered with a 1-5 star rating (5 stars being the highest score and one star the lowest). Twenty students were at school that day, and 17 rated the iPad as a preferred or equal platform for reading. Only three were negative to the reading experience on this new platform. After additional three months of use, we repeated the survey. Again, 20 students were present and we had the same outcome: 17 students still rated the iPad as a preferred or equal platform for reading and three were negative towards reading on the iPad. However, only one that rated the reading experience as negative the first time gave the same negative vote on the second survey. There were thus four students who changed their mind about the reading experience on the iPad.

When asked an open question about reading on the iPad, the students expressed desire for more books for the iPad in their mother tongue. Some said that it would be great to have the entire curriculum on the iPads (no paper books).

F. The second semester

After the summer holidays, the observation days did not resume. A new classroom ecosystem was given the time to settle into its own patterns. One workshop with focus on the iPad as assistive technology was conducted in September 2011 and results reported in [11]. What we could observe on the occasion was that the desks in the classroom were back to their usual formation facing the smart board and the teacher. The iPads were in the students’ bags or on the shelf, none on the desks in front of them.

In the interview with children, at the end of the fall semester, we found that the lack of games in a long run made the iPad less interesting. Furthermore, it has lost its novelty and coolness to a large degree. Several families now owned newer models of the iPad. The new iPads had camera, something that made a difference for the children. The newer iPads were cooler to play with. An important factor as well was the access to App Store, and the fact that they could not download entertainment apps on the school iPads any longer. Although, some could not do it on the home iPad either, as can be seen from the following interview excerpt.

Interviewer: *What can you say about your use of the iPad after the summer vacation?*

The boy: *It was used less.*

The first girl: *Yes, there were no games.*

The second girl: *There was no one who wanted to use the iPad.*

Interviewer: *Why is that?*

The second girl: *Perhaps it was because there were no fun games on them.*

The first girl: *At least that much is certain.*

The second girl: *Nobody wants to take it home.*

Interviewer: *Does that mean that you stopped coming to school early in order to play with iPads together?*

The boy: *Yes, without games it was boring.*

Interviewer: *Do you play at home on your own iPads?*

The boy: *I use it at home. But I do not always get permission to install the games.*

Interviewer: *Do you ask?*

The boy: *Yes, but I cannot buy expensive games.*

Interviewer: *Do you do your homework on your father’s iPad?*

The boy: *No, I rather use the iMac.*

The first girl: *I sometimes use the iPad.*

The other interviewed groups shared similar experiences.

III. TECHNOLOGY ACCEPTANCE

In exploring technology acceptance, one of the most influential models has been the one proposed by Davis et al. [9]. The model has perceived usefulness and perceived ease of use as main external factors forming the attitude towards the use of a technology and ultimately the intention to use it. Technology acceptance in education is more complex, requiring complementary approaches to examine how adaptation and learning behaviors influence motivation. The literature on technology acceptance in elementary school education is still rather scarce, but work by Zhao, Kukulska-Hulme and Teo (see [19,14,16]) are some pointers in this direction.

Teachers are often placed in the central position as a force that influences the attitude towards new technology. They also
have more autonomy to decide on the use of technology, something that in the past had to be done by education policy makers. However, teachers still have to follow the teaching plans closely in their daily work. The teaching plans are made based on a full-time teacher’s involvement. Consequently, for employment of new technology they often need to use their own resources and time.

The teacher in our pilot study desired to take part in the study out of her own interest, receiving no support from the school leadership, or from policy makers. However, her motivation was to use the new technology as an aid in teaching, and not as an opportunity to change the existing learning practices, as is clear from the interviews she gave. In fact, the program she needed to follow was rather demanding, leaving little extra time for experimenting with the new teaching tool.

In this context, we believe it to be of importance to consider the question posed by Knapper in [13, Ch3]: “How can researchers act as mediators, synthesizing the findings of locally generated evaluations to inform policy?” This question requires a response that links together two sets of goals: (1) finding scalable and substantive ways to support local school communities in thinking differently about evaluative questions and about evidence; and (2) finding equally substantive and effective ways to synthesize and disseminate local findings to a much broader policy community.” The research we conducted was very local, with some interesting findings. From a researcher’s perspective, it is customary to report the findings through conference or journal papers, and the engagement often ends there. The aforementioned goals call for taking the next step, and disseminating local findings to teachers, school leadership and policy makers. The teacher from our study has found little interest among colleagues and school leadership in the project. They let her participate in this study, but were not interested in the effects of the study on learning. The school pedagogues on the other hand were a lot more interested, the teacher told us. We conclude these considerations by stating that we have some basis for assuming that we as researchers will do. But my focus here is on something different, on the “subjective computer”. This is the machine as it enters into social life and psychological development, the computer as it affects the way we think, and especially the way we think about ourselves.” Much remains the same in relation to tablets today. Through working with classroom ecology framework, we attained a better understanding of both the “instrumental tablet” and the “subjective tablet”. The instrumental side is answered by principles such as one’s personal relationship with the iPad, the social changes it induces, allowing more freedom in designing the curriculum, avoiding stigmatism in cases of children with special needs, self image, changes in the way of thinking etc.

The concept of information ecology was first introduced by Nardi and O’Day [15] as “a system of people, practices, values, and technologies in a particular local environment”. A classroom information ecology offers a perspective on how the new technology is introduced into the classroom environment and helps describe the flow between the people and the technology in the classroom ecology (who uses what to search for information? When do they use it? Is the information printed out? If so, how?) It also describes the flow between the existing pieces of technology (how does the printer communicate with the computer? How is information shared between different units? What is used to control a slide show?) What changes in the flow when a new piece of technology is introduced into the ecology?

In [17], Turkle states the following regarding computer technology: “Most considerations of the computer concentrate on the “instrumental computer”, on what work the computer will do. But my focus here is on something different, on the “subjective computer”. This is the machine as it enters into social life and psychological development, the computer as it affects the way we think, and especially the way we think about ourselves.” Much remains the same in relation to tablets today. Through working with classroom ecology framework, we attained a better understanding of both the “instrumental tablet” and the “subjective tablet”. The instrumental side is answered by principles such as one’s personal relationship with the iPad, the social changes it induces, allowing more freedom in designing the curriculum, avoiding stigmatism in cases of children with special needs, self image, changes in the way of thinking etc.

We have some basis for assuming that we as researchers may have influenced the children indirectly. Our interest in the iPad research and our engagement during the first semester also contributed to their view of the iPad as “cool” technology. When we stopped the regular visits to the classroom, the students asked often when we planned to come back.

In the context of this study, we may consider learning and construction of knowledge as an act done in cooperation with other students. Teo [16] advocates a series of principles to adhere to during the development of an educational activity. In particular, the principle of reflexivity:

Reflective shows that the student has to mirror his/her own experience on other students, making them experts in their own learning.
The first girl: multiplication table, so I will take the iPad home”.

Interviewer: How is it with cooperation and sharing now?
The first girl: Yes, we share. But I much prefer to use it alone.
The boy: I also like to work alone. But we do not have that many iPads, so we must share.
Interviewer: If you had a choice?
The first girl: Than I would very definitely have it alone.

In conclusion, the “subjective” iPad has suffered, as the students themselves did not manage to find content that they could share or, master. As mentioned earlier, the teacher saw it simply as a tool to help her with her teaching, rather than a new platform for learning that she can experiment with. She tried to find some applications that could work with her schedule, but that quickly turned out to be overly time consuming. She said: “The iPad was used more and more as an extra channel in addition to PCs. It was hard to find apps that complement the curriculum. For example, we found one app about mushrooms, but the language was a problem. It was too difficult for students to understand. Anyway, there simply are no apps for my needs and at the right level of teaching. On the other hand, if I asked them to find some information from Google or Wikipedia it functions well, in particular for teaching natural science and languages. It is not often that they take the iPads home now. I have them on the shelf and I can monitor the use. Sometimes the children use the iPads for a very specific purpose. For example, they would say: “I want to practice multiplication table, so I will take the iPad home”.

V. CONCLUSION

We are at the same place with tablets as we were in the mid-eighties when computers were first introduced. Davis’ model does not apply easily to the complexity of the usage situations in the described setting. A good technology acceptance model for tablets in education is needed. We have identified a number of factors that were relevant for our study, while making a formal model is left for future work. However, in order to design education supported by mobile devices, all stakeholders, from students to policy makers, need to be included as part of the ecology and as part of the TAM. The conclusion of this pilot study is that the iPad became an endangered species. In spite of everyone’s love for it and it’s cool device status.

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