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Exploring the Use of iPads in Danish Schools

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Abstract: Mobile devices, especially the integration and adoption of iPads in school classrooms, is gaining emphasis across the research and development forums of academic, policy, organizational, political, and public spheres. In April 2012, the Danish government announced that they would allocate DKK 500 million to develop the use of IT in elementary schools in Denmark. Since then, many municipalities have purchased iPads for schools for large sums. The existing literature, however, says very little about how these IT resources are being used or should be used in teaching. This paper contributes to the knowledge of how teachers and students use iPads in school contexts. During fall 2013, three elementary schools' second and sixth graders were observed, and their subject teachers were interviewed. The researchers applied a social constructivist perspective and a qualitative research design, using grounded theory methodology. The relevant factors identified were available knowledge and adoptable practice (including innovation evaluation, subject culture, learning activity design, and teachers' and students' skill level with iPads); advantages (including mobility, multimodality, access to information, startup time, and differentiated learning environments); and adoption barriers (including accessibility, training, and economy) as seen in relation to technology, pedagogy, and content. The paper concludes that the identified nature of knowledge, practices, and barriers are similar to the trend of integrating and adopting desktop computers and other educational technologies. However, there are some unique advantages that iPad and other mobile devices can enable through apps, readiness, etc. Policies and strategies should be adopted to combine training and maintenance along with ensuring access to iPads.

Keywords: iPad, School, educational technology, barriers, advantages, adoption, integration

1. Introduction

Mobile devices, especially the integration and adoption of iPads in educational institutions' classrooms and in different learning contexts, is gaining emphasis in many countries (Falloon 2013; Kucirkova et al. 2014; Miller, Krockover, and Doughty 2013). With the arrival of the iPad in spring 2010, as the representative of mobile devices called tablets, "popular press hyperboles has referred to 2010 as the 'year of the tablet' and most have privileged the Apple iPad as the flag-bearer" (Brand and Kinash 2010; Talevski 2010). In New Zealand, Melhuish and Falloon (2010) have drawn attention by discussing that the iPad has similar functionalities as a laptop, but the iPad's mobility and active mode like smartphones made it unique compared to other devices. As part of a pilot study in the math classrooms of United Arab Emirates (UAE) colleges and universities, Al Refi et al. (2013) reviewed that the drivers and barriers of using iPads in classrooms include the following factors:

> save paper, flexibility and portability, save cost, iPad is unable to view flash based programs, iPad encourages independent learning, increase confidence in students, support math apps, personalize learning environment, long battery life, accessibility of apps at home, iPad cannot manage multiple apps at the same time, attractive devices (mobility features), supports e-book initiative, support independent as well as group learning, encourages interaction between the students, increase student engagement, provide immediate corrective feedback, supports student collaboration, induces class distraction, and improve student performances. (p. 42)

Jahnke and Kumar (2014) investigated Danish K-12 classrooms and identified teachers' "use of multiple apps and focus on creativity, production, and collaboration in the learning process" (p. 81). The trend of investigation of the integration and adoption of iPad can also be categorized by the education level in which those studies were situated, namely, pre-school (Manches 2011), elementary school (Chou 2013; Huang et al. 2012), and tertiary education (Manuguerra and Petocz 2011) and to teach individuals with a disability (Kagohara et al., 2012). Most of the empirical work on information and communications technology (ICT) in education, including iPads in schools, has explored practices within a context, endorsing the need for situated exploration, and disseminating across communities

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of research, policies and practice. The facts or phenomena that must be explored are less known to the researcher, but can "produce interesting questions for further investigation now or in the future" (Andersen 2013, p. 20). Therefore, this paper takes as points of departure from the Danish government's emphasis on integrating and adopting digital learning materials in schools (Ministry of Education 2012b, 2012c), and that neither a clear approach nor an effect study in this relation has been found in the current literature.

According to the Ministry of Children and Education, DKK 500 million has been allocated as part of the eGovernment Strategy 2012-2015. The goal is to support the purchase of digital learning materials. All students have access to well-functioning ICT in education, have clear targets for the use of ICT and digital learning resources and learning, and research on IT-based learning methods (Ministry of Education 2012a).

The Danish government's initiatives are not free from criticism by researchers. Concern has been expressed that there is often no clear strategy for how and when iPads will be used (Mortensen 2012). "It is unfortunate that we spend so much money on a technology that we do not know exactly how will get us further. In fact, research today tells us very little about how the iPad specifically works in relation to learning." Pedagogy experts anticipate that the new wave of IT enthusiasm in the form of tablet purchases will end up leading to traditional and unimaginative teaching, because very little relevant software for iPads and other tablets has been developed (Ministry of Education 2012b). Thus, to raise additional questions and contribute to understanding of this concept, focusing on the context of Danish primary schools, this paper explores, how do students and teachers experience the use of iPads in teaching and learning activities in the classroom?

2. Methodology and methods

2.1 Data collection tools

Three primary schools in Aalborg municipality were selected using convenience sampling. To observe the behavior and actions in the context (Bryman 2012), 1.5 hours of structured observations were conducted in one class at each school. Three face-to -face interviews were conducted immediately after the three observation sessions to "gain knowledge about people's living situations, their opinions, attitudes and experiences" (Tanggaard Pedersen 2010, p. 29). Table 1 provides an overview of these qualitative empirical data.

Table 1: Table summary and overview of empirical data

	School 1	**School 2**	**School 3**
Date	26 Nov. 2013	28 Nov. 2013	2 Dec. 2013
Class/level	Second grade	Sixth grade	Second grade
Number of students and teachers	19 students Teacher A	15 students Teacher B	15 students Teacher C
Courses	Mathematics	Mathematics	Danish (language)
What technology is included in teaching?	iPads (6 students) and computer (13 students); teacher instructs using the computer connected to the smart board	iPad mini (students); iPad (teacher)	iPad (students); iPad mini (teacher)
What do students learn? (Educational purposes)	Primarily the doctrine of addition through the use of the program MatematikFessor; become familiar with the program	Primarily the doctrine of geometry through the use of the program Geogebra; become familiar with the program	Development of reading and writing skills
Tools for data collection	Observation (1.5 hours)	Observation (1.5 hours)	Observation (1.5 hours)
	Semi-Structured Interview	SSI: Teacher B	SSI: Teacher C

	(SSI): Teacher A (10 minutes)	(20 minutes)	(20 minutes)
Experience with iPad	The school has a class set of 23 iPads that mainly belong to the first year groups/classes. The set was purchased for the school starting 2012/2013.	The school purchased iPad minis for all students in the middle years group/classes at the school for this school year. However, the devices were handed to the students only about a month before due to a lack of iPad covers. Students have been given their own personal iPads.	All students in first, second, and third grades since the 2012/2013 school year, have been provided with their own personal iPads.

2.3 Data treatment method

Using the constructivist perspective, grounded theory (GT) was applied to analyze the data. First, the meaning of the interview data was condensed by transcribing the most significant quotes (Kvale and Brinkmann 2009). Then, GT was applied to categorize, to make simplifications, to devise relationships among categories, and to communicate clearly.

In recent years, several approaches to GT have emerged, and Bryant and Charmaz (2007) suggest the term grounded theory families from a Wittgenstein perspective, in which there are many similarities to the applied approaches but not one set of phases or one stable definition (2007, p. 11–12). In this research, the project team members' pre-knowledge of theories and practices is recognized and made explicit. What the analyst sees in data occurs from existing knowledge about the domain, which is why different people see and focus on different aspects of the data and therefore construct different analyses (Thornberg 2012). For example, Thornberg states the following about observation: "observation could never be totally free from theoretical influence because seeing is already a "theory-laden" undertaken" (2012, p. 246). Furthermore, "neither data nor theories are discovered, but are constructed by the researcher as a result of his or her interactions with the field and its participants" (Thornberg 2012, p. 248). This means this GT study was conducted from a constructivist perspective in which existing theories (applying known concepts, theories, and models of the fields and new literature reviews) unfold as follows:

- Going into the field without specific theoretical consciousness; the purpose is to explore and wonder.
- The first data analysis is performed without using existing theory extensively to focus on what the data say.
- The second data analysis applies conscious use of existing theory to validate or criticize findings in the data.

Charmaz (2006) articulated GT analysis tools in a constructivist paradigm. Using Charmaz's guidelines for the coding process, and initial coding, the data were reviewed line by line and then divided into passages. Passages could be between 1 and 2 line and up to 10 lines long. For each passage, a 1- to 5-word code-name was assigned to refer to the content. Codes with similar content were put in the same category (Charmaz 2006). Then open and axial coding was used, which formed the final set of categories in a tree-like structure. The codes were condensed into eleven categories, which are shown in Figure 3. The most relevant categories were selected for analysis (Charmaz 2006). Two categories, economy and teacher's role, were deselected since the development of qualitative insights would require further exploration.

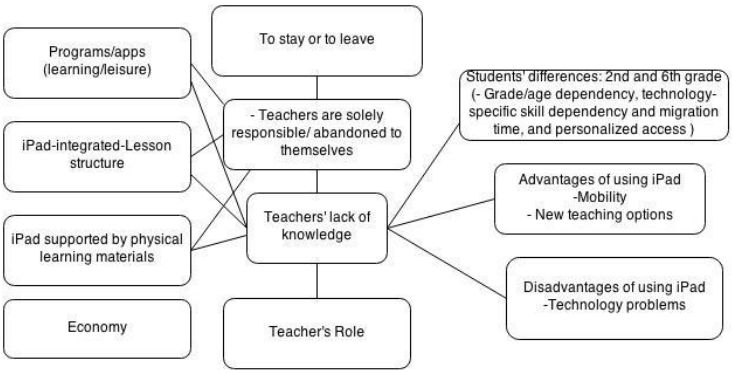

Figure 3: Axial coding: Eleven categories

3. Analysis

This section is divided into two sub-sections: data discovery, where the most prominent discoveries in the data are outlined as elements for devising a theory, and validation, where the elements are validated and critically discussed through the use of external theory.

3.1 Data discovery

3.1.1 Programs/apps in use

The curriculum at School 1 integrated the math program MatematikFessor (translated, "The Mathematics Professor"), accessed via a web browser. The students, through their own logins, solved the problems developed by the teacher. The teacher can follow the students' progress in task responses on an iPad or a computer through a personal login. Students have the opportunity to ask "the professor"/program for help. There is also an element of competition in the program (boys versus girls) to achieve the highest number of correct answers. Students navigated well in the program and engaged in tasks. The curriculum at School 2 integrated a geometry program/app called Geogebra, which helps learners draw figures in different sizes. Students not familiar with the program found it difficult to navigate, and did not show enthusiasm. These domain apps (e.g., mathematics) require the students follow the program step by step, and allow only answers one way due to the fixed structure of the app, which limits involvement with and learning about the subject.

The curriculum at School 3 integrated several apps: Showbie, Nearpod, BookCreator, Explain Everything, and Cabinet. The Showbie app can be described as an evolved version of Dropbox, where the students' work, assignments, etc., are stored and shared. Nearpod is an app for sharing and controlling, through which students receive content on their monitors, prepared and sent by the teacher. While the teacher, on an iPad, scrolls between different drawings prepared by the students, the students can follow on their iPads. The teacher can prepare questions and drawing assignments, send them to the students, and follow the students in their responses. BookCreator engages students with multimodal production, including text, audio, images, videos, etc. Using Explain Everything, students can record video and sound, and all added objects are stored, grouped, organized, and copied. Finally, Cabinet is a text handling and editing tool the student uses in PDF files to strike out words, underline, write, add, color, select all verbs, etc. The five apps are not subject-specific but are useful in several educational contexts (subjects and levels). All five in some way allow student production, student creativity, knowledge sharing, and reflection. Most importantly, the apps give the teacher the opportunity to facilitate a teaching lesson with many activities since the apps are simple and provide faster student production and switching. Through this category of open and non-controlled apps in multiple learning contexts, there may be consistency in iPad use throughout the school and among subjects.

3.1.2 The structures of iPad-integrated lessons

In the first two teaching observations, second- and sixth-grade mathematics at schools 1 and 2, we found similarities between the lesson structures. In the second-grade classroom, the teacher used the blackboard to teach for about 25 min, during which he reviewed the day's assignments and drew shapes on the board. The students participated and asked questions, and they did not use iPads. Then the teacher introduced how the assignments should be completed on the iPad. Students then focused on the assignment for an hour. In the sixth-grade classroom, the lesson was structured during a half-hour introduction to the day's topic for study and assignments, and the students worked

independently with their own iPad to solve the assignments. The teaching took place, at the beginning, primarily via a smart board. Students were told not to touch their iPads while the homework is reviewed. Thus, these lessons included a classic/traditional teaching beginning with primarily one-way communication from the teacher to the students without the students using their iPads. Teacher C at School 3 devised a different structure: “I do not start to instruct them. I just say they need to pick up the book and put their headphones on, and then they go off. And then most of them understand what to do.” In teacher C’s classroom, all necessary guidance for solving the assignments was digitally recorded on a common platform of which the students are aware and can access. If they did not understand the task, then they could replay it.

3.1.3 iPad supported by physical learning materials

At schools 1 and 2, the students used paper and pencil along with an iPad and computer. At School 3, the students worked with their narrative of a story in book format and iPad simultaneously. On the iPad, the questions were available, and students wrote the answers on their iPad. In the book, which was next to the iPad, the students found the answers. It seems that the iPad was involved due to school expectations on the strategic level, and not because teachers could see students’ academic achievement. Teacher B stated: “Now we’ve got computers at school. It must revolutionize education. It has not really happened. The same with smart boards: They would revolutionize education. It has not really happened.” Consequently, iPads are not used as a supplement to existing learning resources but as a kind of “doubling up” on learning tools. In teachers A’s and B’s lessons, effective learning goals were lacking when the iPad was included, whereas teacher C’s lessons appeared to have effective goals and engaged the students. These lead to the following categorization and analysis concerning teachers’ lack of skills and lack of knowledge about the involvement of iPads in education.

3.1.4 Teachers’ lack of knowledge

Teachers A and B reported that they lacked inspiration and new knowledge regarding the use of iPads in education. Teacher C actively worked in iPad-integrated classrooms for several years; in addition to courses on using iPads in education, teacher C has also had contact with people responsible for organizing iPad courses. Furthermore, teacher C was part of a team with other teachers at the school, where they discussed, shared knowledge, and worked to integrate iPads at School 3. At School 3, it was more or less up to the individual teacher to acquire new knowledge. Thus, “Either due to a lack of concrete guidance or personal motivation,” teacher 3 said, “I put myself fixed with a chair and begin to try it myself.” Teacher C said that his lack of knowledge affected the quality and the way he worked with the iPad: “So, it’s not just things that are floating around in various programs—they have six documents open at once ... Where I say: Well, I know how we store on the computer in the old-fashioned way, but I really do not know how to do it on the iPad yet.”

There are indications that the iPad has not sufficiently incorporated as a learning tool in the teachers’ educational designs and therefore was often involved in a simple way, such as by downloading a specific learning program as MatematikFessor. Teacher B pointed to the lack of leadership as a barrier: “The problem is that if we all stand more or less at the same level, and there is no one who can lead and say: We can use this to raise the level.” In fact, teacher B called for some of the things that teacher C was part of. The iPad teams could be a source of inspiration, and a community in which the teachers can lean on both in the doctrine of the iPad technical challenges and in pedagogical integration.

3.1.5 Teachers are not given guidance

It is largely the teachers’ own responsibility to search for inspiration and new knowledge in the field, without a significant guide or guideline for their research. Teacher B said that except for a course in which they were presented with 20 apps that were good for teaching, the teachers had not been required to attend any other courses or similar measures. Teacher B said: “Basically, I sat down and have used it as much as possible. Yes, it might be nice with a course and there might be other things—is there a guide somewhere? … I just wonder ... it's voluntary courses. That means, that it is not something that is recognized in my work. I'm going to such a course today. So, I can actually choose to say, I do not want to, or I have to be elsewhere today.”

Teachers had the opportunity to expand their understanding of the use of iPads in education through courses if they did not mind using their free time. However, this was a school, not a ministerial,

decision, since teachers A and C expressed that they had taken several courses and they were in the same boat as teacher B when it came to self-help.

3.1.6 Students' differences: second grade vs. sixth grade
Time spent on integration and adoption is an important factor, since the sixth-grade students had only had and worked with their iPads for several months, while the second-grade students had had their iPads for little more than a year. We observed "speed" and go-on-attitude" in the second grade at schools 1 and 3 in their use of apps and iPad, even though the second-grade students at School 1 had not previously worked considerably and did not have their own iPads. In sixth grade at School 2, the students had far more technical problems with the iPads, which they searched with the teacher's help. The sixth-grade students navigated more slowly, felt more uncertain, and showed resistance to the use of Geogebra.

Age appears to play a central role. The second-grade students "growing up" with the iPad had some advantages, such as typing on the iPad keyboard. It is perhaps a challenge for sixth-grade students to change from using a PC keyboard to a tablet keyboard. Teacher C anticipated this as a temporary factor and not as a concern: "I also write a report of eight pages on my iPad. You learn. Especially, like those students who have not been used to anything else. There is a fear in the upper classes ... they are of course not used to use the iPad from when they were smaller."

Regarding functionality and perceived affordances, teacher C said: "Students write much faster. And the fact that they can go in and edit (…) I think it is a great advantage too ... I can certainly see that they have written a lot more than what they would otherwise do." The students were quicker to express themselves in writing, and they wrote longer text passages.

3.1.7 To personalize or to borrow
If the students did not own an iPad and could not use it at home, then they might forget their skills or have a lack of access when desired. This complicates the implementation of the planned teaching. Teacher B said that ownership and convenient access enable greater knowledge acquisition regarding iPad and educational use. Confidence and knowledge of the iPad sped up the work flow since the students asked fewer questions related to understanding the technology and its use, and the students navigated faster. These contributed to the quality of the teaching time. At School 1, students borrowed iPads from the school, and teacher A said, "It does not matter if it's an iPad or a computer," because MatematikFessor is accessible on both. However, the fact that students were less enthusiastic in class might be a related issue; it's not clear what the students are less enthusiastic about: the class in general or using a computer or using an iPad or the app.

3.1.8 Advantages of using iPads
A thorough review of the data shows several benefits of using iPads. First, students found delight. Teacher A stated: "I think this is primarily from home; they associate the iPad with having fun." The second benefit is mobility, which we observed. Teacher A said:

> The advantage of iPad over computer is that students can take it outside. We had a lesson with geometry when they were out taking pictures via an app and made a collage. For two blocks of lessons we managed to be outside, take pictures, make collage and print them. We would never have achieved that with ordinary laptop. … spread out in the classroom, out in the common room and a small room next to the classroom.

The students could personalize their learning environment to some extent. Calmness was observed as teacher C sent the students out of the classroom for independent work via their iPad. Moreover, it was surprising to see how long it was quiet in class when students worked with iPads compared to observations in conventional classes. The observations note shows this, from the second grade at School 1: "After 40 min into teaching (...) still very quiet in class."

Third, the iPad helped students learn various skills. Teacher C facilitated tasks from home for the day's lessons for students on a common platform, where students could listen to the recorded assignment and then work independently.

The last advantage was the start-up time, which the three teachers expressed several times. For instance, teacher C said: "I have used several tablets ... the iPad is easy … It is very fast to turn on, shut down and pack up—about 2 min." The iPad made the transition from one activity to another activity at School 3 efficient. At School 1, some students worked with iPads and others on laptops. It

took some time (maybe 10 minutes) before all the students' computers were turned on and on the Internet and found the intended website. Those with iPads were much faster. In addition, MatematikFessor on iPad was faster with scrolling, typing, and tasks.

3.1.9 Disadvantages: technology issues

iPad functionality-related challenges were identified at each school. At School 1, the iPads were being updated, and the research team nearly lost the opportunity to see them in use. At School 2, several students were frustrated since the iPads were freezing or deleting their work. At School 3, students had to spend most of the lesson at the teacher's table where the iPad could be connected to power. Further problems arose since students must speak and listen to the reading of a test. Teacher C explained that the recently provided headphones were incompatible with the covers and could not be connected to the iPads.

Teacher C also mentioned that the students downloaded games, leaving no room for the apps for classroom activities, and the teachers then had to delete games from each iPad. As a result, the school has locked students' access to download or delete new apps. We observed that a student could not continue his reading since his younger brother had deleted an app at home, and there was no time to help student download the program. It seemed technological problems are now part of everyday life.

3.1.10 Disadvantages: students forgot to bring iPads to school

At schools 2 and 3, students sometimes forget their iPads at home. At School 2, the students could borrow a school laptop and access the program through the Internet browser. Since School 3 used only apps, it was necessary to have additional school iPads as back-up. Since teacher C in the observed teaching and in the interview showed more integration of iPads in the classroom than schools 1 and 2, the teacher was asked how dependent the students were on the iPads and what happened when the students forgot their iPads. Teacher C replied:

> Yes, they are dependent. We have two "loaner iPads," so it helps a little. Okay, there was no power at one of them today. We have many stay-at-home parents, and we will simply call home in the morning and say they forgot their iPad. We cannot expect that they do, but actually many do... But they are very dependent to bring it to school. You can create some activities where they can sit in pairs. But they had to record some sound today, and it was not so easy in pairs.

The more a school integrates the use of iPads in teaching, the more the dependence factor rises, and back-up plans are necessary. If several students have forgotten their iPads, or the school-loaned iPads are out of power, as was the case in this study, there is a risk that some students lose the opportunity to attend classes on an equal footing with their classmates.

4. Discussion and conclusion

This qualitative study explored, in the context of Danish primary schools, how do students and teachers experience the use of iPad in teaching and learning activities in the classroom? Although only three classrooms from three schools were studied, the findings are rich and provide nuanced views, which are expected to have a strong contribution in practice and policies for iPad initiatives in Denmark and around the globe.

The study identifies that with the increase of the integration of technology in teaching-learning activities, the roles of a teacher and students, along with the roles of parents, have become heavily dependent on technology. The apps on iPads, both subject-specific and open-ended, require the development of knowledge and skills regarding the specific technology, technology-supported pedagogy, and technology-related-classroom management (Hew and Brush 2006).

Restricting access to (un)install apps, providing backup devices, and providing access to power sources for recharging are the technology-related-classroom management issues identified in this study. Although open-ended apps playfully engage the students, they found the subject-specific (mathematics) apps less enjoyable. Further investigation is required to identify whether the lack of motivation is due to the subject, the nature of the interaction within the app, or other contextual school-related factors. Technology-supported pedagogy includes the structure or learning design of a lesson, which should be incorporated in teacher training instead of expecting each teacher to find an innovative idea. The lack of training for teachers, time pressure, and technical support were identified

as critical issues, which have been stressed in educational technology literature for the last three decades (Ertmer 1999; Hennessy, Harrison, and Wamakote 2010; Khan, Hasan, and Clement 2012). The findings in this study in particular show that teachers and schools need to know more about the feasible learning designs for their specific target group, domain, and context.

The speed and attitude in relation to the use of iPads depend on the time spent adopting the device. The rate of adoption and opportunities to be persuaded/to have developed a positive attitude increase with the higher duration of time spent (Rogers 2003). Furthermore, time is also involved if one has to migrate from one technology (e.g., PC) to another (e.g., iPad). Gaining efficiency (whether for the teacher or student) requires spending time with the technology (iPad) and practicing the desired skills.

Integrating iPads in lessons can greatly transform the structure of lessons, and depends significantly on the teacher's role and her or his adoption of apps, structuring of information, and communication strategies. If the class structure includes explanation of the activities using the app, then a large proportion of the lesson time is spent on introductions, which may cause increased stress factors, for the students and the teacher.

It might be claimed that the use of iPads has shown strong advantages over the PC and can be argued as a significant reason for defending the technical feasibility aspect. The iPad enables mobility (i.e., can be used outside conveniently) and offers multi-functionality (i.e., camera, communication tools, and teaching-learning activities) and multi-modality (i.e., video, audio, image, and text). In addition, iPads are viewed as a fun technology by students, which lead to more attention and engagement for longer duration than otherwise possible. The iPad can create a personal learning environment, breaking the boundaries between formal and informal learning spaces. This makes young students calm and focused while they are engaged in learning activities, as well as have the potential to improve the quality of lessons by enabling students to become informed about lesson content in advance. This can save the teacher time by decreasing the time required for explanation in plenary, and dedicating more time to students who need more help.

We recommend that policies and strategies should be adopted to combine training and maintenance along with ensuring access to iPads. Future studies covering a large number schools and involving mixed methods might be a direction for evaluating and revisiting the current policies and strategies across national, regional, school district, and individual school levels.

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