Between Smartphones and Tablets: Improving Teacher Education Programmes through Mobile Devices

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This research was conducted at the University of Genoa (Italy). The student teachers attended a course focused on the use of mobile devices at school. We tried to examine the impact of mobile learning on university activities for pre-service teachers, the changes in the organization of their studying, the changes in their learning strategies, and the changes in their interaction/cooperation levels. After the course, we administered a questionnaire with both closed-ended and open-ended questions, which highlighted important findings concerning the differences between smartphones and tablets in supporting these aspects of their learning. We found that both types of devices improved interaction and cooperation among students, and being able to search for information was useful for studying. However, changes in the organization of studying and the learning strategies were supported only by tablets and only for specific aspects of learning. This study suggests solutions to improve Italian teacher education programmes and the quality of university activities.

Keywords: mobile learning; teacher education; mobile devices

Introduction

This study aimed to investigate whether and in what ways mobile devices can modify the educational activities of a university subject taking Italian teacher education programmes. The study was carried out at the Department of Education of the University of Genoa (Italy) at the end of a course called "Educational Technology," which is included within the teacher education programme for primary and secondary school teachers. There were three main aims of this study. The first aim was to examine which aspects of teacher education courses are most affected by the use of mobile devices. The second aim was to underline the educational opportunities provided by mobile devices to improve teacher education programmes. The third aim was to improve the qualification level of Italian student teachers with regard to issues arising from the use of mobile devices to allow them to face the educational and cultural challenges of a digital classroom.

Theoretical framework

The chances offered by the cloud and ubiquitous computing (Cope and Kalantzis 2009; Burdick et al. 2012) suggest several opportunities in order to modify and implement the structure of programmes in teacher education. To date, we have managed the teacher education activities with the support of eLearning platforms for sharing materials and interacting with student teachers. With mobile learning, we can imagine activities spread in different times and spaces. According to Harris (2001), "Mobile learning is the point at which mobile computing and eLearning intersect to produce an anytime, anywhere learning experience." Additionally, Schuck et al., (2013) point out that "Mobile technologies have the

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potential to be employed innovatively as powerful learning tools in higher education" (p. 2) because they can allow us broader and quicker access to information and the possibility of sharing ideas and creating materials before, during, and after university and teaching practice activities. Mobility and accessibility have become the keywords for a new teacher education paradigm.

In recent years, we have observed an increasing trend towards integrating mobile learning into teacher education contexts (Baran 2014). UNESCO (2012) emphasizes mobile devices as a global theme that can expand educational access and support instruction, administration, and professional development. Previous studies have focused on the educational opportunities offered by small mobile devices, such as the iPod (Mahruf et al. 2010; Coens et al. 2011), mobile phones, smartphones (Seppälä and Alamäki 2003; Aubusson et al. 2009; Ekanayake and Wishart 2014), tablets, (Kearney and Maher 2013; Bates and Martin 2013; Hargis et al. 2013; Hashim 2014) and combined situations in which various types of devices have been used (Järvelä et al. 2007; Husbye and Elsener 2013; Herro et al. 2013; Şad and Göktaş 2014). The participants involved in these studies have been in-service or pre-service teachers, teacher educators, administrative staff, or teacher advisors, so studies on the relationship between mobile devices and teacher education are heterogeneous. This paper can be included in the area of pre-service education because it involves student teachers who had the opportunity to use smartphones and tablets. This choice was made because we wanted to analyse the effect of the devices that are generally used by young teachers for the development of meaningful interaction and learning.

Previous studies focused on these issues highlight the importance of the possibility of sharing knowledge and skills through a high level of participation and interaction (Ekanayake and Wishart 2014). Kearney and Maher (2013) emphasize the role of mobile learning approaches for the improvement of pre-service teacher education. In particular, they state that "pre-service teachers use the tablets to enhance organizational aspects of their professional learning. They initially use productivity apps in class, often in a 'just in time', spontaneous fashion to take notes; plan, evaluate and observe lessons on professional experience; and record and annotate media, including their own multi-modal reflections. Many pre-service teachers mention the ability of the mobile device to conveniently keep records of their own learning journey both on and off campus" (Kearney and Maher 2013, p. 81). Broda, Schmidt, and Wereley (2011) emphasize the need for educators to adopt a "progressive ethic for teaching and learning, supporting efforts to think differently and use the technology tools to explore and embody the fluid nature of learning and teaching." (p. 3150)

Schuck et al. (2013) report some advantages of mobile learning, including flexibility, convenience, user-friendliness, an enhanced ability to undertake complex tasks, enhanced communication, opportunities for group learning, and increased sharing and interactions with local and global communities. In this way, the authors see mobile devices as vectors for arranging educational opportunities for the contextualization and personalization of learning tasks and as support for project-based and inquiry-based learning approaches.

The learning activities performed on mobile devices feature a different concept of time-space. Formal learning is traditionally "characterized by two constants or boundaries: time and space. Learning places occupy fixed, physical spaces which are defined by relatively impermeable boundary objects such as walls, classrooms and school buildings. Mobile devices create what we term malleable spatial-temporal contexts for learning " (Kearney et al. 2012). It is crucial that we recognize and acknowledge the importance of the organization of the learning environment in terms of time-space because it profoundly affects mobile

learning experiences (Ling and Donner 2009).

Kearney et al. (2012) propose a framework to qualify mobile learning experiences through the use of time-space to develop learning and professionalism among pre-service teachers.

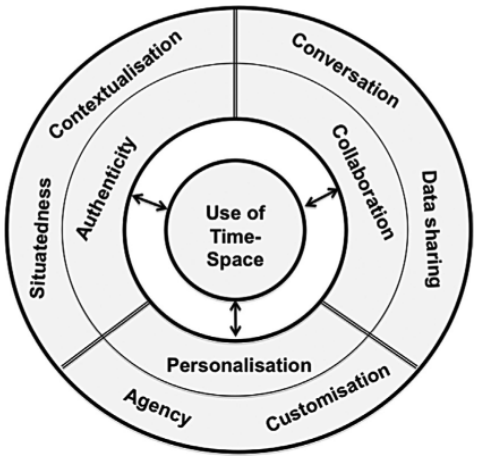

Figure 1. Three distinctive characteristics of m-learning experiences with sub-scales (Kearney et al., 2012).

Three distinctive characteristics of mobile learning experiences, along with their respective sub-scales, are described by the authors. Authenticity represents the possibility of facing real instructional situations in real contexts. In fact, "mobile learning episodes potentially involve high degrees of task and process authenticity as learners participate in rich, contextual tasks (setting, characters, tools), involving real-life practices" (Kearney et al. 2012). Learners can generate their own rich contexts (Pachler et al. 2009) with or through their mobile devices. Thus, student teachers have the opportunity to contextualize their learning in situated experiences by participating in a real community of practice. Collaboration among student teachers can be improved through mobile learning experiences because mobile devices support dynamic and real-in-time dialogue and conversation, with a high possibility of material and data sharing that can be retrieved online or generated by student teachers. Finally, personalization refers to the opportunity offered by mobile devices to customize the learning paths of student teachers. Student teachers can use tools and apps to record, organize, and reflect on their own learning experiences over time; they can negotiate learning choices (e.g., content and goals), and ultimately, they can design their own learning paths by selecting, producing, or sharing materials.

In our framework, authenticity represents the challenge of modifying university activities (lectures and classes, workshops, and teaching practice); collaboration refers to the changes and opportunities in implementing interaction and cooperation among student teachers; and personalization is connected with potential changes in the studying organization and learning styles and strategies of student teachers. Our study aimed to analyse how these factors are supported during teacher education activities, such as during a class or in teaching practice. In particular, our framework focuses on the role of the new spatial-temporal dimensions offered by mobile devices to examine how they can modify, enhance, improve, and affect student teachers' interaction, collaboration, and learning strategies.

Research design

Context and research question

The Italian teacher education programmes for primary and secondary school are different. Primary school teacher education lasts five years and includes subjects focused on both pedagogical and psychological aspects. This course is attended by student teachers after receiving a high school certification. Secondary school teacher education is a one-year master's degree course in a specific subject (maths, history, philosophy, etc.). Both programmes include a subject called "Educational Technology," which is focused on the use of mobile devices at school.

This research was conducted during the 2014–2015 academic year. The professor presented online digital materials, and the students had to elaborate, share, and cooperate online through their own mobile devices. For instance, the professor uploaded documents to cloud storage, and the students had to begin an argumentative discussion that highlighted and underlined the most important points while adding comments and exchanging materials.

All of the student teachers had smartphones, but some of them did not have tablets. In this case, they worked together with colleagues to experience both devices. At the end of the course, the students took two types of examinations. The first was a traditional exam in the form of a written test that focused on the theoretical aspects included in a textbook. The second was innovative: the students had to simulate a lesson with the use of mobile devices and prepare all the materials.

Based on this educational situation, we had the opportunity to analyse the main factors in a teacher education course that could be affected and, consequently, modified and improved by mobile devices. The research question can be summarized as follows: has the use of mobile devices affected the main aspects of a subject included in a teacher education programme? In particular, we wanted to analyse the following areas:

(A) University activities (lectures, workshops, and teaching practice);
(B) Changes in individuals' studying organization at home;
(C) Changes in students' learning styles and strategies;
(D) Changes in the interaction/cooperation among students.

Participants, procedure and instrument

The participants involved in the study attended three different kinds of courses. The SFP course (*Scienze della Formazione Primaria*, or "Teacher Education Programme") was for primary school teachers. The TFA course (*Tirocinio Formativo Attivo*, or "Effective Teaching Practice") was for secondary school teachers and it was composed of student teachers with little teaching experience. The PAS course (*Percorsi Abilitanti Speciali*, or "Special Qualified Course") was for secondary school teachers and it was composed of student teachers with a lot of teaching experience (at least three years). For these reasons, as you can see in Table 1, the PAS students were older than the students in the other courses (41 years old) and they have been teaching for nine years on average. The TFA students were a bit younger (33 years old) and they have been teaching for two and a half years. The SFP students were very young and they did not have school experience.

We chose a mixed approach to collect both qualitative and quantitative data because we wanted to stress distinctive benchmarks for the mobile learning activities in teacher education and to develop a more profound understanding of the reasons for these points of reference. After the end of the course, we administered an online questionnaire to

the participants. The questionnaire was developed by the authors and was composed of 16 closed-ended questions and 4 open-ended questions focused on the areas indicated in the previous paragraph. Each closed-ended question was divided into two parts. The first referred to smartphones and the second to tablets to identify the differences between the use of the two types of devices.

Table 1. The participants' characteristics.

Level	**Participants**	**Gender**	**Age (M & SD)**	**Teaching area**	**Seniority (M & SD)**
SFP	49	46 F (93.88%)	25.102 (5.11)	PRIM 10.87%; DO NOT TEACH 89.13%	Not available
		3 M (6.12%)	25.33 (4.04)	PRIM 33.33%; DO NOT TEACH 66.67%	Not available
PAS	113	100 F (88.5%)	42.55 (6.03)	LIN 57%; SCI 35%; TEC 8%	9.25 (3.61)
		13 M (11.5%)	40.08 (6.31)	LIN 61.5%; SCI 30.8%; TEC 7.7%	9.03 (3.62)
TFA	99	51 F (51.5%)	33.47 (7.83)	LIN 41.2%; SCI 29.4%; TEC 11.8%; PRIM 5.9%; DO NOT TEACH 11.8%	2.59 (1.88)
		48 M (48.5%)	33.88 (7.48)	LIN 31.3%; SCI 33.3%; TEC 27.1%; DO NOT TEACH 8.3%	2.61 (2.19)
Labels: PRIM = primary; LIN = linguistic area; SCI = scientific area; TEC = technical area					

In Table 2, we show the structure of the questionnaire. A five-point Likert scale was used to register the responses for the closed-ended questions: Yes, completely = 5, Yes, a lot = 4, Neither yes nor no = 3, No, a little = 2, Not at all = 1. The aim of the structure of this questionnaire was to clearly highlight the modalities of student teachers while they were using both smartphones and tablets.

Table 2. Structure of the questionnaire.

			Sample item	
Area		**Sub-area**	***close-ended questions***	***open-ended questions***
A	University activities	A1-lectures A2-teaching practice at school A3- teaching practice at university A4-workshops	Did the use of mobile devices make the lectures more interesting?	Can mobile devices improve the organization of teacher education programmes?
B	Changes in individual studying/organization at home	B1-studying at home B2-search for information B3-digital materials B4-books and other instruments or media B5-personalized learning	Did the use of mobile devices modify your studying style at home?	Did the mobile devices change the way you prepared for the exam?
C	Changes in learning styles and strategies	C1-memorization C2-elaboration of information C3-critical thinking C4-metacognition	Did the use of mobile devices help you in thinking over your own learning style?	Did the mobile devices support the development of your critical thinking?

D	Changes in the interaction/cooperation among students	D1-interaction among students D2-cooperation among students D3-sharing digital materials	Did the use of mobile devices increase opportunities to cooperate with other student teachers?	Did the ways of interacting and cooperating among student teachers change when they used mobile devices?

Layout of the closed-ended questions

e.g., C3. Did the use of mobile devices help you in thinking about your own learning style?

[T] Tablet	Yes, completely	Yes, a lot	Neither yes nor no	No, a little	Not at all
[S] Smartphone	Yes, completely	Yes, a lot	Neither yes nor no	No, a little	Not at all

Data analysis

The data analysis focused on the quantitative data, whereas the qualitative data were used to explain and understand the quantitative results in the discussion section.

Table 3. The item distribution.

	areas	device	SFP	PAS	TFA
SECTOR 1 M >4	A	*Tablet*	-	-	-
		Smartphone	-	-	-
	B	*Tablet*	2	2	2
		Smartphone	-	-	-
	C	*Tablet*	-	-	-
		Smartphone	-	-	-
	D	*Tablet*	1-3	1-3	2-3
		Smartphone	1-3	1-2-3	1-2-3
SECTOR 2 3.5<M<3.99	A	*Tablet*	1-2-3-4	1	3-4
		Smartphone	-	-	-
	B	*Tablet*	3-4	1-3-4-5	4
		Smartphone	2	2	2
	C	*Tablet*	-	-	-
		Smartphone	-	-	-
	D	*Tablet*	2	2	1
		Smartphone	2	-	-
SECTOR 3 3<M<3.49	A	*Tablet*	-	-	1-2
		Smartphone	1-2-3-4	1	1-2-3-4
	B	*Tablet*	1-5	-	1-3-5
		Smartphone	-	1-3-4-5	4
	C	*Tablet*	2-3-4	2-3-4	2
		Smartphone	3-4	2-4	-
	D	*Tablet*	-	-	-
		Smartphone	-	-	-
SECTOR 4 Item <3	A	*Tablet*	-	-	-
		Smartphone	-	-	-
	B	*Tablet*	-	-	-
		Smartphone	1-3-4-5	-	1-3-5
	C	*Tablet*	1	1	1-3-4
		Smartphone	1-2	1-3	1-2-3-4
	D	*Tablet*	-	-	-
		Smartphone	-	-	-

NB: Area A of the questionnaire for PAS students provided only item A1.

In Table 3, we grouped the items into four sectors to highlight the most significant aspects and underline the differences among the three types of courses. The first sector includes the items that received a high evaluation (greater than 4), the items in the second sector received a good evaluation (between 3.50 and 3.99), the items in the third sector were evaluated positively but with low scores (between 3 and 3.49), and finally, the last items (sector 4) received a negative evaluation (less than 3).

We can state that:

- the items are evenly distributed among the three types of students (SFP, TFA, and PAS);
- the items of area D are concentrated in sector 1, with high scores together with item B2, which also focused on the retrieval of useful information to study more thoroughly, but only for tablets (B2 [T]);
- the items related to university activities (area A) with tablets are grouped in sector 2 with a good evaluation, whereas items in the same area but with smartphones are included in sector 3;
- the items of area B (changes in individual studying organization at home) are distributed between sectors 2 and 3; in the second sector, we find the items with tablets are predominant; in the third sector, there are items with smartphones, but we can underline a high-level dispersion; in addition, the students teachers of primary school (SFP) include the item with smartphones, even in the sector with lowest scores (sector 4);
- the items of area C (changes in learning styles and strategies) appear as the most critical because they are grouped into sector 3 (with tablets) and sector 4 (with smartphones); the TFA students include all items of area C in sector 4.

To identify the presence of statistically significant differences between the areas of the questionnaire, we conducted an analysis of variance with repeated measures (rANOVA). Cronbach's Alpha was high for all areas of the questionnaire, so we could aggregate and subdivide the data into the parts related to smartphones and tablets. As shown in Figure 2, we compared the data and found the following:

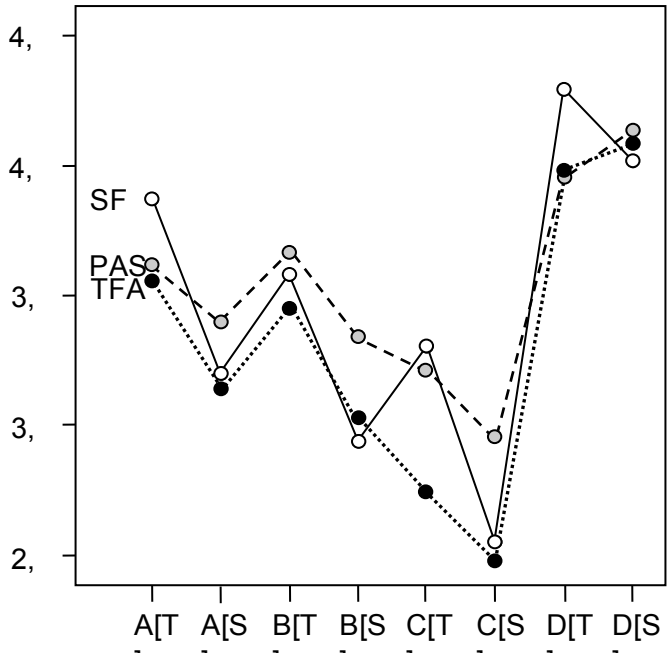

Figure 2. rANOVA with repeated measures.

- the SFP students think that tablets offer the opportunity to modify university activities (A[T]), but there is no significant difference between the groups;
- the PAS students consider the smartphone as a useful device in order to modify individual studying organization at home (B[S]); the scores are higher compared to those of SFP students, but not to those of TFA students; the difference is not significant among the three courses ($F_{(217.2)} = 2.846$; $p = .060$); however, comparing in pairs, the post-hoc test (conducted with the Bonferroni method) shows the difference between PAS and SFP students;
- the TFA students do not see the tablets as useful devices to improve their own learning stategies (C[T]); in fact, the scorse are statistically lower compared to those of both SFP and TFA students ($F_{(219.2)} = 8.061$; $p = .000$);
- instead, the PAS students consider smartphones as very useful devices to improve their own learning strategies (C[S]) compared to TFA students; there is a significant difference among the courses ($F_{(212.2)} = 4.748$; $p = .010$) and the post-hoc test confirms the difference between PAS and TFA students.

Discussion

When analysing the data grouped in the first sector of Table 3, we find that both types of devices, i.e., tablets and smartphones, support interaction and cooperation among students, and they are useful for rapid information searches. Thus, we can affirm that the use of both smartphones and tablets can improve interaction and collaboration among students, and the retrieval of information useful for studying.

The qualitative analysis supports the quantitative data. The open-ended question regarding cooperation (area D) was, “Did the ways of interacting and cooperating among student teachers change when they used mobile devices?” One of the SFP students answered this question by saying, “Thanks to mobile devices, I’ve been able to communicate with my university-mates from everywhere at any time and to collaborate with them during digital activities very rapidly and in a functional way.”

Combining the quantitative analysis (referring to the second sector of Table 3) and the qualitative data, we can affirm that university activities (lectures, workshops, and teaching practice) may be improved with the use of mobile devices. In this case, tablets are more useful because they have large screens and can be used to create digital materials, which seems impossible with smartphones because of their small size. The participants noted that only tablets can support the effectiveness of lectures, workshops, and teaching practice to improve the quality of university activities. Smartphones are quick and convenient for the exchange of information and materials, but they are useless for reading, modifying, or creating digital materials. One of the SFP participants wrote the following answer to the open-ended question from area A (“Can mobile devices improve the organization of teacher education programmes?’): “The mobile devices allow a global approach to the subjects, because the topics debated during a lesson can be studied more thoroughly and integrated with whatever kind of information, in the sense that they can be personalized; for instance, the teacher is talking about a topic that excites my curiosity, so I’m looking for additional information about that topic online and I integrate my notes.”

Study organization at home (area B) has conflicting results. It can be improved mainly by using tablets because the small screens of smartphones do not allow students to easily create digital materials. Tablets appear to be crucial for preliminary study organization, but some students have difficulty when they have to pick up their digital

materials to study for an exam. We must underline that the PAS students prefer the use of smartphones; in fact, one of them claims: “With my device, I can find information, websites, materials, videos useful for studying at any time and everywhere and, above all, I can check always MY materials and MY documents, even if I forgot my USB stick! The mobile devices make all places a studying place. Everywhere they make you feel...at home!”

Area C (learning strategies) is complex because the most critical point is represented by changes in the students’ learning styles and strategies, in particular for TFA students. Tablets seem to help students by enhancing the elaboration of relevant information, critical thinking and metacognition, but they do not support the memorization of information. One TFA student says: “I think that the critical thinking development is not enhanced directly by the use of the mobile devices but I think that they can support such development...since they can allow the access to a lot of channels and information. Of course, only the access is not enough but a precise intentionality is necessary.”

Findings and conclusions

In conclusion, we can emphasize some ways that mobile devices are particularly useful for the development of Italian teacher education programmes. First, mobile devices can improve teacher education programmes with regard to opportunities to find and share information, create digital materials, and enhance cooperation among students. This is particularly true for tablets, but smartphones are also useful because of their flexibility and because they allow students to contact their classmates to exchange information rapidly.

For these reasons, university activities should support mobile devices’ affordances, such as arranging lectures that require searching for information, elaboration of materials, and sharing ideas in order to discuss and improve this critical comparison.

Area C is our main aim for the future. We want to investigate more thoroughly the connection between interaction and the development of critical thinking and learning strategies. It is important to highlight the link between the usefulness of mobile devices in supporting interaction and collaboration, and it shows a clear and evident improvement of the learning strategies and study organization of each student.

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