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Developing mobile learning practices through teacher education: Outcomes of the MLEARN pilot

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Outcomes of the MLEARN pilot

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Abstract

Purpose – This paper explores the context, development and outcomes of a cross-European in-service training programme, developing mobile learning practices in school classrooms – MLEARN – in The Netherlands, England, Greece and Italy. This paper focuses on: contextual backgrounds; a training needs analysis; and initial, mid-term and final outcomes from teachers and learners.

Design/methodology/approach – Evidence was gathered about: contextual backgrounds through literature reviews and key informant responses; a training needs analysis through online survey responses from teachers and trainers; and outcomes of uses from five surveys, largely completed online by teachers and learners, after some 2, 3, 5, 9 and 13 months of use.

Findings – Findings from survey periods were compared to identify shifts and gaps. The training programme led to successful outcomes; there was rapid uptake and use of the mobile devices, as well as shifts in emphasis across the period of the pilot, dependent on contextual factors. But long-term integration requires focus on specific learning activities, as well as on integration beyond a one-year period.

Social Implications – Uses of mobile devices are increasing, across countries and age ranges. How devices can be used to support learning and teaching in contemporary contexts is not temporally independent. Country curricula, legislation, training programme access, and teacher and learner awareness and perceptions, all influence practice.

Originality/value – Teachers have limited access to training programmes in this field. This study investigated a key pilot in this under-developed research area. Key factors need to be considered when programmes are developed and run.

Keywords Teachers, Mobile learning, Schools, Research roles, Teacher training, Using mobile devices

Paper type Research paper

1. Introduction

Previous studies of mobile learning in educational contexts have explored examples of use in practice, factors that have influenced integration into practice and benefits arising for both learners and teachers. Studies of a range of mobile learning projects run across Europe and outside Europe (Dykes and Knight, 2012; Shohel and Power, 2010), reviewed lessons learned and limitations arising, while a review of research literature has indicated how mobile learning practices can be developed to support a range of pedagogic approaches: behaviouralist, constructivist, situated, collaborative and informal and lifelong (Naismith *et al.*, 2004; Ting, 2013). Findings from these studies show that greater accessibility to information and the provision of information in context are key benefits associated with mobile learning. Particular contexts in which

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benefits can arise have been defined as spatial/location, temporal, social, or access/technical in nature (Koshman, 2011). Mobility, face-to-face social interactions, uses of authentic teaching and learning materials, constant alertness, the focus gained from mobile "learning moments", and learning and time convenience are important features associated with activities in these different contexts (Economides and Nikolaou, 2008). The possibility of developing practices concerned with the concept of "interwoven learning interactions" has been highlighted when handheld devices are used in learning activities and in series of these activities (Ting, 2013). Informality and ownership have been identified as factors that positively influence uses of mobile technologies and the ways activities might interweave and be interwoven (Kukulska-Hulme and Traxler, 2005; Wu and Zhang, 2010). Recognisable benefits of uses of handheld devices that have been investigated have included alertness, choice of student preferences, saving time, broadening assessment tasks, supporting special educational needs and supporting language learning, all enhancing pedagogical value (Economides and Nikolaou, 2008; Wu and Zhang, 2010).

From literature and online searches, and from key informant responses undertaken as a part of the study reported here, access to and numbers of courses that have focused specifically on uses of handheld devices in initial and in-service teacher education have been limited, and information about these opportunities has not necessarily been widely accessible to teachers in the four countries participating in the European Union (EU)-funded MLEARN project (Passey and Zozimo, 2014a). A report for this project (Passey and Zozimo, 2014a) found that mention of handheld devices in the four national curriculum and school guidance documents was minimal. In summary, although the curriculum and its intentions in Italy support practices that lend themselves to uses of handheld devices, the penetration of information and communication technologies (ICTs) in schools was reported to be generally low, and it was reported that teachers may not have been trained in the use of these or other related ICT facilities. Although uses of ICT are supported and encouraged in schools in Greece, the use of mobile telephones is not allowed. Devices for uses in schools in Greece, therefore, need to conform to handheld computer specifications, while facilities for the capture and editing of sounds or images may need to be disabled. Many teachers in schools across The Netherlands use ICT to support teaching and learning; there are agencies in place that support ICT developments and the promotion and dissemination of ICT practices, including those with handheld devices. In England, ICT and computing are specified in curriculum documents that are statutory; teachers are asked to adopt pedagogies to match the needs of their classes and pupils, using appropriate ICT and handheld technologies.

Existing research reviews indicate that teacher education should provide, in as fully a contextualised and integrated way as possible, a focus on three interconnected elements (Mishra and Koehler, 2006):

(1) technological knowledge (what the device can do and how to use it);

(2) content knowledge (what subjects and topics can be addressed using the devices and their applications); and

(3) pedagogical knowledge (how this is done through the development and deployment of appropriate teaching and learning activities).

When using handheld devices rather than static facilities, there is a need for teachers to consider how the learning environment might be expanded beyond the classroom because of the portability features of the devices. Similarly, features of these devices more strongly support aspects of communication and their links to teaching and learning than static devices do. Already, some schools and agencies have explored ways handheld devices can support learners with special communication needs. The literature also shows that teachers have used mobile devices in curriculum activities that involve and support practices concerned with research, capturing and using imagery and video clips, presenting to teachers and peers, discussing captured and presented work with teachers and peers, recording and sharing ideas with peers, providing anonymous feedback, pupils creating their own notes and books in multimodal formats, discussing strengths and weaknesses in presented work shared by pupils, creating videos for presentation to wider audiences, presenting perfect models or techniques, organising notes and work, and pupils recording video clips of lessons for later playback. Taking these uses into account, activities highlighted as being worthy of exploration in teacher education events are (Passey, 2010, p. 69):

- *Review and reflect*: "Here, pupils capture audio, imagery and video during lessons, use these in plenary sessions to reflect on what has been covered, consider the key elements learned, how these fit into wider subject or topic pictures and how ideas might be used or taken further outside the classroom". This focus on reflection is highlighted as important for learning by, for example, Schön (1983).
- *Think forward*: "Here, pupils access future topic material via the Internet and capture relevant thoughts or ideas to contribute to discussions or presentations in class or through on-line discussions. Pupils can be encouraged to use the handheld devices at home to research topics for themselves". The importance of understanding how to tackle learning, identifying future end points and sources of support, for example, is highlighted by Vygotsky (1978).
- *Listen to my explanations*: "Here, pupils record audio when they are completing homework assignments and these verbal explanations are listened to and marked by teachers". Verbal explanations are important for many learners, highlighted by, for example, Gardner (1991).
- *Snap and show*: Here, pupils capture imagery, which is downloaded to a server and accessed through a computer or interactive whiteboard screen, for wider pupil discussion, perhaps made accessible to parents so that they can see and discuss events that have happened in school". The importance and influence of imagery for learning is highlighted by, for example, Arnheim (1969).
- *This is what I've done and how I've done it*: "Here, pupils create presentations of how they have used mobile technologies to tackle particular activities, which are recorded and made accessible on appropriate websites for teachers and parents to see. Observing other pupils' stories and reports, pupils can include sound recordings of their own voice as well as text and pictures to form multi-modal 'texts'". The critical importance of discussion and explanation for learning is highlighted, for example, by Alexander (2008).
- *Tell me how I could improve this*: "Here, pupils can share their work in multimedia formats with peers, mentors, teachers or trusted adults to seek comments,

evaluative feedback, assessments of their work and ideas to improve their work". Formative feedback for learning is highlighted as having key impacts upon outcomes, for example, by Wiliam (2010).

The challenge for the MLEARN project, therefore, was to identify ways to integrate details of practice and teacher education needs from these previous research studies, to develop a teacher education programme that could stimulate and support practice within the four national pilot groups of teachers, across schools, from nursery and special, to vocational and high schools. An important step in this process was to consider how a training needs analysis could be undertaken, and how research details could then be fed into a teacher education programme. Subsequently, the research endeavour would then focus on how the practices and experiences of teachers and learners in each of the countries were developing over time.

2. Training needs analysis

Training needs assessment can be considered an ongoing process, gathering data to determine what training needs exist, so that training programmes can be developed to help an individual, institution or organisation accomplish its objectives. The importance of training needs assessment and analysis is well established (US Office of Personnel Management, 2016), where it is argued that these needs should be concerned as much with identifying what is known and are strengths of individuals and organisations, as it is with what is not known and can be gained from training interventions.

Training needs analysis can serve as a basis for evaluating the effectiveness of a teacher education programme as well as determining the costs and benefits of the same programme. Indeed, a training needs analysis can be important in identifying problems that may not be solved by teacher education itself. If policies, practices and procedures need to be corrected or adjusted, this is clearly potentially a concern for those in senior management positions (such as national policy makers), rather than it always being a teacher education concern (Brown, 2002). It was recognised that this aspect might be particularly relevant when considering the outcomes of a needs assessment survey, as the four different countries have their own specific policies, practices and procedures, not necessarily determined or able to be managed by teachers themselves.

For the training needs analysis of the pilot, two target groups were involved:

(1) trainers and partners in each country; and

(2) teachers to be involved in the teacher education programme.

Four countries were involved; substantial differences in terms of handheld devices' acceptance within teaching practices, and resources in place to implement mobile learning initiatives and other activities, were known to exist. The survey was devised using findings from the previous background report (Passey and Zozimo, 2014a). Two forms of a questionnaire were developed to gather details, one for partners and trainers and one for teachers. For both groups, the surveys comprised a mixture of open and closed questions. Findings were reported at both an overall and individual country level, for teachers and for trainers (Passey and Zozimo, 2014b).

In total, 27 teachers responded from across the four countries. The age range taught was 4 to 19 years, with most teaching across the 6- to 14-year age range. Subjects taught were wide, but most taught either all subjects or science and technology. There were 21

teachers out of the 27 who reported they had learners with special educational needs, 11 out of 27 who reported they had learners with communication needs in their classes and 22 out of 27 who reported they had classes with special support teachers. Prior use of digital technologies for teaching was high; 25 out of 27 reported this, with main prior digital technologies used for teaching being personal computers (PCs), laptops, internet, robots and interactive whiteboards. Handheld devices used previously in teaching were lower, with 9 out of 27 reporting their main prior handheld devices used for teaching being iPads, tablets and laptops. Prior use of digital technologies by learners for learning purposes was quite high, with 20 out of 27 teachers indicating main prior digital technologies used by learners for learning being PCs, laptops, internet, robots and interactive whiteboards. Prior handheld devices used by learners for learning was lower, with 6 out of 27 reporting the main prior handheld devices used by learners for learning being smartphones, iPods, Android devices, iPads, tablets and laptops. Many teachers knew of benefits of using handheld devices for teaching and learning, with 16 out of 27 indicating main benefits being enhanced attractiveness and engagement for learners and improving the management of courses. Fewer teachers knew of issues arising when handheld devices are used in teaching and learning, with 11 out of 27 identifying main issues as technological. Main forms of support requested from teacher education sessions were technological and content knowledge. Main features or benefits requested from the teacher education sessions were an enhanced focus gained from mobile "learning moments", the provision of constant alertness and the use of authentic teaching and learning materials. Main pedagogical approaches requested from the teacher education sessions were collaborative, situated and constructivist. Existing knowledge of Apps or software were mainly "a few" or "none", with 38 already-known Apps identified in total. Main practices requested from teacher education sessions were capturing and using imagery and video, research and pupils creating their own notes and books in multimedia formats. Main examples of practices requested from teacher education sessions were "think forward", "snap and show", "this is what I've done and how I've done it" and "tell me how I could improve this". Main formats of teacher education sessions requested were hands-on trials of practice, and demonstrations.

In addition to the teachers, four partners and trainers responded to the survey. Their responses were similar to those from the teachers, but they differed in some important ways. Main prior digital technologies used for teaching were reported to be interactive whiteboards, netbooks, visualisers, PCs, and laptops. So their background in terms of digital technology uses was not likely to be entirely the same as those of the teachers. Main prior digital technologies used by their learners for learning were PCs, laptops, iPads, and tablets; so their experiences might not be identical to teachers in that respect. Main forms of support requested from teacher education sessions were issues and challenges, technological and pedagogical knowledge. Main features or benefits requested were mobility, developing face-to-face social interactions, supporting special educational needs, and language learning support. Again, this difference was highlighted as being potentially significant for the design of a teacher education programme. Main approaches requested from the teacher education sessions were collaborative, constructivist, situated, informal and lifelong learning; the latter categories might have arisen because of this group's wider or longer experience with the handheld technologies. Main practices requested from teacher education sessions were capturing and using imagery and video, creating videos for presentation to wider

audiences, pupils recording video clips of lessons for later playback, and pupils creating their own notes and books in multimedia formats. These were highlighted as important differences to be considered if the focus of the teacher education programme was to support both trainers and teachers equally. Main examples of practices requested from teacher education sessions were "review and reflect", and "this is what I've done and how I've done it". The first of these examples was unique to the trainers and partners, and this distinction was also highlighted.

Using the details gathered from the needs analysis, a five-day teacher education programme was devised by the key trainer and MLEARN partner group. During each day, technological knowledge (operating the devices, Apps and peripherals), content knowledge (considering Apps that supported specific subject and topic areas) and pedagogical knowledge (examples of practice and a focus on one of the five activities highlighted by Passey, 2010) were integrated into demonstration and hands-on sessions. The teacher education programme was initially run to support trainers in each partner country, and these trainers then developed their own teacher education programmes to support teachers within their individual countries. The intention was to support trainers in four countries, who could then train a minimum of ten teachers in each of their countries.

3. Early outcomes for teachers

Early outcomes were identified through online surveys that teachers and learners completed. Teacher surveys used open questions, while learner surveys used closed questions. By late December 2014, following one or two months of pilot uses of mobile devices (depending on the start dates of each teacher), survey responses were received from teachers in three countries, from Italy (18 valid responses out of 19 total), England (26 valid responses out of 27 total) and Greece (8 valid responses). The teachers taught in kindergarten, primary, secondary and vocational schools. Many had used the devices one to five times, but some used them more often than this. Although many teachers found the devices easy to use, some did not, for logistical or legislative reasons, or because of lack of familiarity or understanding (which suggested that the teacher education programme was not always fully effective for all teachers). However, most enjoyed using them, but working with learners with severe disabilities was clearly not easy or not possible. Most found the devices offered greater flexibility and mobility. Most reported benefits were concerned with engagement and independent learning, but teachers in Italy additionally reported enhanced motivation and opportunities for working in "an adult world".

In Italy, responses were received from teachers in six schools. About one-quarter of the teachers were from primary schools and three-quarters from secondary schools. About half used the devices one to five times, but about one-quarter used them more than this. About half found the devices easy to use, but about one-quarter did not (for technical or contextual reasons); most enjoyed using them.

In England, responses were received from teachers in four schools. About half of the teachers were from primary schools and half from secondary schools. About half used the devices one to five times, but about one-quarter used them more than this. About one-quarter found the devices easy to use, but about half did not (for technical and contextual reasons, and because of lack of familiarity and understanding). However, most enjoyed using them.

In Greece, responses were received from teachers in two schools. Most teachers were from a secondary vocational school. About one-third used the devices one to five times, but about two-thirds used them more than this. Some found the devices easy to use, but others did not (for logistical or legislative reasons). Most enjoyed using them.

4. Early outcomes for learners

In terms of learner reports of outcomes following one or two months of pilot uses of mobile devices, survey responses were received from learners in three countries, from Italy (147 valid responses), England (61 valid responses) and Greece (39 individual responses and 1 group response). Learners were from kindergarten, primary, secondary and vocational schools, representing a balance of boys and girls. Although most found the devices easy to use, about one in ten learners did not. For the majority, the size was reported to be "right" and text and pictures could be read and seen easily; but for some, they were not sure how to use them. Most liked the devices, but a few said they did not like them. Uses were varied, with use in classrooms, with groups of learners, on their own, writing text, taking pictures, recording video and looking at websites. Most learners felt they were benefiting – technically, cognitively, socially and widening how they were learning – but learners in Italy additionally reported motivational benefits more than learners did in other countries. Responses from learners in each of the three countries are shown in Table I. It should be noted that in Table I, numerical values are absolute, but in the case of the rows showing "Top 6 uses", the numerical values are proportions of positive responses compared to the total numbers of responses.

To place these outcomes into a more specific context, evidence from the training needs analysis indicated that participants from Italy had used handheld devices previously in teaching (by five of the nine teachers), so these experiences might have particularly supported learner outcomes. Main issues identified by the teachers in Italy were concerned with overall learning issues and teaching issues, while main features or benefits requested from the teacher education programme were supporting special educational needs, enhancing focus gained from mobile "learning moments", the concept of "interweaving learning interactions" and language learning support. These requests suggested that while some teachers had used handheld devices, they may have felt that their practices could be developed more. This view was also supported by the fact that the main teaching practices requested from the teacher education sessions were research, pupils creating their own notes and books in multimedia formats and creating videos for presentation to wider audiences. Teachers involved were generally already aware of issues and ways of using digital technologies in teaching and were active in using them within their schools.

From the training needs analysis from England (and the low number of respondents should be noted, as this might lead to a narrow picture), the age range taught was 11 to 18 years, an older age range than that for many teachers in other countries. Main prior digital technologies used for teaching were PCs, laptops, netbooks, visualisers, a variety of handheld devices, and iPads and tablets. This suggested that these teachers might have had a different technological background from those in other countries. Handheld devices used previously in teaching were reported by the teachers, so the proportion of those with experience was high. Main prior handheld devices used for teaching were interactive games, and a variety of handheld devices including projectors, microphones, iPads and tablets. Main prior digital technologies used by learners for learning were PCs, laptops, netbooks

Table I.
Learner responses after one to two months of use in three participating countries

Learner responses	Italy	England	Greece
Number of valid responses	147	61	39 and 1 group response
Number of schools involved	5	6	2
Types of schools involved	Half from primary and half from secondary	Two-thirds primary and one-third secondary	More than half from kindergarten and others from vocational school
Gender balance	Half boys and half girls	Three-fifths boys and two-fifths girls	Two-thirds girls and one-third boys
Ease of use	1 in 10 did not find them easy	1 in 10 did not find them easy	1 in 100 did not find them easy
Size	For most the size was "right"	For many the size was "right"	For the majority the size was "right"
Seeing text and pictures	Most could see them easily	Some could not see them easily	Could be seen easily
Knowing how to use them	Some did not know	Some did not know	–
Liking the devices	Most liked them and none did not like them	About half liked them and some did not like them	Most liked them but a few did not like them
Top 6 uses: working in the classroom	0.75	0.52	0.41
Top 6 uses: working in a group with other children	0.68	0.36	–
Top 6 uses: writing my own text	0.63	–	–
Top 6 uses: taking pictures	0.45	0.39	0.79
Top 6 uses: reading text online	0.44	–	0.38
Top 6 uses: working on my own	0.41	0.33	–
Top 6 uses: looking at websites	–	0.46	0.54
Top 6 uses: recording video	–	0.43	0.62
Top 6 uses: making notes somewhere	–	–	0.36
Reported benefits	Technical, motivational, cognitive and social	Technical, cognitive and social	Technical, cognitive and social
Ways they were benefiting	Widening their learning	Widening their learning	Widening their learning

and visualisers. This suggested a different background for these learners from those in other countries. Main prior handheld devices used by learners for learning were interactive games, handheld projectors and microphones, iPads and tablets, which again suggested a different technological experience for these learners. Main benefits already identified by the teachers were adaptability to the learner, attractiveness and engagement, improving the management of courses and facilitating the process of learning. This width of benefits suggested a wider interest and perhaps a wider background experience with technologies. Main issues identified by the teachers were technological and teacher learning issues. The latter was different from those in other countries, and suggested a different balance of teacher concerns. Main forms of support requested from teacher education sessions were pedagogical knowledge, which again was different from those in other countries, and suggested a different focus of their concerns. Main features or benefits requested from the teacher education were use of authentic teaching and learning materials, the concept of "interweaving learning interactions", the benefit of informality, the influence of ownership, how learners could choose or make preferences, broadening of assessment tasks and language learning support. This width of requests suggested a different balance in this respect too. Main approaches requested from teacher education sessions were wide, again suggesting a different balance.

From the training needs analysis in Greece, the teacher participants indicated that the age range taught was 6 to 16 years, with most covering the 13- to 15-year age range. So, more teachers in this group taught older learners than in other countries. Main prior digital technologies used for teaching were hardware, projectors and multimedia. So the teachers' backgrounds with previous technologies were likely to be different from other countries. Main prior handheld devices used for teaching were experimental instruments in physics and chemistry. Again, this highlighted a difference in technological experience. Main prior handheld devices used by learners for learning were experimental instruments and Android mobile telephones. This highlighted a further difference in terms of experience of their learners from the picture provided by the wider teacher group. Main benefits identified were facilitating the process of learning, which was a different main benefit identified. Knowing of issues arising when handheld devices were used in teaching and learning were highlighted by one out of five teachers, which was lower than that for other countries. Main forms of support requested from teacher education sessions were technological, content and pedagogical knowledge, the learning environment, aspects of communication, issues and challenges. Main approaches requested from the teacher education sessions were constructivist, situated, collaborative, informal and lifelong learning; the latter approaches suggested the teachers would again benefit from a very wide range of approaches. Main practices requested from teacher education sessions were organising notes and work, research, discussing strengths and weaknesses of work presented and shared by pupils, and creating videos for presentation to wider audiences. This rather different profile suggested that these teachers had different concerns in terms of practice.

When the evidence from the learner responses presented in Table I is considered, it is clear that there are differences across countries. Considering this evidence in terms of the initial concerns for the teacher education programme, using the Mishra and Koehler (2006) categories, the responses suggest that technical knowledge has been gained and used (for example, writing their own text and taking pictures), content knowledge has been a focus (for example, cognitive gains are reported widely), but pedagogical

knowledge has varied more in terms of responses (for example, making notes outside the classroom is reported in the "Top 6 uses" in Greece but not in Italy or England, while working in a group with other children and working on their own is noted in the "Top 6 uses" in Italy and England but not in Greece). Similarly, if forms of pedagogy are considered from a learning concept perspective, then behaviouralist, constructivist, situated, collaborative, informal and lifelong, and learning and teaching support outcomes are not all similarly suggested by learner responses. For example, collaborative learning (if arising from group work with other children) is highlighted most in Italy, while situated learning (if arising from making notes outside the classroom) is highlighted most in Greece, and learning and teaching support (if arising from working in the classroom) is highlighted most in England and Italy.

Similarly, there are differences noted in terms of the ways that the evidence suggests focus on wider learning environments and on communication. For example, wider learning environments are suggested by the evidence of making notes outside the classroom in reports from learners in Greece, but these are not highlighted by reports in England or in Italy. In terms of communication, however, working in a group with other children is highlighted in Italy, particularly, and less so in England, while recording video is noted more in Greece and England.

It is interesting to speculate at this point about the reasons for these differences. It is quite possible that differences are arising both because of the restrictions that national curricula and guidelines play, but in balance, this might be offset by the ways that mobile devices are opening up opportunities for teachers and learners to add variety to their approaches for teaching and learning.

5. Mid-term teacher and learner outcomes

Overall, the picture from responses after five months and nine months was very similar. Focusing on the survey after some nine months of use, responses were received from teachers in all four countries. Teachers were from primary, secondary and vocational schools. Many had used the devices between one and five times since the previous survey (four months earlier), but a few used them more times. Some teachers found the devices easier to use since reporting in the previous surveys. Most reported they enjoyed using them, because they said they added "fun and entertainment" to the learning. Most found the devices offered opportunities for collaborative work and for researching information; however, some teachers (a minority) were still learning how to explore the devices further for teaching purposes. Most teachers reported benefits concerned with independent learning and how the devices eliminated limitations of time and place to access learning.

In terms of learner reports of outcomes following nine months of pilot uses, responses were received from learners in all four countries, from Italy (47 valid responses), England (9 valid responses), Greece (61 valid responses) and The Netherlands (25 valid responses). Learners were from primary, secondary and vocational schools, representing boys and girls. Most of the learners reported that they found the devices easy to use, and for many, the size was reported to be appropriate, but reports varied on whether text and pictures could be read and seen easily. Most learners said they liked the devices, however. Their reported uses varied, with use in classrooms, with groups of learners, on their own, writing text, taking pictures, recording video, looking at websites and reading text online. Most learners felt they were benefiting – technically, cognitively, socially and widening how they were learning.

Responses from learners in each of the four countries are shown in Table II. It should be noted that in Table II, numerical values are absolute, but in the case of the rows showing "Top 6 uses", the numerical values are proportions of positive responses compared to the total numbers of responses. In these cases also, the most commonly reported "Top 6 uses" from Survey 1 (shown in Table I) were retained, so that a form of comparison could be made.

After nine months of use, although the size was reported to be "right" and text and pictures could be read and seen easily by many learners, the proportion had decreased somewhat from those reported in earlier surveys. Perhaps learners were either becoming more discerning, as their "novelty interest" was lost, or the ways teachers wanted to use the devices did not match entirely with size and ability to read text and see images. Although most learners reported they liked the devices, a clear proportion did not respond entirely positively. Reported uses had not shifted largely, with uses in classrooms, some with groups of learners and some on their own. But while writing text, taking pictures, looking at websites and reading text online were commonly reported, recording video and making notes in various locations were less evidenced. Nevertheless, many learners felt they were benefiting – technically, cognitively, socially and widening how they were learning – with specific mention of more time being spent with teachers and enjoying school more.

6. Final teacher and learner outcomes

After 13 months of use, responses were received from teachers in three countries (England, Greece and The Netherlands). Teachers were from primary, secondary and vocational schools. Many had used the devices between one and five times since the previous survey, but a few had used them more often. Most teachers described examples of learner activities they had undertaken:

- learning through review and reflection;
- thinking forward about their learning;
- listening to explanations others were giving;
- snapping and showing ideas for others to discuss;
- showing what they had done and discussing how they had done it; and
- letting others comment on how to improve what they had done.

However, the balance of these activities had shifted since the previous surveys (discussed more in the conclusions section). A number of teachers described how they had used Apps such as MovieMaker and e-quizzes, and how these and others had supported students' explanations. Other teachers described how they encouraged their students to share with their peers and to seek peer discussion.

After these 13 months of use, responses were received from learners in two countries (England and Greece) (shown in outline in Table III). Learners were from primary, secondary and vocational schools, representing boys and girls.

Most of the learners reported that they found the devices easy to use. For the majority of learners, they used mobiles every day in school and a few times at home. Reported uses varied, but with many working with them in classrooms; looking at websites and reading texts online were most commonly reported uses. Most learners felt they were widening how they were learning. However, overall, the picture had shifted in some

Learner responses	Italy	England	Greece	The Netherlands
Number of valid responses	47	9	61	25
Number of schools involved	2	2	3	1
Types of schools involved	Primary and secondary	Secondary	Primary, secondary and vocational	Primary
Gender balance	About half boys and half girls	Two-thirds boys and one-third girls	Two-thirds girls and one-third boys	Three-fifths boys and two-fifths girls
Size	Some say the size is "right"	Most say the size is "right"	Some say the size is "right"	Many say the size is "right"
Seeing text and pictures	Most can see pictures and some can read text	Many can see pictures but fewer can read text	Many can see pictures and some can read text	Many can see pictures and read text
Liking the devices	Majority enjoy using them	Mostly very much or sometimes	Many very much and some sometimes	Two-thirds very much and two-fifths sometimes
Top 6 uses: Working in the classroom	0.74	0.33	0.34	1.00
Top 6 uses: working in a group with other children	0.55	0.22	0.31	0.80
Top 6 uses: writing my own text	0.49	0.56	–	0.72
Top 6 uses: taking pictures	–	–	0.44	–
Top 6 uses: reading text online	0.51	0.44	–	–
Top 6 uses: working on my own	–	0.44	–	0.72
Top 6 uses: looking at websites	0.66	–	0.30	0.92
Top 6 uses: recording video	–	–	0.21	–
Top 6 uses: making notes somewhere	–	–	–	–
Ways they were benefiting	Spending more time with teachers, enjoying school more and learning how to use the mobile device	Enjoying school more and understanding some things better	Learning new technical skills	Learning how to use the device for learning, learning new technical skills and working more with pictures and video

Table II.
Learner responses after some nine months of use in four participating countries

Table III.
Learner responses after some thirteen months of use in two participating countries

Learner responses	England	Greece
Number of valid responses	50	121
Number of schools involved	3	1
Types of schools involved	Primary and secondary	Secondary vocational
Gender balance	Two-thirds girls and one-third boys	Three-fifths boys and two-fifths girls
Frequency of use	Many used them a few times or every day	Many used them a few times in school and a few times at home
Liking the devices	Majority liked the devices very much or sometimes	Majority liked the devices very much or sometimes
Top 6 uses: working in the classroom	0.14	0.41
Top 6 uses: working in a group with other children	0.11	0.58
Top 6 uses: writing my own text	–	–
Top 6 uses: taking pictures	0.11	0.56
Top 6 uses: reading text online	0.13	0.49
Top 6 uses: working on my own	0.14	–
Top 6 uses: looking at websites	0.14	0.68
Top 6 uses: recording video	–	–
Top 6 uses: making notes somewhere	0.08	0.50
Ways they were benefiting	Understanding some things better and finding out more information	Finding out more information, learning new technical skills and working with pictures and video more

respects from that reported through the previous survey. Uses had become more limited and so had reported benefits (especially in the schools in England). These shifts could have been because of the smaller number of countries reporting in this survey. But if not, then these shifts suggest that, after a year, uses tend to revert to more "traditional" practices within schools. Reports of productive uses of the mobile technologies were reduced, while reports of receptive uses had increased.

In terms of forms of activities undertaken, teachers reported in total, across all countries, the following numbers of examples of activities being undertaken after 9 and 13 months of use: "Review and reflect" (23), "Think forward" (4), "Listen to my explanations" (14), "Snap and show" (11), "This is what I've done and how I've done it" (15) and "Tell me how I could improve this" (13). It is clear that "Review and reflect" was a much more popular activity than the others (also, interestingly, favoured by trainers when they completed the training needs analysis). In future development, the importance of "Think forward" activities (which were favoured by teachers when they completed the training needs analysis) would appear to be in need of much greater attention, perhaps balanced against a reduction of emphasis on "Review and reflect" activities.

7. Conclusions

This paper has indicated how research has been involved in a cross-national EU-funded project focusing on developing a teacher education programme to support teachers in effectively using mobile devices in classrooms. Background details highlighted how different national contexts needed to be considered; a training needs analysis indicated features for how a wide teacher education programme could be designed and developed, but that important national differences needed to be considered concurrently; and surveys have indicated positive outcomes for many teachers and learners, with some important exceptions.

It should be noted that the number of teachers and trainers involved in this initiative is clearly not representative of the entire population of teachers or trainers in each of the four partner countries. It is also clear that national pilot teacher groups are not necessarily a representative population of teachers (from across Italy, for example), and the needs of these teacher cohorts, therefore, may not be representative of a wider population (which may be less familiar with uses of technologies at the outset). The means to consider these issues further has been developed within the project; it has been shown that the training needs analysis instrument can identify these variations within and across different populations. Although the level of research evidence gathered is low in quantitative terms, the qualitative evidence being gained is certainly pertinent at an individual teacher level. This study has shown that a training needs analysis for teacher professional development in using mobile technologies can be constructed and used to help define a professional teacher education programme. This is potentially important if teacher education is one of the important obstacles that is preventing current wider uptake and adoption of mobile learning practices.

Although from a small and selected trainer, teacher and (perhaps less so) learner group, the research findings indicate that uses of mobile devices can be developed in many classrooms as well as outside classrooms and benefits can be identified by both teachers and learners. The research shows that the degree of implementation following the training programme can happen quickly (within one to two months). Learner responses show that use of the mobile devices was gained at very early stages, with

most learners finding them easy to use and enjoying their use (with exceptions of perhaps one in ten learners). The majority of learners found the size to be appropriate, and they reported they could see images and read text easily. Uses varied, but there was clear use of the devices to support group and collaborative as well as individual work, with the creation of text, images and video that was integrated into multimedia productions. The mobile devices were used by both primary and secondary school learners and teachers, with benefits widely reported across the sectors. These benefits covered not just technical and cognitive benefits but social benefits enhanced engagement and the widening of ways of learning. Enhancement of independent learning, of customised learning and a reduction in limitations of time and place of learning were all identified by teachers and learners as benefits arising from use. Flexibility offered by the devices was a key element of benefit identified by teachers. These results were provided by both learners and their teachers, from kindergarten, primary, secondary and vocational schools, offering views of use and outcomes across the 2- to 23-year age range. Positive results were also reported by both boys and girls, with no indicators of either gender not benefiting or benefiting more.

Overall, the training and the uses that followed can be considered successful. Positive outcomes arose, reported by both teachers and learners alike. The mobile devices were able to be used successfully by teachers and learners, irrespective of their curriculum (although the need and ability of teachers to adapt uses to their curriculum and legislative requirements was clear). Learning activities to support important approaches to learning were developed by teachers (demonstrated effectively by video outcomes that some schools subsequently presented). In terms of forms of activities undertaken, however, it was clear that "Review and reflect" was a much more popular activity than the others. In future development, the importance of "Think forward" activities would appear to be in need of much greater attention, perhaps balanced against a reduction of emphasis on "Review and reflect" activities.

Although the training programme would appear to have the potential to support wider use in schools in different countries where curricula differ, it is also salient to note that schools might consider this form of development as "undertaking a project" (meaning that it has a time limit) rather than a "moving to a standard practice" (meaning it happens as a matter of long-term continuity). It might be that the state of play after one year needs to be considered carefully. If teachers do consider this training as a project, then how the outcomes of such a project can be integrated into "standard practice" also needs to be considered and developed appropriately.

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