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Abstract

This paper examines how a mobile learning application can enhance children's outdoor learning experiences. The study draws upon empirical evidence gathered in one case study conducted in a Finnish primary school setting in the fall of 2012. The data were collected with student and teacher surveys. The case study indicated that the mobile application provided children with tangible, motivating, and educative experiences. The mobile application also clearly encouraged social interaction. In addition, the case study highlighted the significance of pedagogy. Thus the appropriate way to utilize mobile applications in an educational context requires a balance in which the technology use is complemented with the curriculum, pedagogical goals, the children's needs, and human interaction.

Keywords: education, instruction, mobile learning, outdoor learning

Enhancing Children's Outdoor Learning Experiences with a Mobile Application

The aim of this paper is to explore and evaluate what kind of impact a mobile application has on children's outdoor learning experiences. Outdoor learning is one of the most practical educational methods for teaching a unique natural phenomenon in the world (Tan, Liu, & Chang, 2007). Earlier studies have indicated that modern information and communication technologies can enhance the quality and experiences of outdoor learning in several ways (Osawa et al., 2007). For instance, real-life observations combined with access to digital technology and content can help learners make distinctions among different species (Shih, Chu, Hwang, & Kinshuk, 2011). In turn, mobile applications that give learners an opportunity to collect content and express themselves can have a positive influence on study motivation and involvement (Huizenga, Hordijk, & Lubsen, 2008). Technological tools thus provide new choices and more flexibility for personal expressions and learning for children (Blagojevic & Thomes, 2008). Learners can express their perspectives more freely and choose their own preferred route and speed to study (Shih et al., 2011). Significant changes in teacher teaching and student learning have been reported (Zhang et al., 2010). In particular, the benefits for motivation and learning achievements have been emphasized in many earlier studies (e.g., Tan, Liu, & Chang, 2007; Chen, Tan, Looi, Zhang, & Seow, 2008; Hwang, Shi, & Chu, 2011).

In this study, the feasibility of a mobile application and outdoor learning experience was examined with one case study conducted in a primary school setting in Central Finland in the fall of 2012. The case study focused on the implementation process of the mobile learning application Nature Tour, which was developed in the project Personal Mobile Space at the University of Jyväskylä, Finland (see Kankaanranta, Neittaanmäki, & Nousiainen, 2013). The outdoor learning experiences were examined and analyzed through a framework which includes

the core characteristics of mobile learning. Student and teacher questionnaires were utilized to collect data immediately after the experiment.

The following sections discuss related work, the Nature Tour mobile application as well as the experimental design. The results are then reported and the paper concludes with reflective remarks.

Related Work

Outdoor education is an experiential method for learning which occurs primarily in the outdoors and which emphasizes relationships between people and natural resources (Priest, 1986). Outdoor learning offers many opportunities for learners to deepen and contextualize their understanding within and across different curriculum areas. Well-constructed and well-planned outdoor learning experiences can engage learners with the natural world and offer opportunities for personal learning skills development in areas such as communication, problem solving, information technology, and thinking skills (Learning and Teaching Scotland, 2010). Outdoor education, therefore, has been recognized as the most feasible method for teaching natural phenomena (Tan, Liu, & Chang, 2007). Nonetheless, the field trips that are part of outdoor learning can be physically and mentally challenging and sometimes even difficult to be adapted to educational situations (Bedda-Hill, 2012). Earlier studies, however, have indicated that information and communication technologies, such as mobile technologies, can enhance natural science and outdoor learning in various ways.

One example of a mobile technology-based system and outdoor learning is the Ambient Wood project by Rogers et al. (2002). A variety of mobile devices and multimodal displays were utilized to present the relevant digital information for children in the field. The aim of the activity particularly was to augment the physical environment with various forms of digital information so that children's interaction and perceptions would be extended in surprising and

unusual ways. The goal was to enhance children's involvement through discovery, experimentation, and reflection. The study indicated that the mobile-based outdoor learning activity was highly engaging and provided novel learning experiences for children.

Another example of mobile learning in an authentically situated context includes a butterfly-watching system implemented by Chen, Kao, Yu, and Sheu (2004). The aim of the mobile technology-based system was to support independent learning by enabling the butterfly observer to identify the family, name, ecology, and behavior of a certain butterfly. Content-based image retrieval techniques allowed the user to acquire information on butterflies more quickly and easily in the field. A similar kind of system has also been implemented for bird-watching. This study indicated that the children who took advantage of the bird-watching system improved their learning outcomes.

Osawa et al. (2007) also developed a mobile technology-based support system for outdoor learning. The students received a location-dependent description and an instructive hint for exploration by using mobile devices and the radio frequency identification (RFID) tags as well as Quick Response (QR) codes. The students considered the system to be practical for outdoor learning. The study indicated that the outdoor education support system enhanced student motivation as well as improved the quality of outdoor education.

As these studies have shown, mobile devices can enhance outdoor learning experiences as well as facilitate students' learning outcomes in many ways. In particular, increased learner engagement, study motivation, and learning achievements are highlighted in many earlier studies. Chen et al. (2008), for instance, stated that the mobile devices might improve the students' understanding about the phenomenon of the natural world. Similarly, Huang, Lin, and Cheng (2010) argued that mobile devices could engage students in learning activities as well as

facilitate the organization of conceptual information. Shih et al. (2011), in turn, stressed that mobile devices can allow students to learn their own preferred route and speed, which in turn can enhance students' motivation and learning effectiveness. Lee, Lee, and Kwon (2011) argued that mobile technologies can motivate and interest students in learning more about the phenomenon of the natural world compared with traditional field studies. However, they also highlighted the importance of the teacher's role as well as the significance of customized materials. Shih et al. (2011) have stressed that the adaptation of the mobile devices in different situations, environments, and schools requires special attention to both the mobile system and instructional designs.

Hence, it is not only the mobile technology affordances that are significant but also how mobile technologies are employed in the context of the learning environment as well as the associated pedagogy (Chen et al., 2008). In other words, the potential exists to use mobile technology within pedagogy, but it is important to keep in mind that the mobile devices themselves do not guarantee meaningful outdoor learning experiences. Much depends on the teacher's pedagogical choices and activity design.

Nature Tour Mobile Application

Children's outdoor learning experiences mediated by mobile devices were examined in a single case study that utilized the Nature Tour system (*Luontoretki* in Finnish). The system (see Figure 1) was developed and implemented in the project Personal Mobile Space (see Kankaanranta, Neittaanmäki, & Nousiainen, 2013) by using the Qt cross-platform application and UI framework as well as C++ language. Communication with a web server was executed with the Django Python Web framework and PostgreSQL. As a whole, the Nature Tour system includes a mobile application and a website which together constitute a learning environment for environmental and natural studies.

The Nature Tour system was developed with special consideration for Finnish early childhood and lower primary education settings. In Finland, all schools follow a national core curriculum, which contains the objectives and core contents of different subjects. However, education providers (the local education authorities and schools) usually draw up their own curricula on the basis of the framework of the national core curriculum, and teachers themselves can decide on the methods of teaching as well as the textbooks and other learning materials (the Finnish National Board of Education, 2004). The core of learning in Finnish early childhood education are the interactions between children, adults, and the environment. Hence, nature and the immediate neighborhood are considered the essential elements of the learning environment (Ministry of Social Affairs and Health, 2004). The objective of basic education, in turn, is to support pupils' growth into ethically responsible members of society and to provide students with the knowledge and skills needed in life (the Finnish National Board of Education, 2004). Curriculum subjects that are specifically appropriate for outdoor learning are environmental and natural studies in Grades 1 to 4 and biology in Grades 5 and 6. The core contents of environmental and natural studies and biology include, among other things, basic features of living and lifeless nature, common species, life stages of flora and fauna, as well as nature through the seasons. The instruction is usually inquiry-based, investigative, and problem-centered and it is conducted both outdoors and in the classroom. The activities include, among other things, identification of the main flora and fauna in neighboring areas (the Finnish National Board of Education, 2004).

The Nature Tour mobile learning application was developed to aid the identification of the main flora and fauna, as well as to help in the gathering of observations about plants and other natural phenomenon. The application, for instance, includes relevant information (e.g.,

picture and core information) of the common species, which supports the identification process in the field. It also enables the user to record observations with photographs or with audio recordings and to send these observation recordings to a website where they can be viewed later on. For instance, a child can try to take a picture of a domestic bird (e.g., the great tit or mallard duck) or try to record it chirping or quaking. Or alternatively, a child can record plant observations such as pictures of the main characteristics of the plant (e.g., flowers, stems, branches, and leaves) for a digital herbarium. Herbarium collection, for instance, is part of the curriculum and biology teaching in Finnish primary school.

The primary objective of the mobile application is to enhance children's outdoor learning experiences by helping in the identification of species as well as in the documentation of the field trip. The starting page of the mobile application (Figure 2) contains categories such as Nature Tour (Luontoretki), Outdoor Games (Ulkoleikit), Indoor Games (Sisäleikit) and Celebrations (Juhlat). The Nature Tour category is utilized for nature observations and species identification. Other categories simply allow wider use of the mobile application in daily life. The Nature Tour category includes subcategories such as animals, plants, and fungi. Each of these categories opens up a list of the common species. By selecting a species, the user can see relevant information about it (Figure 2). In the sample screenshot of a species page for magpies, (Figure 2), the user can see a picture of the bird and read a brief description of it. The species page also includes observation functions (photograph or audio recordings). So if a child sees a magpie, he or she can first find relevant information about it and then try to take a picture of it or record its song.

The continuity of the learning experience can be promoted with activities before and after the field trip. For instance, before the field trip, children can familiarize themselves with plants,

animals, or fungi because the mobile application is associated with a website, which provides helpful information. After the field trip, the children can access the recorded observations and work with the observation materials by, for example, creating presentations. The website also provides an opportunity to compare what species or phenomena have been observed across the country. For instance, one group from southern Finland and another group from northern Finland can record their observations of a meteorological phenomenon, such as the first snow, and make comparisons.

The mobile application requires the ability to read although it also contains a great deal of pictorial information. Older children are able to use the application by themselves, but with younger children, aged six or under, usage requires adult guidance. Even though the application is designed to provide concrete experiences in nature, the teacher's contribution is still significant. The teacher plans the situations in which the application is used, the learning goals, and how learners are going to use the application to achieve these learning goals. Thus the mobile application is designed in such a way that it does not limit usage to a particular pedagogical model. Instead, teachers have the opportunity to design activities that respond to their needs and objectives. In other words, using the application requires a design in which the curriculum, student needs, and human interaction are considered. Hence, the mobile application by itself does not guarantee the quality or meaningfulness of the children's outdoor learning experience. In an outdoor learning approach, it is particularly important to design the activities and interactions with people and natural resources.

The Experiment

The impact of the Nature Tour application on children's outdoor learning experiences was examined with one exploratory case study conducted in a primary school setting in Central Finland in the fall of 2012. The case study was part of a project funded by TEKES (the Finnish

Funding Agency for Innovation, Personal Mobile Space. The use of a case study method was considered appropriate because it provides in-depth examination and gives an understanding of perspectives, opinions, and expectations (McLeod, 2008). Even though the collected data may be specific to a particular school, or student, or teacher, explanations and conclusions may provide an understanding of how other schools, students, or teachers work. (Gillham 2010). Case studies can also employ various methods such as interviews, observation, and field studies (Hamel, Dufour, & Fortin 1993), which were considered important. The following subsections describe the experimental design of the study: participants, data collection methods, pedagogical strategies, and analysis framework.

Participants

Nineteen Grade 2 students (aged 7–8 years) and their teacher from one school in Central Finland took part in a half-day experiment in the fall of 2012. The group used loaned smart phones (Nokia 5800 XpressMusic) preinstalled with the prototype of the Nature Tour mobile application. The teacher designed and implemented the outdoor learning activity independently to be suitable for the current curriculum and the children's skill level. It is noteworthy that all of the students already had some experience with mobile device usage. The group also had experience with inquiry-based learning (e.g., small-scale investigations and projects).

Data Collection Methods

The research data were collected after the experiment with a teacher email survey/interview and student surveys. The teacher email interview included fifteen open-ended questions. One question was related to the background information and 14 were thematically related to the core characteristics of mobile learning (the context, time and space, device aspect, learner aspect, and pedagogical aspect). The student questionnaire, in turn, included sixteen

questions. One was open-ended and the others were scaled questions. The questions in the student questionnaire were associated with use of the mobile device and the application as well as with the students' overall learning experience.

Pedagogical Goals and Strategies

As already highlighted, the teacher designed the outdoor learning activity. In this case, the learning was extended outside the classroom into nature, specifically to the woods near the school. The objective of the outdoor learning activity was to explore and learn local area trees and especially their leaves. The teacher stated that the aim is to learn at least 10 different species each year. According to the teacher, species cannot be learned by only looking through a textbook; concrete experiences are also needed. Therefore, the pedagogical approach to the activity was discovery learning. Discovery learning is a constructivist-based approach where the key idea is that learners are more likely to remember concepts if they discover them on their own, apply them to their own knowledge base and context, and structure them to fit into their own background and life experiences. In this way, learners become actively involved in shaping the content (Leonard, 2002). In this case, the students took pictures of tree leaves, identified species, and drew structural diagrams as well as created a memory game. The students shaped the content in several ways to acquire knowledge about trees and tree leaves. The use of the mobile application also became linked meaningfully to classroom teaching and learning, and so the activity blended traditional teaching and learning.

In this case, the mobile application mainly helped to record observations during the field trip. Each child could record their own observations and work with their own material. After the field trip, the observation pictures were sent to the website, from where they were printed out. Working together, the teacher and the classmates utilized the printed pictures, along with

structural diagrams of tree leaves, to identify the tree species. The students also drew their own versions of the leaf structure diagrams based on the printed images and constructed a memory game for memorizing the trees and their leaves. In this way, teaching and learning were not bound to the device or application only. Instead, the activity gave the students the opportunity to discover, explore, and reflect on the issue in various ways: in nature observing and recording actual tree leaves and in the classroom processing the collected materials in several ways.

Analysis Framework

The outdoor learning experiences were explored and analyzed through a framework that includes the core characteristics of mobile learning (see Figure 3). In the analysis framework, the mobile learning experience is seen as a result of a mobile learning activity and the mobile learning process. The characteristics that are incorporated into the mobile learning experience include, among others, spontaneity and personality. The core characteristics of a mobile learning process, which also affect the mobile learning experience, in turn, are the learner, device and social aspects. These three aspects intersect, which means that when learners are engaged in a mobile learning activity, they may move within different physical and virtual locations and participate and interact with each other as well as with information and systems (Koole, 2009). Learning can occur in different contexts inside and outside of the classroom. In other words, learning can happen anywhere and anytime, and learners can have control over the place, pace, and time when they learn. As a consequence, learning can be personalized, situated, and authentic (Traxler, 2007; Shih et al., 2011) and mobile technologies can transcend spatial and temporal restrictions. Both learners and teachers can benefit from the mobile-based system due to its convenient and instant access to educational resources (Chen & Kinshuk, 2005).

In the framework, the learner aspect specifically refers to an individual learner's cognitive abilities, memory, emotions, possible motivation, attitudes, and experiences, which, as highlighted by Koole (2009) in her FRAME model, all play a significant role in the learning process and learning experiences. In the device aspect, the physical, technical, and functional characteristics of the mobile device are emphasized. These characteristics influence device usability, which in turn influences learner experience. The social aspect is then associated with the process of social interaction and cooperation, the importance of which, as a part of the learning process, cannot be underestimated. As Koole suggests, different kinds of interactions may stimulate learning.

The framework also includes pedagogical practices. Pedagogical practices are emphasized in studies by, for instance, Parsons, Ryu, and Cranshaw (2007), Ozdamli (2012), and Kearney, Schuck, Burden, and Aubusson (2012). Pedagogical practices influence the learning activity, mobile learning process, as well as how and what kind of mobile learning experience arises. In other words, the teacher's contribution is seen as significant because the teacher plans the learning goals and content, the situations in which the mobile application is used, and how learners are going to use mobile technology to achieve the learning goals. For instance, in an outdoor learning approach, the teacher designs the interactions with people, the application, information, and natural resources.

Based on the literature relating to outdoor learning experiences mediated by mobile devices as well as the mobile learning framework, the expected results before the case study were as follows: (1) A mobile application can transcend spatial and temporal restrictions, i.e., it support learning anywhere and anytime; (2) The mobile learning experience is personalized and motivating for learners; (3) Mobile devices and applications are easy-to-use, intuitive, and help

learners to concentrate on the task, not the device itself; (4) In the mobile learning experience, learners can exchange information and acquire knowledge with rich connections to other people and resources mediated by a mobile device; (5) The pedagogical practices influence the learning activity, the mobile learning process as well as the mobile learning experience.

Results

The mobile learning implementation was evaluated through the mobile learning framework (see Figure 3). Based on the framework, observations were categorized into pedagogical practices, the mobile learning process as well as the overall mobile learning experience. At the same time, it was also explored whether the expected results were met or not. The results of the experiment are described and summarized in the following subsection.

Pedagogical Practices

The experiment turned out to be successful because it was well-planned and in the background there was a well-defined pedagogical objective, namely, learn to identify local area trees. The learning was extended outside the classroom and the pedagogical approach, discovery learning, supported the activity. The learners were actively involved in the learning process and they shaped the content. The teacher reported that the clear pedagogical objective helped to make the field trip situation and activity more organized. For instance, it was, as the teacher suggested, easier to guide students to search and observe nature in a more goal-oriented way: “The children’s attention was drawn to nature surprisingly well because the use of the device and the instructions were clear to the students.”

According to the teacher, the implementation of the mobile activity and making the mobile application a part of the daily routine was easy. The teacher claimed that the mobile application provided an opportunity to work in different ways inside and outside of the classroom. In particular, he highlighted that “the application enabled the implementation of a

traditional field trip in a different way.” The teacher further stated that the mobile application was beneficial for teaching and learning and that mobile devices could be used to diversify learning activities. One more noteworthy fact was that the students were able to construct their own material and work at their own pace. The use of the application was also linked to classroom teaching and learning as the recorded observations were utilized after the field trip to acquire further knowledge about trees and tree leaves. Thus the activity blended traditional teaching and learning and included a variety of tasks both inside and outside of the classroom.

The study clearly indicated that technology use requires a balance between the curricula, student needs and human interaction, in other words, pedagogy. Therefore, the study indicated that the pedagogical practices influence on the learning activity and the mobile learning process as well as the mobile learning experience. The mobile device or application by itself does not ensure a meaningful learning experience for children. The ways in which mobile devices are used and how the use is associated with pedagogy are equally important. In this case, the mobile device use was adapted meaningfully as a part of teaching and learning. Using the mobile device was one part of a learning continuum that included multiple learning tasks. Hence, the activity as a whole afforded a tailored experience for the children.

Mobile Learning Process

This section concentrates particularly on the learner, device, and social aspects and how those were reflected in the experiment. The teacher reported that the mobile learning application suited all the students well and there was no need to adapt the use of the application in any way. The application also clearly increased student motivation because it made it possible for every student to record their own observations easily during the field trip and to work on their material afterwards. Through these, the learning experience became personalized for the students. The

benefits highlighted by the teacher in his answers were related to study motivation: “The students were able to work with their own material, and this clearly increased the student interest and motivation.” The teacher added that one of the best experiences for him was to observe the student enthusiasm and that the students were skilled and used the mobile application without problems. The teacher stressed that the mobile application allowed students to observe nature in a way that was different from the way they would view it on a traditional field trip. The survey results also indicated that the students were curious about the new approach that deviated from their routine exercises. Nearly all (95%) of the students reported that they would like to use the Nature Tour mobile application again and all of the students agreed that recording observations with the mobile application was fun. As much as 89% of the students reported that the use of the mobile application was interesting (see Table 1). The mobile application clearly increased student engagement. In the open-ended answers the students highlighted, for instance, that it was nice to be on a field trip and to record observations with a mobile phone. The study indicated that an outdoor learning experience mediated by a mobile application such as Nature Tour can be engaging, personalized and motivating for learners.

Furthermore, the study also indicated that an easy-to-use device and application supports the implementation and helps students concentrate on the task, not on other irrelevant things or the device. All the students already had some experience using mobile devices. According to the teacher, the students reported to him that using the application was easy. This finding is also consistent with questionnaire answers (see Table 1). As many as 89% of the students agreed with this statement: *The Nature Tour mobile application was easy to use*. According to the teacher, no major technical problems occurred during the experiment. The students’ answers (Table 1), however, indicate that some minor problems with the reliability of the equipment occurred,

because 47% of the students disagreed with the following statement: *The smart phone always functioned as I wanted*. Also, over half (58%) of the students reported that they needed help with the application (Table 1). However, the teacher noted that the reported problems did not interfere with the field trip: “The field trip went well and the students liked to use the mobile application. There were no problems.” The students’ answers, however, highlight the importance of ensuring that the equipment functions effortlessly, because even small problems may be reflected in the overall learning experience.

In this experiment, the mobile technology was not used for mediating collaboration or social interactions. However, according to the teacher, the students eagerly showed their observation photographs to him after the field trip. The mobile application therefore clearly promoted social interaction with the teacher, so it was encouraging to find that mobile activities can enhance social interactions. However, more attention should be paid to social interaction. In particular, the relationships and interaction between other learners, experts, systems, and content should be considered and planned in more detail.

The activity also combined and blended both virtual and physical content and space. The observations recorded during the field trip were utilized to acquire knowledge after the field trip in the classroom. Nevertheless, the mobile application was mainly used to record observations with photographs. The application also contains information about species, but only 22% of the students reported that they used significant time to read the information texts, and as many as 78% reported that they used no or limited time to read the texts (see Table 1). So it can be concluded that the students did not utilize the information texts to acquire new knowledge. However, as already described, the observation recordings were utilized to acquire knowledge after the field trip. As many as 89% of the students reported that they recorded many plant

observations with the mobile application (see Table 1). So, in a way, mobile technology did help students acquire knowledge. Even though the mobile application was not utilized in the expected way, the teacher reported that it was convenient and beneficial for teaching and learning. The reason why the application was not utilized as expected relates to the pedagogical choices that the teacher made. The teaching and learning were not limited to the device or application. The device and application were meaningfully adapted to be one part of a learning continuum that included several tasks and other aids such as structural diagrams of tree leaves.

Mobile Learning Experience

The study indicated that the overall learning experience for the children was engaging, meaningful, personalized, and motivating. In the field, the children were able to work at their own pace and photograph the things they wanted. According to the teacher, the students were motivated to observe nature and record their observations: “The students wanted to make observations and take good pictures without that teacher having to order them around or supervise them.” The student enthusiasm was also reflected in the survey answers because the students’ overall estimation of the activity was positive (Table 1). Nearly 70% of the students (69%) thought that the activity was superb and 16% of the students thought that the activity was okay. None of the students reported that they did not like the activity.

The spontaneity aspect of the activity was quite challenging because the activity was organized according to the class schedule and the experiment was carried out in a short period of time: half a day. This situation meant that a time constraint emerged. Education, in general, is more or less scheduled: on a semester, daily, and hourly basis. A strict schedule with the pressure to go through a large amount of educational material may, at the worst, lead to traditional classroom teaching and learning with traditional teaching and learning resources. In this case, the

learning, however, was extended to an authentic context in nature and students were able to work at their own pace. The use of the mobile application was also linked to classroom teaching and learning. Therefore, the mobile learning activity, on the whole, fulfilled the potential of mobile learning well and indicated that the Nature Tour mobile learning application may support learning anytime and anywhere.

Conclusion

This study explored what kind of impact the Nature Tour mobile application has on children's outdoor learning experience. The learning experiences were explored through a framework that includes the core characteristics of mobile learning. The Nature Tour mobile application experiment turned out to be a successful. It indicated that the mobile application can provide children tangible, motivating, and educative experiences in nature if the activity is well-planned and has a clear pedagogical objective. The children were able to use the application outdoors without problems. Linking the use of the mobile device meaningfully to the teaching was also easy. Overall, the learning experience became meaningful and motivating for the students.

Hence, the mobile application clearly brought a motivating and engaging element to learning. The benefits of mobile technology for study motivation have been highlighted in many earlier studies (e.g., Tan, Liu, & Chang, 2007; Chen et al., 2008; Hwang, Shi, & Chu, 2011). In this experiment, especially the fact that the students were able to work with their own material increased their interest and motivation. This finding is consistent with Huizenga, Hordijk, and Lubsen (2008), who have argued that mobile applications that give learners an opportunity to collect content and express themselves can have a positive effect on involvement and motivation.

The experiment also indicated that pedagogical practices strongly influence the learning activity, mobile learning process, as well as mobile learning experience. According to the

teacher, the mobile application can act as an aide, but especially with young children there must be real-life observations and experiences, such as something concrete to touch, smell, and even taste. This requirement increases the importance of activity design and pedagogical practices because the application by itself does not guarantee the quality or meaningfulness of the outdoor learning experience. This finding is consistent with the argument by Chen et al. (2008) that the mobile learning experience is also influenced by the context of the learning experience as well as by pedagogy. As Shih et al. (2011) have highlighted, the attention should be on both system and instructional designs. Even though the Nature Tour mobile application is designed to provide concrete experiences in nature, the teacher plans the situations in which the application is used, the learning goals and how learners are going to use the mobile application to achieve these goals. In this experiment, the clear pedagogical objective made the activity organized. Furthermore, the discovery learning approach enhanced students' involvement. As a consequence, students were motivated and engaged, and they concentrated on the task.

The expected results were sufficiently met. Time restrictions emerged, but otherwise the experiment indicated that the mobile application can support learning anytime and anywhere. The mobile application also helped the students acquire new knowledge about tree leaves. An additional positive finding was that the Nature Tour mobile application stimulated interactions with the teacher. However, the social aspect is otherwise slightly questionable, because the mobile technology was not used for mediating collaboration. The experiment also clearly highlighted the importance of pedagogy and pedagogical design. A different pedagogical approach would have encouraged a different experience. It is important to note that the learning activities are always constituted through a situated interaction of the pupils, teachers, and technologies (Mercer and Littleton, 2007).

Traxler (2009) has argued that mobile learning is an inherently noisy phenomenon where context is everything and confounding variables abound. This is why the positive results may also be caused by some other factors. The novelty effect, for example, is one of the intrinsic drawbacks of mobile learning research. The novelty effect, according to Cheung and Hew (2009), means that learners and teachers are more likely to use technology because it is new to them than are participants who have used technology for a longer period of time. Hence, the novelty effect may bias the results to some extent. For this reason, there should be longer-term experiments to reduce the novelty effect. The repetition of the approach over a longer period would also provide more evidence of the feasibility of the approach. Along with these, the learning outcomes and motivations as well as the effect of educational activity outside the classroom should be investigated more systematically. In this study, it is impossible to specify the exact role of the mobile application in the learning process and outcomes, even though the teacher argued that the activity helped the students to learn the most common types of trees as well as leaf structures. It is important to emphasize that the pedagogical approach and practices influenced the activity and learning outcomes. In this case, the mobile application acted as an aid and provided new and enhanced ways of working in the field, and the usage was meaningfully linked to other kinds of learning tasks. Ultimately, it was the whole that mattered: the learner, device, interactions, and pedagogy.

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Table 1

Primary school students' feedback about the Nature Tour mobile application (N = 19)

1 Gender	Girl	47%
	Boy	47%
	Empty answers	5%
2 The Nature Tour mobile application inspired me to observe nature.	Not at all	0%
	Somewhat	16%
	A lot	89%
3 I recorded plant observations with the application.	Not at all	0%
	Somewhat	11%
	A lot	89%
4 I recorded other things with the application.	Not at all	37%
	Somewhat	26%
	A lot	37%
5 I used time to read the information text.	Not at all	21%
	Somewhat	53%
	A lot	21%
6 I learned new things with the application.	Not at all	0%
	Somewhat	21%
	A lot	79%
7 I learned new things about the mobile device usage.	Not at all	16%
	Somewhat	5%
	A lot	79%
8 I needed help with the mobile application.	Not at all	42%
	Somewhat	42%
	A lot	16%
9 I think that the Nature Tour mobile application was easy to use.	Disagree	11%
	Agree	89%
10 The use of the Nature Tour mobile application was interesting.	Disagree	11%
	Agree	89%
11 Recording observations was fun.	Disagree	0%
	Agree	100%
12 I would like to use the Nature Tour mobile application again.	Disagree	5%
	Agree	95%
13 Reading from the screen was easy.	Disagree	11%
	Agree	89%
14 The phone always functioned as I assumed.	Disagree	47%
	Agree	53%

15 Rate the Nature Tour mobile application.	Fantastic	32%
	Very good	37%
	Nice	11%
	Passable	5%
	I did not like it	0%

16 What else would you like to say about the Nature Tour mobile application?	I don't know.
	It was nice to use a mobile device.
	Nothing.
	It was nice to be on a field trip and recording observation pictures.
	It was really nice.
	It was nice to record observation pictures.
	It was nice.
	Nice.
	The field trip was nice.
	Nice!
Really nice.	
It was fantastic!	



Figure 1. The Nature Tour Mobile System (a mobile application and a website).

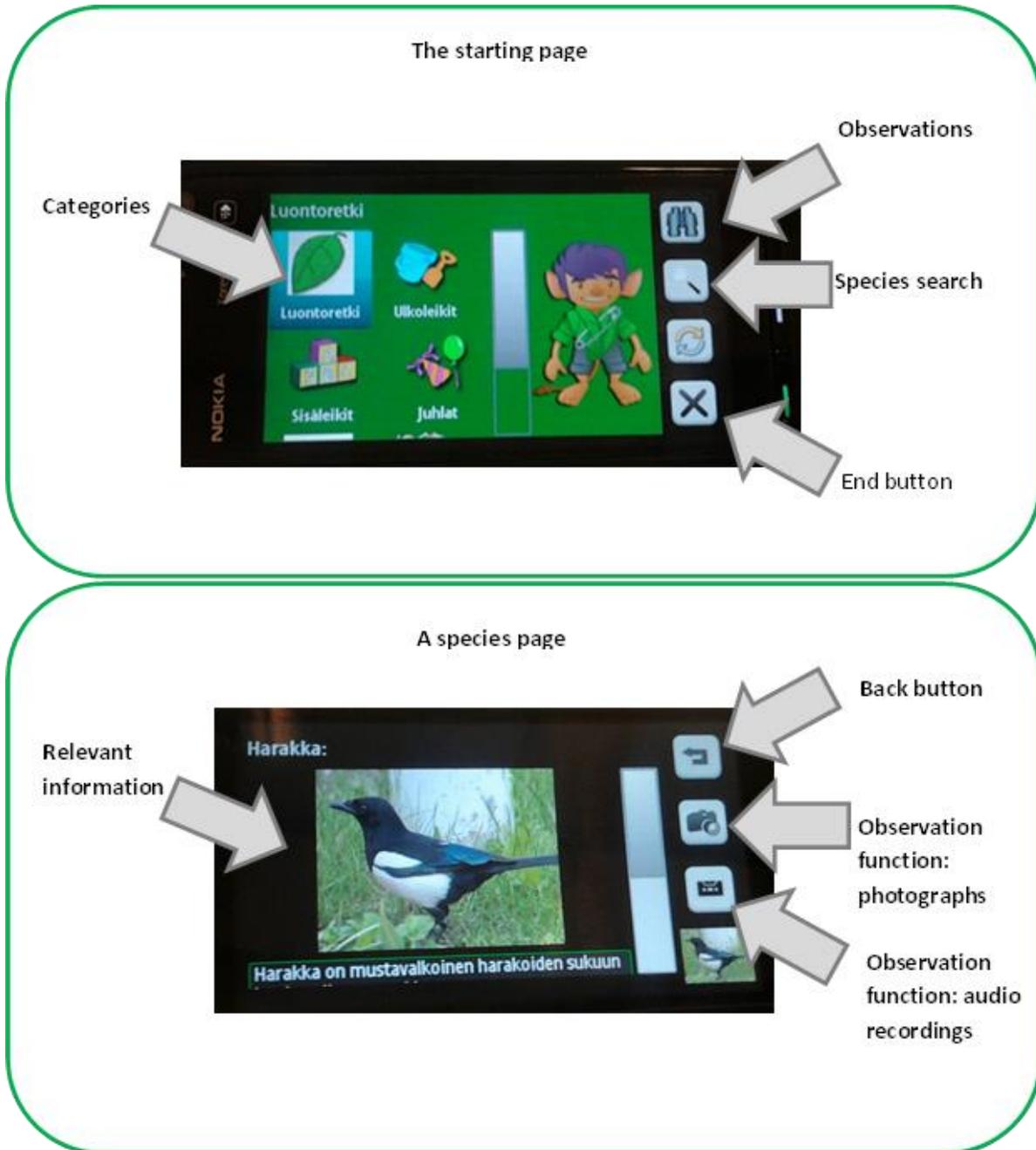


Figure 2. Screenshots of the mobile application.

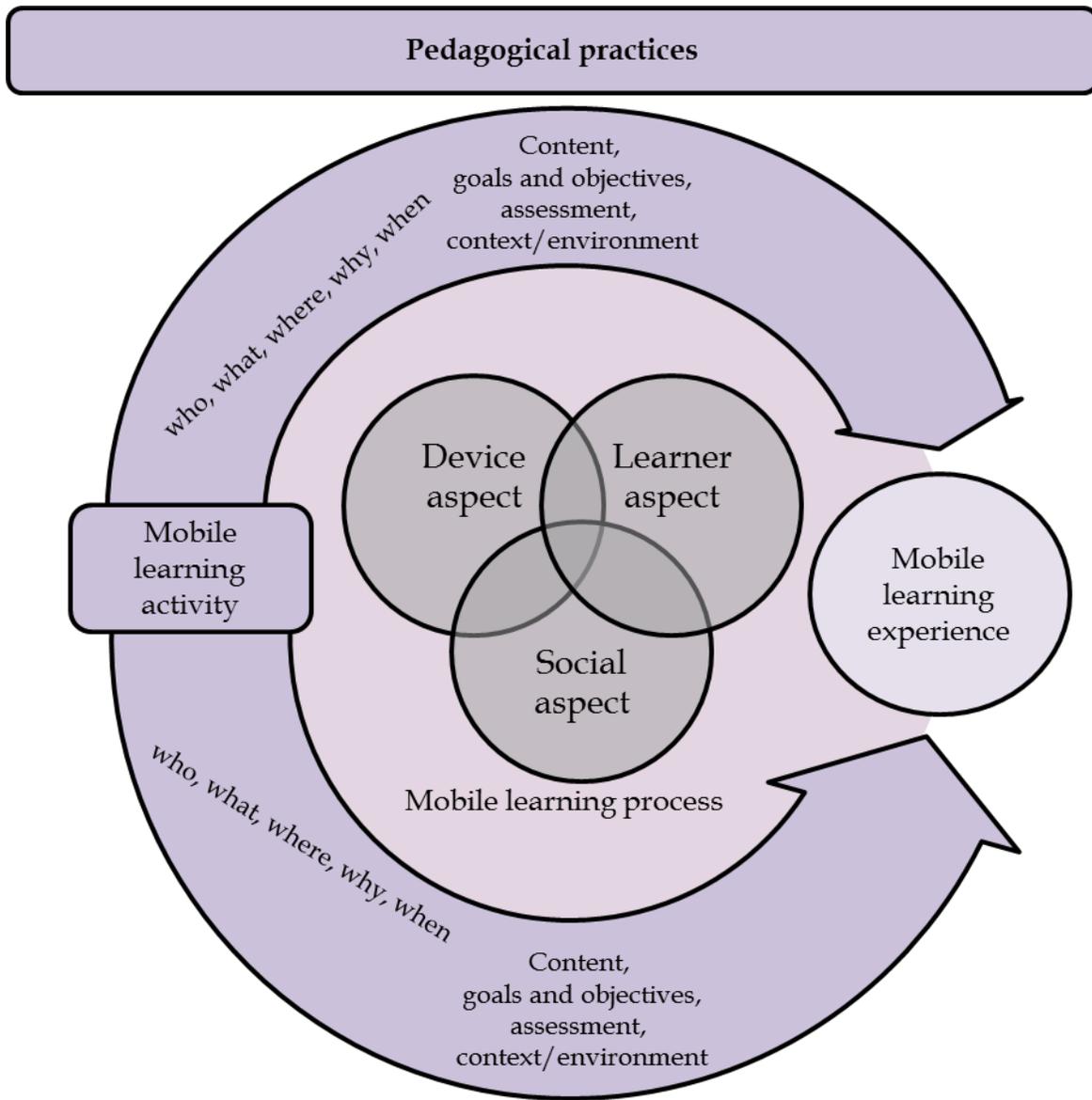


Figure 3. The analysis framework.