

## Fifth graders' perceptions of mobile phones and GIS technology

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### ABSTRACT

The era of M-learning, specifically the use of mobile phones, has been hardly noticeable in elementary schools. GIS technology is also rarely implemented there. In this study, 5<sup>th</sup> grade students' perceptions of the use of GIS technology through mobile phones were examined as part of an environmental education program designed to help preserve endangered species. The results show that the students provided special, valuable, critical and mature perspectives on the advantages and disadvantages of using mobile phones as part of the innovative pedagogy they apply in school. The use of the mobile phone and the new application as part of M-Learning made it easier for most students to create authentic learning, that is, learning focused on problems in the real world, and included a project of relevance and interest to the learners. The process of learning through mobile phones and GIS technology, which combined the creative use of teaching methods unfamiliar to students, focused on and was adapted to the learners' abilities, offering a diagnosis and constructive guidance based on success and community. In conclusion, 5<sup>th</sup> grade students testified that their elementary school could enter the M-Learning era by integrating mobile phones and adopting a student-centered learning approach.

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## 1. INTRODUCTION

The era of M-Learning, including use of mobile phones as part of the teaching process, has been recognized by higher education institutions as well as high schools. However, its implementation in elementary schools is not common. The GIS feature, which has been used in higher education institutions for the past several years, and has recently taken its first steps in high schools as well, is hardly implemented in elementary schools [1]. Clearly, elementary schools are the last to enter the M-Learning era and implement GIS technology for various reasons. Therefore, an examination of the perceptions of 5<sup>th</sup> graders who used mobile phones and GIS technology as part of an environmental education program for the conservation of the Lesser Kestrel, a small endangered species, is critical to examination of ways in which elementary schools can enter the M-Learning era. Thus, the present study contributes to the research by allowing us to understand the advantages and challenges of an elementary school considering entering the M-Learning era by integrating an environmental education program using mobile phones and GIS technology. Such a combination is not found in the literature, and if so, it is most unusual. In addition, this study has enriched the existing information on the ways in which mobile phones can be positively used among elementary school students.

### 1.1. M-learning era

M-Learning includes the use of mobile technology, on its own or in combination with information and communication technology (ICT) to enable learning anywhere, anytime. Learning can develop in a variety of ways, people can use mobile devices to access educational resources, connect with others and

create content, both inside and outside classrooms. Today, mobile phones are the basis for mobile learning. They have become the center of our lives [2] and a basic consumer product found in almost every home in the world. In the developing world, too, mobile phones are common, including populations defined as having a low socioeconomic status [2], [3]. The use of mobile phones has long since departed from the field of voice communications only, as a device designed to allow a conversation between two remote people using wireless technology [4]. People use mobile phones to take pictures, record video or audio, play music, check the weather, find directions, translate words, pay bills, read eBooks and play games [2], [5]. The use of mobile phones has also entered the education system, mostly in higher grades or academic institutions, and very little in elementary schools [4], [6], as a result of restrictions and laws prohibiting the use of mobile phones during school hours. However, in quite a few cases, the use of mobile phones during the lessons does not match the lesson's goals, creates distractions and lowers the students' involvement with lesson content, is done secretly without the teacher's knowledge and damages the students' grades [7].

### 1.2. Pedagogic challenges of M-learning

Mobile phones enable an environment that enriches and enhances the possibilities of new communication and interaction [8]. The interaction between person and phone poses new and complex challenges for young students, including support for complex tasks, mediating network interactions and managing and exploiting digital information, which challenge teachers to think creatively about mobile learning and develop the confidence to try new ideas [4]. Technology has made our world more complex, sophisticated and challenging, as well as requiring different learning abilities. This change includes the need to adapt the learning system and create learning environments that support the development of higher level thinking skills [9]. As a result of technological developments and the consequent changes in our world, there is a need to provide tools enabling students to cope with a technological environment that in the past had not always been part of the education system. The M-Learning environment provides better development of life skills, including organization, problem solving, investigation and collaboration skills. This learning environment develops by providing tools for more collaborative learning as well as reducing competition. Studies have also shown that technology integration increases the likelihood of interaction within the learning environment as many new technologies are interactive, making it easier to create environments where students can learn by doing, receiving feedback, and continually sharpening their understanding and constructing new knowledge [10]. For teachers in this era, the availability of mobile phones requires a 'recalculation' of their role re- the curriculum. Mobile phones promote a change from teacher-centered to student-centered teaching and learning [3], [5], [7]. Transfer of knowledge from teacher to students is no longer an option. Instead, we have two-way communication, with both teachers and students transferring and receiving knowledge [11]. Use of mobile phones makes learning student-centered and knowledge-centered, rather than memory-focused. Learning with mobile phones uses frequent feedback and assessment, becoming community-centered and collaborative. This conceptual change enables the teacher to make use of all the technological advantages of mobile phones, as well as enabling the personalization of the individual student and the learning pace. The teacher allows the student to take responsibility for the learning process and construct the skills and knowledge acquired as part of his/her training towards adult life and coping with future technological challenges [3], [8].

### 1.3. Geographic information system

The combination of technology development and big data sources has led to the development of Geographic Information System (GIS) technology. Today, GIS is one of the most innovative technological tool in the education system. One of the most important features of GIS is the system's dynamic nature and its rapid changes as a result of collaboration [12]. GIS technology is currently used in a variety of government offices, military systems and civilian systems, and has recently been used in several schools worldwide. GIS technology has several advantages: (1) it enables exposure to large databases that need to be dealt with through a variety of analysis tools; (2) it enables the gathering of information and presentation of phenomena and spatial trends; (3) planning alternatives can be presented as a decision-making tool [13]; (4) it promotes collaboration, group learning and interdisciplinary learning; (5) it enables online work and is accessible to work from anywhere with is an Internet connection; (6) it enables development of learning skills such as critical thinking [12], spatial thinking [12], and improving analytical ability [5]. These advantages are part of the school's aspirations to provide the students with tools for dealing with future adult education. At the teachers' level, one of the main advantages of the GIS is the need for professional development and change of teaching and assessment methods, promoting the assimilation of a student-centered rather than a teacher-centered approach. The teacher in this case becomes a mentor, supporter and guide, encouraging self-learning while creating motivation for learning among the students [11], [14], [15]. There are also a number of limitations for the use of GIS, all of which are not dependent on the student but

rather on the education system. The technological progress of the education system often fails to follow the technological advances in the real world. As a result, technological limitations such as Internet bandwidth or constant disconnections limit GIS use and cause frustration among both students and teachers. In addition, teachers' ability to transfer the lessons associated with learning through GIS are sometimes limited, as they had not been exposed to GIS technology as students and therefore are unfamiliar with it. Moreover, there is no systematic requirement for integration of GIS, and teachers are not provided with paid time for this purpose [1], [14].

#### **1.4. Environmental education**

The global awakening to environmental problems in the 1970s led to the convening of world conferences in which positions were set and decisions made regarding human activities in relation to the environment. This awakening did not overlook educators, especially from the sciences, who began to formulate a new educational field called Environmental Education. The aim of environmental education, as formulated in the 1970s and 1980s, was to educate for action towards solving environmental problems that man created by increasing learners' knowledge and awareness. It was thought that knowledge would increase awareness and provide problem solving tools [16], [17].

The combination of these three knowledge bodies, mobile phones, GIS technology and environmental education, has led to the following research question: What are the perceptions of 5<sup>th</sup> graders regarding the use of mobile phones and GIS technology in an environmental program designed to help preserve an endangered species?

## **2. RESEARCH METHOD**

### **2.1 Objectives**

To understand 5<sup>th</sup> grade students' perceptions of the use of mobile phones and GIS technology as part of an environment education program.

### **2.2 Research context**

The environmental education program aimed at the protection of the Lesser Kestrel was established in 1996. Since then, 5<sup>th</sup> grade students at Falcon School have been helping protect the local Lesser Kestrel population nesting in their school and the surrounding area. In order to cope with the lack of nesting sites in the communities near the school, students have been building nest boxes and conducting surveys in the relevant communities to find roofs where they can be hung. Until 2017, the survey was conducted using hardcopy maps and papers. In 2018, a new application was developed to replace these. The students habitually conduct the surveys after school hours, so that use of mobile phones for this purpose is based on their private telephones. Exposure to the new application was conducted in theory only, as school rules prohibit students from bringing mobile phones to school. Thus, the students experienced the application in the afternoon, with no technical support from the teachers. The time allotted for students to conduct the survey was one week. After conducting the survey, the students examined the characteristics of all the houses they visited and held a democratic discussion during class to decide where to place the nesting boxes.

### **2.3 The app**

The survey was conducted using the Survey123 application, part of the ARSI ArcGIS Online environment. Survey123 provides a simple, intuitive data collection solution using online forms, enabling one to create, share and analyze surveys with a geographic location component. It allowed students to add responses through their mobile phones while in the field. In addition, the app allows students to associate survey answers with an image of a geographical location on the map using the built-in GPS technology on their mobile phone. Each form sent from a mobile phone is added as a point to a single geographic information layer containing all the survey and answer points sent by the students. The information layer containing the answers from the survey is presented on a map with an up-to-date, real-time snapshot of the survey results accompanied by diagrams. The students did not experience it during school hours due to the ban on bringing mobile phones to school.

### **2.4 Research tools**

The present study takes a case study approach. Case study is a research approach increasingly used in educational settings [18], based on a naturalistic and holistic research approach which includes a broad description and interpretation of the phenomenon [19]. In this case study three research tools were used: a quantitative questionnaire, a qualitative questionnaire and focus groups.

### 2.4.1 Questionnaire

The study used a mix-methods approach. The quantitative part was based on a 30-item closed Likert scale student questionnaire (1-not at all to 5-very much). Some of the questions are based on the literature [18], while others were made up by the researcher. The questionnaire was divided into six sections (Table 1) with internal consistency of Cronbach's alpha higher than 0.712. The first section included four questions related to students' comfort level while using the mobile phone and application ( $\alpha = 0.747$ ). Section two included seven questions related to students' discomfort level while using the mobile phone and application ( $\alpha = 0.777$ ). The third section included five questions related to motivation for learning following the use of mobile phone and application ( $\alpha = 0.878$ ). The fourth section included four questions related to the contribution of mobile phone and application to pedagogy ( $\alpha = 0.830$ ). The fifth section included two questions related to negative aspects of mobile phone and application use ( $\alpha = 0.712$ ). The last section included eight questions related to positive aspects of technology ( $\alpha = 0.819$ ).

Table 1. Examples of questions in each category

Category number	Category name	Examples of questions
1	Feels comfortable using the app	a. I feel comfortable about my ability to work with a new app. b. I feel confident learning new apps by myself.
2	Feels uncomfortable using the app	a. Using a new app confuses me. b. I'm scared when using a new app.
3	Motivation as a result of the use of technological tools	a. Using the app made students more involved in the survey. b. Using the app made me more involved in the survey.
4	The contribution of technology to pedagogy	a. The app can be a useful learning tool for students. b. Using the app improves the quality of instruction.
5	Negative aspects of conducting the survey using technology	It was more convenient to do the survey with paper Using the app made me waste my time during the survey.
6	Positive aspects of conducting the survey using technology	a. I'm aware of the benefits of using the app in a survey. b. Using the app made the survey more efficient.

### 2.4.2 A qualitative questionnaire

In addition to the closed questions, students were asked to answer two open questions: (a) Do you think there is a need to use smart technology during learning? (b) What is the contribution of technology o learning?

### 2.4.3 Focus groups

The present study used six focus groups, three in each of the classes, with approximately nine students in each group, both boys and girls. The duration of the discussion in each focus group was about 45 minutes. The discussions in the focus groups were recorded and transcribed. The discussion included questions such as: Describe the survey and what you did. What was surprising in the survey? What was difficult in the survey? What should we keep or change next year? What would you recommend for next year? These questions were designed to allow students to develop a discussion about their experiences and emptions while carrying out the survey [20].

## 2.5 Sample & data analysis

Fifty-two 5<sup>th</sup> grade students who used mobile phones and the GIS application were asked to the answer the mixed-methods questionnaire. The findings were analyzed using primary and secondary coding and category creation [19].

## 3. RESULTS AND DISCUSSION

This section presents the findings from the analysis of the quantitative questionnaire and the open questions answered by 5<sup>th</sup> grade students who conducted the survey as part of the environmental program in Falcon School. The questionnaire was designed to examine the students' perceptions of the integration of mobile phones and the new application as part of an attempt to streamline the survey after 22 years. The findings are based on a combination of both quantitative and qualitative findings. Since the qualitative analysis discovered additional categories that had not been included in the quantitative questionnaire, I added them at the end of the section.

The six sections of the quantitative questionnaire are presented in Figure 1. This data shows that high scores (3.37 and higher) were given to all items which relate to the use of mobile phones and the new

application in a positive manner. Low scores (1.56 and lower) were given to two items which reflected negative aspects of mobile phone and app usage.

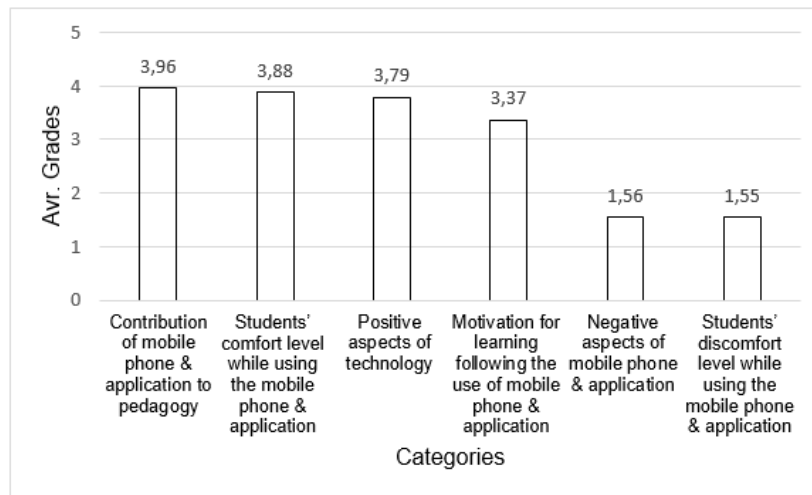


Figure 1. Average score of categories found in the quantitative questionnaire

### 3.1 Comfortable or uncomfortable feeling using a mobile phone and the new app

High scores were found for the comfort level of using mobile phones and the new application (3.88), as compared to the low score (1.55) found for the discomfort level. The difference in quantitative grades is reinforced by qualitative data. The use of mobile phones, including the new application and the use of GIS, did not surprise the children. Although they did not know the application specifically, it seems that the use of a new app is not alien to them, as a number of students said: "Because we know all the technologies really well"; "Children understand technological devices more than written texts", and "because we are part of a technological generation." It is evident that they were self-confident and felt comfortable in the technological world and the possibility of operating the new application. In conclusion, it can be said that the students felt comfortable using mobile phones and the new app, and did not seem to feel uncomfortable as a result of using them. Learning about the application in theory only during school hours, with no practical experience, did not cause students to feel uncomfortable about using it during the afternoon survey.

### 3.2 Positive or negative aspects of the use of a mobile phone and the application

The positive aspects of conducting the survey using mobile phones and the new application received an average score of 3.88, as compared to the low score (1.56) given to the negative aspects. The students often referred to positive or negative aspects of conducting the survey using mobile phones and the new application in the context of their studies. Most of the positive aspects that the students mentioned relate to the learning process. The qualitative analysis also shows the students' positive attitudes towards the use of mobile phones and the new application. The findings present the positive aspects of conducting the survey using mobile phones and the new application, followed by the negative aspects.

#### 3.2.1 Positive aspects: diversity, learning experience, time utilization and comfort

The students expressed a variety of positive arguments related to the use of mobile phones and a new GIS application related to the survey as part of the learning process in the environmental education program. First, the students referred to diversity: "It's a different type of learning" and "It takes us out of the school routine." The use of mobile phones and the new app also caused interest among the students, as reflected in their answers: "...the more interesting it is to learn" and "...the more interesting it is, the more fun it will make the survey." In addition, the students feel the learning experience has been improved as a result of mobile phone integration and the new application: "Making the learning experience more fun and thus more children will participate"; "Because this app is more experiential"; and "Using technology is easier, simpler and more fun." Another aspect of learning that the students mentioned was time utilization: "It also makes the survey more efficient because there are almost no problems with the application.", and "The application made the survey more rapid." A fourth positive aspect that the students noted is the convenience

of working with the mobile phone and the new application, rather than conducting the survey with pages that are "less convenient and more tedious. It is easier to write everything on a phone and not on pages". An interesting conclusion is the following student's quote: "It's very challenging and a lot of fun to learn because it's something we do not do at school and it's also different from our routine." The idea that the use of technology is still perceived by the students as a departure from routine is surprising, because of the considerable investment being made in the school to integrate technology in general and the environmental education program in particular. However, it is possible that the student views the integration of laptops as an integral part of the learning system, and the use of mobile phones and the application that has not yet been done in the school is perceived as a departure from routine. In conclusion, the students expressed many positive arguments that support the integration of mobile phones and the new application as part of the survey, which is an important part of the students' learning program.

### 3.2.2 Negative aspects: social inequality and technological problems

Some of the students who have used mobile phones and the new application also discovered a number of disadvantages in applying this innovative technology during the survey.

#### *Social inequality*

The first disadvantage stems from the sense of inequality. Although most of the students had their own mobile phones (72%), a number of students did not (28%). Students who did not have mobile phones felt uncomfortable about having to use their friends' phones, as one of the students notes: "... but during the survey I did not have a phone and it was a bit annoying because almost everyone had and I had to use my friend's phone". Students who had a mobile phone also sensed the lack of social equality, as one of them notes: "I felt uncomfortable that my friend did not have a phone." Despite the cooperation and the creation of work groups where the presence of a mobile phone was ensured, the students who did not have them felt uncomfortable, which is not surprising.

#### *Technological problems*

Students were able to point out all the disadvantages of using technology arising from communication problems: "Because if there is no Internet it gets stuck.", or "There are tasks that need Internet and we don't always have it." Another problem which the students had to deal with the lack of data retention: "In my group, three houses were deleted and we started again and this delayed us.", or "... so we continued with the problem and then it was not sent and it just creates unpleasantness because you really tried and then in the end it was not sent at all. " A further problem was lack of technical support during the afternoon survey: "Because I had a problem with the application and the teachers could not always be available.", or "Because something did not work for us in the application and it was hard to deal with it alone." A fourth problem was frustration as a result of use of the mobile phone and the new application: "But out of a lot of houses where we did the survey, we saw only two houses on the map and it wasted a lot of time." Another problem raised by the students was fear that the mobile phone's battery will not allow them to complete the survey due to its short life span: "But the phone can run out of battery.", or "But there are also problems when the battery ends." It is apparent that the students experienced a variety of technical problems in using advanced technology based on mobile phones and the new application.

### 3.3 Motivation for learning

The high score of this parameter (3.37) is supported by the findings from the qualitative analysis. Many students referred to this, among other things claiming that the use of mobile phones and the new application encouraged motivation: "The children are more interested and it gives them a desire to be partners because the phone and other technologies are hypnotizing, and this can cause it.", or "...more interested in the material and it made me want to succeed more and greatly helped in understanding the material." These quotes indicate their motivation to conduct the survey, and in fact study, when the curriculum included the use of mobile phones and the new application.

### 3.4 The contribution of technology as a pedagogical tool - creating a database, as a substitute for writing, as a different type of learning and developing a sense of ability to deal with technology

This aspect has the highest score (3.96). The qualitative analysis contributes to this section in four different ways.

#### *The advantage of using technology as a tool to create a database*

The students' approach to the new technology as a tool has advantages in creating a database that includes a variety of items for all stages of database organization and presentation. The first stage of creating

a database is collecting information. Students' contributions to this stage included, among other things, the following examples: "It's more effective because the result is sent straight to the computer", or "direct messages". Not only the data collection advantages are identified by students, but also organization of information in the database: "It frames the information in a quick and convenient way.", or "All the information goes straight to the table and is arranged." The students were also able to identify the final stage of organizing the information in a database: "The data can be organized in a graph more quickly, and it is also easier to know what the answers are." Collecting, organizing and presenting information as part of the creation of a database, as expressed in the students' quotations, is surprising in light of the use of professional concepts in which the students expressed their knowledge, naming concepts from the domain of databases.

#### *The advantage of using technology as a substitute for writing with pencil and notebook*

One of the reasons the students expressed their desire to use mobile phones and the new application while conducting the survey was to get around using pencil and paper, i.e. to avoid writing: "Because it's a bit tedious to write on a page and you have to find something to put on the page.", or "You do not have to write all the time." Additional reasons related to the use of pencil and paper included: "Our handwriting is unclear" and "Sometimes the writing is too small and the teachers can't see what's written." In the current reality, where most students make daily use of mobile phones, it should not be surprising that they find it difficult to write with a pencil.

#### *Different learners*

An interesting point some of the students raised is their attitude toward classroom learning, specifically the integration of technology as a learning tool. Some students argued that technology causes cognitive development: "Because information gets into your head better when you learn from your phone or computer.", or "I also think technology can develop a better way of thinking." Clearly, some of the students feel that technology can improve learning and develop thinking, and that learning with technology will achieve better educational outcomes. However, others did not see technology as a tool that could help them in the development of learning: "Because there are children who are less comfortable to do this technologically.", or "On paper I get better information." In conclusion, it seems that students' opinions are divided regarding this issue. Some advocate technology as a tool that can help students develop cognitively, while others feel that it is more convenient to use traditional learning tools.

#### *Challenge and develop self-efficacy to deal with technologies*

The use of mobile phones and the new and unfamiliar application enabled some students to feel the challenge of using technology for the first time: "It is very challenging and great fun to learn, because it is something we do not do at school and it is usually out of reach." The new application did not leave the students indifferent: "We learned to deal with the application and the technology ...". The example demonstrates that not only did the students not remain indifferent, the new app even encouraged them to learn. Part of the students' motivation to succeed in dealing with the new application stemmed from their desire to prove themselves "...so they can see that we were more professional." In conclusion, the use of mobile phones and the new application can enhance students' self-efficacy to operate an unknown application: "Coping alone with mobile devices is important".

### **3.5 The contribution of technology to life and the impact of technology on the environment**

The qualitative analysis made it possible to learn about the students' attitudes towards two other aspects.

#### *The contribution of technology to life*

The students examined the use of technology and its practical contribution to their daily lives in the present and the future. Their reference to the contribution of technology in the present can be seen in the following quote: "We learned to work with software and technology, and this could contribute to the continuation of the project or the continuation of the surveys." As mentioned above, the young students also thought about the future. Students are aware of future skills that will help them cope with the challenges of life. For example "Not only for the school, anything like that increases the amount of knowledge and helps later on in life." The student understands that the school is only a model for the rest of their life, and in school students are expected to receive the tools that will help them later on in their lives. These examples illustrate that at least some of the students made use of the new technology based on a practical view of their lives and its contribution to the project, as well as a future contribution - receiving tools to deal with 'real' life following graduation. These students help to substantiate the claim that one of the school's goals is to provide them with practical tools for coping with life in the future. In addition, students were able to associate the use

of technology and the new application with innovation: "Exposing us to new things.", and linking it to teaching innovation: "We're all learning something new.". To sum up, we can see that some of the students view school as a preparatory stage towards life in the digital era in which we live, and which will develop even more as they become adults.

#### *Technology and the environment*

One of the points raised by some of the students is the impact of technology on the environment: "It is necessary but not good that to produce electricity [which mobile phones consume] we need to contaminate the environment.", or "Does not waste a lot of pages.", and "More environmentally friendly". While the last two quotes show a direct link between using the application and reducing paper use, the first quotation shows a complex higher understanding, including an indirect and triangular relationship between the use of technology, energy demand and environmental pollution, created as a result of the need to produce electricity.

To sum up the findings, it is apparent that the students evaluate the use of mobile phones and the new application positively, but at the same time they demonstrated critical thinking skills and pointed out the difficulties in using mobile phones and the new application. It is interesting to note the importance of the use of mobile phones and the new application for their adult lives and the environment in which they live.

#### **4. CONCLUSION**

The use of mobile phones and the new app has provided a teaching tool enabling the assimilation of educational elements which include development of the learners through personal experience, a dynamic learning environment, independent discovery of content, knowledge, skills and values, experiential learning, extracurricular learning, outdoor learning, developing personal responsibility, self-efficacy and expanding the school environment. The students expressed great satisfaction with the opportunity to operate mobile phones and the GIS application for conservation purposes, and were not bothered by this demand, even though they did not experience it during school hours due to the ban on bringing mobile phones to school. Another view of the values that students feel they have been exposed to, which teach critical thinking, is their attitude to the social injustice created by the use of mobile phones. The ability of students in the 5<sup>th</sup> grade to "see the other", students without mobile phones, and relate to them in their words, indicates social sensitivity. Another aspect that the students emphasized was the learning experience in the sessions in which the survey was conducted. The environment in which the survey was conducted, different from the schoolyard, extended the definition of learning space for the students in the M-Learning era. In this era, the learning environment of the technological generation constantly using mobile phones goes beyond school fences and classroom walls. According to the students, the new app motivates them and develops their self-learning capability to cope with technological challenges in integrating authentic learning. In conclusion, 5<sup>th</sup> grade students indicated that their elementary school could enter the M-Learning era by integrating mobile phones and creating a learning environment in which the student is at the center of the learning process. The students noted that the innovative teaching method and the authentic task of helping to preserve the Lesser Kestrel aroused a great deal of interest. This has raised their motivation to learn independently while taking responsibility for the learning process, focusing on the task and the proper use of mobile phones.

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