- The system must be a portable lightweight device
- The system must permit use with gloves on
- The system must not obstruct the work in the field
- The system must support the student's ability to learn in the field
- The system must have a long-life battery
- The system should offer a consistent layout to avoid unexpected changes from one screen to another

4.6 Conclusion

This chapter presented two case studies with undergraduate biology students to develop an overall understanding of using mobile devices for capturing and sharing the experiences in the student field work. This understanding leads to identification of the user requirements for use of a mobile technology system intended to assist students in capturing and sharing their learning experiences (LX). Therefore, the contribution of this work can be summarized as follows:

- Understanding the task requirements and how embedding mobile technology in the field trips in general and partially in Biology field work
- The system design guidelines are a suitable basis for developing and designing new mobile technologies for field trips.

The results show a good level of acceptance for mobile learning and indicate a positive attitude towards the behavioral intention to use mobile learning. Students showed great interest in using mobile devices in the biology field experience as a learning tool, especially in capturing multimedia such as photos and videos.

This led to identification of three main reasons that cause a challenge for students on using the mobile device in capturing and sharing learning experience (LX) in the field trips. These were the difficulty of use by students in the context in practical and efficient way, due to the nature

of the surrounding like the weather condition or geographic environment. The second cause is the limited time in the field, so the students were looking for a faster method to collect their experiences. In addition, the third cause is that the students suffered from spatial isolation sometimes when they used the mobile devices especially when they were taking text notes.

5. Discussion and Conclusion

5.1 Introduction

This chapter presents a discussion of the findings of the research studies to show how this contributes to current-state-of the art in this field. After that, it will identify the limitation of this research. Finally, conclusions and recommendations for further work are presented. The overall aim of this research was to investigate how the use of mobile technology in educational field trips impact capturing and sharing of the learning experience.

5.2 Understanding the Context of use

Previous literature has demonstrated the value of field study to facilitate and enhance student learning in several disciplinary areas. Field trips provide popular and memorable experiences for students to understand the different aspects of natural sciences and it is considered as an essential effective method in the environmental studies such as geography, biology (Gay et al, 2013). Field trips are a popular method for introducing students to concepts, ideas, and experiences that cannot be provided in a classroom environment. This is particularly true for trans-disciplinary areas of teaching and learning, such as environmental education, geography, and biology (Storksdieck, 2006).

Then, the research focused on two groups of undergraduate biology students from two different German universities, both attending biology field study trips. However, the nature of field trips in each of these case studies was different, partially in the nature of the environmental

work area. One was in a marine environment field study trip, while the other case study usually occurs in rural landscapes.

5.2.1 Understanding the User Requirements in Context

The first part of this research aimed to understand the context of use, and the user characteristics in higher educational biology field trips in order to determine how mobile technology could best be applied to this context. This answers first and second research questions.

The first research question addressed was:

RQ 1: How do students capture and share their learning experience during thefield trip?

- What is the meaning of learning and field experience during the field trip?
- What kinds of tools are suitable to capture and share the learning experiencein the field?

The second research question addressed was:

RQ2: What are the user requirements of mobile technology to supportcapturing and sharing learning experiences during the field trip?

In order to answer these questions, two studies were conducted as described in chapter4.

One of the study contributions was to identify the type of information that the students collect and share in their field studies. Detailed observation was made of field study activities conducted by students taking higher education courses in biology. These subject areas were selected as they provide examples of different types of biology field study. The outcome of these observations provided:

1. Identification of user needs and requirements in different educational field study contexts (See tables x and x2 in chapter 4).
2. Generation of system requirements for use of technology in educational field study (See section 4.4.2 in chapter 4).

This identified similarities and differences between different contexts of use with regard to: the purpose of study (e.g. what type of field experience is to be captured), how this information is used (i.e. what students need to do with this information), and how it is captured (the methods they used to collect and share this information).
It was found that the two groups of biology students from different biology topics (Marin ecology and Botany biodiversity) used similar techniques to capture and record data, including photos, videos, notes, etc., but worthy of mentioning as well that there were some differences in terms of the type of data they wished to record. For example, while the marine ecology students collected both qualitative data (for example, notes and sketches) and quantitative data (for example: measuring), botany field trip students collected qualitative data only, such as note taking and sketch drawing.

The analysis also identified how the students use the data that they have collected in order to enhance their learning. The students assigned importance of the field experience to help them to learn through interacting with the physical environment and with colleagues in the field, as well as gaining a memorable field experience which helps them to improve their coursework. For example, the students reported that they would use their collected field experience in writing their field reports and to fill their critical diaries and e-portfolios. This finding supports the views of (Emmons, 1997, and Fuller et al, 2003, Storksdieck, 2006) which stated that the main objectives of the field trip are the ability to learn through activities such as observing and interacting with the real environments. In addition, students gain practical skills to enhance their learning using different equipment to record, measure, test

and analyze the new perspective gained from their experience in the field in order to evaluate and reflect knowledge and skill development.

The field trip experience also enhanced the student understanding of the subject knowledge by sharing skills, interacting socially with colleagues, and transferring their experiences, as well as for Lifelong learning, where some teacher students mentioned that they need these field trips for their future as a teacher. Learning how to learn, i.e., learn- ing to recognize learning strategies and monitor, is a prerequisite for lifelong learning (Cliath et al, 2000, Field, 2011). Also, as Park (2020) defined lifelong learning as proper skill mixes for future jobs include strong cognitive skills, basic information and communication technology.

This leads to an important concept which called Professional development, also known as professional education, is learning that leads to or emphasizes education in a specific professional career field or builds practical job-applicable skills emphasizing praxis in addition to the transferable skills (Speck, 2005, Summer, 2006). Also, teacher professional development is defined as teachers' learning how to learn, besides how to apply their knowledge in practice to support pupils' learning (Postholm, 2012). Therefore, based on the results of this research, the main objective of field trip is that help students to develop transferable skills (Scott, Fuller & Gaskin, 2006). Also, enable students to develop different skills and prepare a substructure for their future learning (DeWitt, 2008, MacCallum, 2022).

Moreover, the author observed three main activities students mainly used to document their experience after and during their field trips. That is also an important aspect to address for a better understanding of students' activities after their field trip and how they transfer and save their information for short and long periods of time. Jäkel (2021)

suggests the following future research question; What forms of documentation do students use of what they have learned in outdoor education in addition to writing it down? (p. 304). Three main activities were identified in order to document students experience information after and during their field trips. The information can be in the form of texts, photographs or multimedia. The first documentation activity is transferring data; the students transferred their multimedia data to digital storage media from their mobile phones to their laptops. They also used Microsoft Offices to transfer the data, such as Microsoft Excel for quantitative data and Microsoft Word for note-taking.

The second activity is saving the data mainly by using cloud-sourcing services, such as Dropbox, for long-term use, especially when students feel the information is valuable. The author has observed from student interviews that when students get data information from the field, such data carry a particular value and great interest for them. Therefore, most of the students were keen to save and organize the data information they collected from the field, which is the third activity of documentation the organizing data. Regarding organizing data that was collected from the field, many students organized their data digitally for their own late experiences.

On other hand some students have one or two activities of documentation by using paper based, especially in Botany field trip group, the reason was as author saw depends on the nature of information the students collected from the field, like samples of different plants, where was possible to do some prosses on it in their university lab after the trip and keep it dry in a notebook with a written information near each sample. From other side, most of Marin ecology field trip group have transfer, save, and organized their data digitally.

This shows the important role of mobile technology, also in transferring the collected data for saving and organizing, not only capturing this

data information from the field. Smartphones and tablets can also be used to create documents and save information during field trips (Medzini , 2015, p.17).
The time taken to record the data information is of the same importance as the students communicating with each other in the study group in outdoor education (Jäkel, 2021, p.304).

Therefore, the study examined the nature of sharing experience in the field and found that both sets of students want to share their notes and experience, but that the type of information shared was a bit different for each group. For example, the Marin ecology students share the raw data that they collected from the field, but they don't like to share their analyzed data with all their colleagues, until the final seminar. The Botany biodiversity students, on the other hand, preferred to share selective data regardless of the privacy issues which the students set by themselves. Privacy issues were a bit different between the two case studies, and the reason based on the nature of evaluation of students results in the end of the course, where in Marine biology, students have been evaluated by writing a report and representing results in a final seminar for each group one month after the trip, while in Botany biodiversity field trip students, the way to evaluate was by making a final group work notebook, which was possible to share results with other groups as well.

In general, the students did not show any concern about avoiding note sharing. Indeed, the results of the two-case study reveal that the student's actually preferred to see each other's notes in order to show support for their data collection.

Furthermore, the Botany group of student's field trip preferred face-to-face discussion, whereas, in the Marine ecology field trip s ecology field trip, students liked using social networks for group discussion,

such as WhatsApp. Finally, both groups used emails and cloud file sharing services like Dropbox to share their data. In addition, students used Bluetooth to share their data in the field, especially in the Botany Biodiversity field trip. The explanation for the use of different techniques used by each group may be due to the nature of the field trip environment that they go to. For example, the Botany students work in rural areas, which are a harsh environment to use mobile technology in; poor internet connections require the students to use basic techniques such as using Bluetooth in order to share their data in the field.

With regards to methods that the students use to capture and share their experience in the field, it was observed that all groups of students take a number of devices with them. These include a mixture of traditional and modern tools such as notes and sketchbooks for note taking, digital cameras for capturing photos, and mainly mobile devices, which all of the students have used at least one time throw the six- days field trip, for taking photos and videos and so on.

However, in addition to these, the students used a variety of measurement tools such as a ruler, in addition of using binoculars, and a magnifying glass. This observation is consistent with the result of (Weng et al, 2012) who noted that the list of tools taken on a field trip gets longer the more types of information need to be collected for the field study. In addition, (Weng et al ,2012) stated that the need to carry a lot of equipment may make it difficult to work effectively on site.

Therefore, this research was interested to see whether a single device could be used to capture and share the field experience instead of several devices. In this research, although students have often used the mobile device also tablets, but this was not always enough, where they needed to bring with them in some days from six-day field trip other different tools such as Magnifying glasses, binoculars, pens and paper, and measuring tools. But from my point of view, I agree with Weng et

al, that carrying several equipment's may make it difficult to work effectively in the field. But in this case study, what helped the students to work with several pieces of equipment was students cooperation within the group during the trip. Otherwise, it would have been difficult for a student to use several tools simultaneously.
This cooperation between students defines as "Collaborative Learning" which requires the mutual engagement of all participants and a coordinated effort to solve the problem (Kelly, 2002). In general, it's much more efficient for students to use a single device or tool, especially in the field, where most of the students don't want to be disturbed with several deceives or tools.

The first part of the research process, which is represented by the first research question, was to identify the requirements for a mobile system that could be used by students in the field. Research conducted by (Priestnall et al ,2009) compared five different mobile devices for data collection in the field and identified a number of issues relating to the usability and design of these technologies. They concluded that there was a need for a design guide to meet user requirements for mobile devices that could be used in the field. This represented a gap in the research literature as most of the studies concerning design guidelines for field study have focused on how to improve the learning experience in the field trip rather than studying how to enhance the use of the mobile technology in the field e.g. Yeh et al (2006), Kukulska-Hulme, (2007), Rost and Holmquis (2010), Ryokai et al (2011), Lo (2019) and Fernandes & Rodrigues (2018).

Therefore, one of the objectives of this research was to establish system requirements for a mobile device to be used in field study. This objective was addressed through two sources of information; the first by reading literature about mobile devices used in the field trips, the second from observation study, analysis of data collected and subjec-

tive opinion from undergraduate students who carried out field studies. The established requirements covered different aspects related to design of suitable mobile technology to be fit for use in the field for capturing and sharing experience activity, focusing on the biology field trips. (See chapter 4 section 4.3.2).

Consequently, this study developed an overall understanding of the user needs and requirements in field trips, leading to establishment of design guideline for adaptation of mobile technology to assist students in capturing and sharing their experiences.

However, Wentzel et al (2005) report that there is a difference between applying the technology in fieldwork, for the sake of technology and, applying mobile technology to enhance the fieldwork. Thus, it is important that the selection of technology and applications for use in field study should be made on the basis of how well it supports the user and requirements of use. Therefore, the work in this study has a major contribution to these requirements, which can create conceptual model, which is fundamental to interaction design (Rogers et al , 2023).

Therefore, the outcomes of this work are summarized as follows:

1. Understanding the user behaviors in the field which would contributes in enhancing future works that aimed to study embedding mobile technology in the field trips
2. The system design guidelines can be used as a basis for developing and designing new technologies for use in field trips.

The results show a good level of acceptance for mobile learning and indicate a positive attitude towards the behavioral intention to use mobile learning. Students showed great interest in using mobile devices in the biology field experience as a learning tool, especially in capturing multimedia data such as photos and videos.

5.2.2 Understanding the Use of Mobile Technology in the Field

This part of study aimed to answer the third main research question. As the first part of research, the same qualitative methods including researcher observation and participant interviews were used in order to understand how students used the smart devices to collect their experience in the field.

The third research question addressed was:

The study identified main similarities and some worthy of mentioning differences between the two student groups in terms of how they used their smart devices. The main similarity between the two groups was their preference for collecting their interest in a multimedia format rather than taking notes. On the other hand, the main contrast appeared in the way that they shared their experience and this was affected by the nature of the field environment. In the Marine ecology field trip, the participants had the chance to access the internet in the field and therefore they shared their experience via email and social networks. Whereas, the Botany biodiversity students could not share their data or use the internet services in the field, so they chose to connect face-to-face due to poor internet connection. The limitation that the lack of internet access causes in the geography field has also been addressed by Welsh et al (2012). He introduced the use of three smartphone applications for geo tagging photographs to encourage post-field trip reflection on a landscape. One of the limitations they reported was the impact of poor internet signals. They argue that the geo tagging photographs method would be most successful by using smartphones when be applied to urban and semi-rural areas and less successful in valleys and rural areas.

A lesson to learn from this study was that several difficulties faced the participants during their mobile usage in the field trip. The study identified three main causes that could affect negatively usage of mobile devices in capturing and sharing experience in the field trips. These are:

- Time pressures

A high percentage of the participants in the study mentioned that, since there is a time limit to visit the field, they have to try to quickly capture as much of the experience as they can. Thus, they focused on photos because that helps them to remember the details more clearly than taking notes, which is also time consuming sometimes from many participants point of view. This observation is consistent with the result of Lo (2013) stated that "In terms of the data collection tools (i.e., photo, audio, and video), the survey displays students' preference in using photos and videos. Students' reasons include the easiness (or quickness) to use photo, and the details that photo can display" (p.299).

On the other hand, students in this study, based on the study approach, were free how to use their mobile phones when and where they wanted, without any instructions or restrictions by the author, where most studies, usually are use a specific mobile platform or App, in order to examine for example students learning potential, or even their interact or behave by using mobile technology for their learning processes.

From my point of view, I believe that such way of research able to gives a low-reliability results, because according of this study results, most of the students showed that they use their mobile not all of the time, but in certain situations, otherwise this could cause to the time consuming for them, they use only when they need and possible to use, or they used different tools such as a digital cameras or paper-based tools, unless the current mobile devices are modified to become more suitable for students to use, such as in the field trips, which is one of the goals and contributions of the study, by build system design guidelines, that can be used as a basis for developing and designing new technologies for use in field trips.

- Spatial Isolation

Many of the participants in both groups commented that they experienced spatial isolation when using their mobile devices in the field. They found that they lagged behind the group or found it difficult to continue and follow up on their group and tutor in what they do and discuss, especially when they typed their notes, which need focus to type on a small mobile screen which is not much visible under the sunshine, which is naturally a prevailing situation in the field trips which take place outside (this will more discuss in the next case). However, the feeling of isolation was less when they used the device to capture pictures.

This problem has been detected in other field education contexts. Ruchter et al (2010) examined the impact of a mobile guide system compared with the use of traditional tools on different parameters of literacy in environmental education. The study identified that the children who used the mobile device guide system experienced alienation from nature. The study designed an alienation sum scale to investigate the effect of this experience on children's learning. The alienation nature sum scale has been identified as "a sum scale of items relating to prior knowledge on common plants, animals and an understanding for plants as a food source as well as the self-reported frequency of direct experience of nature" (Ruchter et al, 2010, p. 1058).

The results indicated that the children with a lower degree of alienation from nature achieved higher environmental knowledge scores. Tal and Gross (2013) studied the use of smartphones for experiential learning outdoors and also found that using these devices distracted the students from their experience in the field. This was due to the need for the students to be busy with their phones, focusing on how to use the instruments, which distracted them from the field experience.

- Difficulty of use in the context

The mobile device's difficulty in the context was due to the nature of the surrounding geographic environment and weather. For example, many participants mentioned in the interview that difficult to hold mobile phones with wet hands. Also, they were worried that this device could drop in the water during the Marin biology field trip or even drop down while climbing some rocks in the Botany Biodiversity field trip group. As well as the nature of the outside environment, such as the weather, played a significant role for many students in choosing which tools to use, mobile devices or paper base tools. For example, when the weather was windy, some students faced problems using paper-based tools. Therefore, they have no other choice but to use mobile devices. On other hand the type of learning experience also determines which tool to use where most of students use mobile devices than paper-based too to collect multimedia such as photos and videos from the field.

However, it was observed that students were restricted from using Mobile devices to collect their learning experience in the field during sunny weather for both groups of students because the mobile screen was not much visible during sunny, partially for typing text and notes. Therefore, many students had to switch between paper- based tools and mobile devices on these field trip days.

This part of study presented two case studies with undergraduate biology students to develop an overall understanding of using mobile devices for capturing and sharing experiences in biology field trips. This led to identifying three main reasons that cause negative effects of using the mobile device in capturing and sharing learning experiences (LX) in field trips. These were that the students sometimes have difficulty using these devices in the field trips in different contexts to support their activities in the field.

The second cause is the limited time in the field, so the students were looking for a faster method to collect their experiences. In addition, the third cause is that the students suffered from spatial isolation when using mobile devices, especially when taking notes. Finally, the type of learning experience most students collect from the field at least once through their field trip days was mostly the multimedia such as photos.

The general content and contributions of this research lead us to a very important concept called Technological Pedagogical Content Knowledge (TPACK). During the last decade, TPACK has received great attention from the research community (Angeli, 2014).

Where the TPACK framework based on that the effective incorporation of technology into the teaching of a specific content or subject matter requires understanding and addressing the relationships between these three components: technology (Mobile technology), pedagogy (Biology), and content (Field trip). A teacher who is able to deal with these relationships represents a different form of experience. In general, the Technological Knowledge (TK) defined how teachers demonstrate professional knowledge of technology. While the technological component of TPACK in Technology is most beneficial to learning when it brings a change in professional teaching practice (Papert, 1996, Polin, 2015) and in learning designs. For teachers, TK is also knowledge of the skills needed to use technology to effectively plan instructions, and not only concerned with knowledge about technology (Mishra, 2008, Bell, 2013) including science teachers (Maeng, 2013, Karadeniz, 2013, Calik, 2014, Canbazoglu, 2016, , FAUZIAH, 2019).

Therefore, the contributions of this research is not only for designers and researchers, but also for teachers. TPACK considers what teachers required to incorporate technology tools and resources into course content and teaching practice. The TPACK framework believes on that the effective incorporation of technology into the teaching of a specific content or subject matter requires understanding and addressing the

relationships between these three components: technology, pedagogy, and content. A teacher who is able to deal with these relationships represents a unique form of experience.

5. Limitations of the Research Undertaken

There are a number of limitations to the research undertaken in this thesis. Firstly, gaining access to the field trips which the universities organize was difficult. This was because of the limited number of field trips made during the semester, where most of the field trips take place mostly in the summer semester. Moreover, the small number of participants in each field trip limited the possibility of having a large set of participants to be studied in this research, but on the other hand, this research was a six-days planned field trips students observed for each case study, and this increased the reliability of this research results, wherein the most of other previous studies, were for only one day or two participants observation, which don't give an exact result because students switch in using for their mobile phones depends on many factors like the workplace in the field, weather, reason of use, type of information to collect, or even sometimes their mood.

In addition, the increasing number of available mobile applications affects the choice of which applications would be suitable for note-taking activities in the field. Large numbers of professional applications have been designed and produced after this research, such as speech-to-text apps, which become more common and more professional to use; this mobile application, for example, makes it simple and easy to convert speech into text for mobile devices. Consequently, choosing well- designed applications would lead to better reflection on the usage of these devices.

Finally, this work offers some guidance on the tools that are generally needed to develop and meet students' requirements. It is recognized that, as technology is rapidly developing, new devices will offer a

greater variety of tools and may include many of those recommended from this research. However, the increase in choice of tools available may only add to the complexity of smart devices and increase student confusion regarding how best to use their device to capture and share information in field study settings. Thus, there will be a greater need to provide guidance and training on how to make the best use of this technology.

5.4 Recommendations and future research

Future studies can be conducted to determine the best practice to follow in assessing mobile technology in educational field trips can facilitate capturing and sharing of the field experience, since this research did not concern itself with best practice. That would include for example:

Working with larger samples of participants can bring additional validity to the current work by applying different research approaches. This could include quantitative approaches for example to measure the students' performance in the field by using mobile devices.

Moreover, it also recommended focusing on the effect of using these devices on an assessed work that students should submit following the field trip in order to study measurable impacts of these devices on the students' learning ability in the field. In addition, future research can encourage teachers to train themselves and their students on how to use these devices in the field and to design activities that help the students to learn how to use the devices as well as encourage the students to use these devices in the field.

The last interactive activity from the user-centered design approach which is the "evaluation," has been skipped due to COVID-19 Anyway, each interactive activity from the user-centered design approach has it its outputs, which are represented by this research results (more details in section 3.3.2/ Table1).

In his seminal work, The Reflective Practitioner, Schon (1983) reminds us reflection is a "certain kind of work" that must be initiated when there is a problem to be solved (p. 40). The events of 2020 certainly called teacher educators' attention to many problems that required creative and innovative solutions. As we continue to engage in deep understanding and reflective inquiry into the problems we encountered, we must continue to investigate how we can use the information we have gleaned from this year to make decisions about future instruction and research (Ferdig, 2021).

5.4 Conclusion

The research presented in this thesis was focused on three key themes: understanding the context of use (i.e. the nature of field trips and the benefit on student's education), traditional methods for capturing information in field trips (i.e. student note-taking), and the impact of mobile technologies to support this process.

The research addressed several themes through stages of the interaction design life cycle. In the early stages, the work aimed to obtain a comprehensive understanding of the role of mobile technology in supporting note-taking activities in the field.

This study identified a number of similarities and differences between two case studies related to the kind of activities that are conducted in the field, the type of data collected, and student behavior in sharing their learning experiences during and after the field trip event. The outcomes of these two different case studies led to exploration of the use of mobile technology for capture and sharing of information collected during undergraduate biology field trips. In addition, the study outcomes also integrated a guidance system for mobile system requirements elicitation, which covers the user needs in the field. Also, this research investigated the kind of support that mobile technology can usefully provide during fieldwork.

Unlike previous research discussed in the literature review which had examined the use of bespoke applications and technologies designed for specific field study contexts, this PhD study examined the use and usefulness of smart mobile devices. The intention was to determine how easy it is for students to use digital technology that they already own to capture and share information in the field study context. These findings are similar to the results of Ruchter and colleagues (2010) and Schaal (2012), who used mobile devices for environmental education at a flood plain site and compared it to traditional instruments (brochures, personal guides). They also reported positive effects of mobile learning on environmental knowledge and motivation, especially for adult users.

Nevertheless, the study identified three main reasons that may produce a negative experience of using the mobile device in a field study context: students have a limited time in the field, so the students were looking for a faster method to collect their experiences; some students experienced spatial isolation when they used the mobile devices especially when they were taking notes; mobile device's difficulty use in the context due to the nature of the surrounding geographic environment and weather.

This PhD work has demonstrated that mobile devices, such as the smartphone and tablet can enhance the activities of capturing and sharing learning experience during biology field trips. This work highlights the importance of studying the usability of embedded new portable or wearable technologies which the students would use within the context of use (i.e in the field). For example, introducing new mobile applications, reconfiguring phones and tablets, or wearable computerized devices such as smart glasses and watches.

In this study, the author observed students' behaviors and asked for their perspectives on data collection and sharing their learning experience during biology field trips, starting with observing general tools the students use in their field trips and then specifying a Mobile devices tool.

The finding is not just limited to the specific mobile system that we discuss here for designers but can be applied to different educational sectors, such as in teacher training policy, to be more aware of how the students use mobile devices in the field so they can better plan for the biology field trip with realistic and more effective learning goals. Also, for researchers for more future research, but without giving students a ready or a specific application to use, or at least by taking into account students' needs, which is different depending on the situation. Because students could be unfamiliar with or just not comfortable using a certain application, this doesn't mean they are uncomfortable using Mobile phones in general or other applications. From the author point of view, this will not reflect students' actual use of mobile phones. Therefore, this could affect the reliability of the results.

These findings also could influence the education sector to consider using smart mobile devices as field equipment and find ways to encourage students to use them to achieve the best use in the field to support their learning activities during field trips. Where, one major problem that has delayed the penetration of smartphones as a teaching aid is the lack of appropriate training for teachers in how to use these new devices and applications in education (Medzini et al., 2015, p.21).

The overall conclusion is that the generation of mobile devices studied in this research, such as smartphones and tablets, can also create easier access to data capture and data sharing learning experiences in undergraduate field trips. The results show a good level of acceptance for mobile learning and indicate a positive attitude towards the behavioral

intention to use mobile learning. Students showed great interest in using mobile devices in the biology field experience as a learning tool, especially in capturing multimedia data such as photos and videos.

However, the limitations of using mobile devices in the field, such as small screen size or structure, or limited input capability, require special attention to be paid to usability aspects already during the application design phase.

The Mobile Technologies for learning in the biology field trip, outside the classroom, described in this study have demonstrated that activities of this sort are highly feasible and that the technology is sufficiently mature to upgrade learning in the field. The activities were interesting and varied and used mobile technologies in a meaningful way. Smartphones seen as an educational tool that made a major contribution to the educational biology field trip.