Identifying the Potential of Mobile Phone Cameras in Science Teaching and Learning: A Case Study Undertaken in Sri Lanka

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ABSTRACT

This research was motivated by previous work using mobile phones to support science teaching and learning in a variety of ways. This paper explores in detail how mobile phone cameras can support science teaching and learning during the planning, implementing, and evaluation stages of a lesson. A case study of a science lesson carried out in a school in Sri Lanka is described. The methodological approach of this study is qualitative and data were collected using observations, informal interviews and field notes. The results show that mobile phone cameras support the teacher in a range of ways during lesson planning, lesson implementation, and evaluating learning. Furthermore, the camera function of mobile phones was reported by teachers and students as enhancing the effectiveness of student learning, providing more opportunities for students’ active participation, increasing interactions and collaborative learning opportunities.

Keywords: Cameras, Collaborative Learning, Mobile Phones, Science Learning, Science Teaching

INTRODUCTION

Studies have been carried out worldwide to investigate the use of mobile phones for a range of different teaching and learning processes. It is now recognised that the mobile phone can add new dimensions to the teaching and learning process because it possesses a wide range of attributes such as its spontaneous, personal, informal, contextual, portable, ubiquitous and pervasive nature and its functions that include talk, text, still camera, video, radio, and internet (Kukulska-Hulme, 2005).

One of the most important features in the mobile learning environment (Parsons et al., 2007) is mobility itself which creates exciting opportunities for new forms of learning to emerge, these can change the nature of the physical relationship between teacher, learner and the object of learning (Laurillard, 2007). Mobility demolishes the need to tie particular learning activities to particular places or particular times (Traxler, 2010). The freedom of mobility offers opportunities for the learner to

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learn autonomously (MacCallum & Kinshuk, 2006). It also provides opportunities to obtain learning experiences outside the teacher-managed context (Naismith et al., 2004) by expanding learning beyond the four walls of the classroom, thus allowing interactions in the real world and bringing new interactions back into the classroom (van’t Hooft & Swan, 2007). In an increasingly fast-paced world where the ability to communicate electronically is increasing, the portability of mobile devices facilitates learning, irrespective of the time of day and the location of the learner (Cooney et al., 2007). Scanlon et al. (2005) note that the mobility and portability of the mobile phone have the potential for making positive changes for accessing information and enhancing interaction in science learning. In terms of the functions of mobile phones, Marriott (2005) considers present-day mobile phones to be complete multimedia centres that combine the capabilities of the still camera, video camera, personal organiser, and a web browser into one single device. These functions could further add a new dimension to science teaching and learning which contains content and scientific processes that are currently viewed as difficult to teach (Taber, 2005; Wellington, 2004; Barton, 2004) by enhancing communication and interactions between teacher and students and amongst students, and enabling collaboration in practical activities or field work. Students are known to be interested in the use of mobile phones for learning as they could assist with communication, create more collaboration and enable creativity (Botha et al., 2009). However, the success of adopting mobile phones in a lesson depends on the teacher’s preparedness to adopt the mobile technologies (Kukulska-Hulme et al., 2009). In this article we are focusing on the potential of using the mobile phone camera in science teaching and learning in school settings.

Theoretical Context

Webb and Cox (2004) claim that Shulman’s (1987) model provides a useful description of the processes that teachers engage in when they are planning, teaching and evaluating their technology enhanced lessons. Shulman (1987) notes that, in general, teaching is initiated by some form of ‘text’; a textbook, a syllabus, or an actual piece of material that the teacher or students wish to understand. Then the teacher adds variety and nuances (examples, simulations, dialogues, demonstrations) into what is to be taught to students so as to develop and expand the subject content and a range of other attributes a student should possess for learning (Shulman, 1987). The process of changing the ‘text’ to the outcome (new comprehension by both the teacher and the student) goes through six processes, namely: comprehension, transformation, instruction, evaluation, reflection and new comprehensions. These processes impose a challenge to the teacher whereby his or her pedagogical reasoning and actions are tested throughout the planning, implementation and evaluation cycle and become vital.

Understanding of student learning is an important aspect of the pedagogy of teaching. There are a number of studies reported in the recent research literature suggesting theories underpinning mobile learning. For example, Naismith et al. (2004) categorise the learning activities associated with mobile technologies around seven main learning theories or areas of behaviourist, constructivist, situated, collaborative, informal and lifelong learning and learning and teaching support in their “Literature Review in Mobile Technologies and Learning” written for Futurelab, UK. Of these Wishart (2007) considers that the constructivist approach to learning is the theoretical approach most relevant to mobile learning. In addition, Sharples (2003) claims that mobile learning devices also assist conversational learning by offering opportunities for the construction of conversations with oneself, between learners, between teacher and learner, and with the world.

Examples of Previous Research Using Mobile Phone Cameras with School Children

Recent research literature provides evidence on the use of mobile phone and Personal Digital
Assistant (PDA) cameras in school science lessons. For example, Hartnell-Young and Heym (2008) noted the value of using the mobile phone’s camera to ensure the validity of a scientific experiment during a secondary level science lesson in the UK. In this study, students used mobile phone cameras as a collaborative activity to capture evidence during experiments into plant growth. The images that were taken during their experiments helped students to accurately record physical observations. Further, the authors mentioned that both teachers and students valued the chance to review the images as the students were able to look at the gradual biological change over a period of time. Earlier, Chen et al. (2004) reported on a study on the use of PDA cameras for nature learning where different kinds of butterflies in Taiwan were identified using a butterfly-watching system (a database of different butterfly species in the region with content-based image retrieval and an online nature journal). The students visited the butterfly farm where the networking system was set up, used their PDAs to take photographs of the butterflies they observed and then to query the database which would return possible matches for the species. The students decided which match was the best and the database would verify their selection based on image content similarity. The students then made the final decision, which was recorded using their PDA together with their notes of the entire experience.

Mobile phone cameras have also been trialled successfully in other subject areas. Sharples et al. (2007) report a study termed My-ArtSpace, which addressed the importance of connection between preparation prior to a school museum visit, the visit itself and follow-up in the classroom. The day prior to the museum visit, the teacher introduced the lesson and gave out worksheets that students would follow in the museum. During the museum visit, students were loaned a mobile phone, which could access a web-based client. The students, in pairs, used this to take images and send them to the My-ArtSpace website. Later, back in the classroom, they prepared PowerPoint presentations using the images and created online galleries on the MyArtSpace website. According to the findings of this study, this activity met teachers’ and students’ expectations, supported curriculum topics in literacy and media studies, enhanced student engagement and bridged the gap between the museum and the classroom learning.

Hartnell-Young (2007) reports a study that used mobile phones with Short Message Service (SMS), still camera and Global Positioning System (GPS) functions for communication between pupils in the classroom and a group of pupils following a teacher designed hill trail activity. In this study, the pupils also used a combination of mobile phone and web based technology. The team on the hill trail, who had a GPS receiver with their phone, took pictures of the terrain and sent them to the website set up for this activity. The home team at school monitored the arrival of the new images on the website and checked whether the hilly terrain team was on track by comparing the map on the screen with the location of the picture. The researchers reported that the conversation between the two groups of students, facilitated by the images sent by the students in the hill trail, supported learning through bridging the gap between the outside world and the classroom.

Even though the research studies described here discuss the potential of mobile phone cameras in science teaching and learning, they only consider the lesson implementation stage identified by Shulman (1987). However, it is worthwhile to explore how the camera function supports the teacher during the planning, implementing and evaluation stages of a lesson. Therefore, in this research, we focused on how mobile phone cameras support science teaching and learning during these three stages of a lesson. The research itself was carried out in Sri Lanka.

This paper is structured as follows: first, we examine the existing situation in Sri Lanka in terms of using mobile phones in Sri Lankan schools. Then an overview of the methods used for data collection and analysis is provided. Thirdly, findings are outlined and discussed in relation to the literature. Finally, conclusions are

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drawn, limitations of the study are highlighted and future work in this area is suggested.

**Background to the Study**

Even though it was found from the literature survey that the use of mobile phone cameras could enhance science teaching and learning, mobile phones are normally not permitted in schools. This is recognized as one of the main barriers to the widespread use of mobile phones in science teaching and learning. Thus, before carrying out this study, the authors analyzed the possible barriers to the implementation of mobile phone based lessons in Sri Lanka guided by the steps given in Hartnell-Young and Heym (2008) on ‘how schools can introduce mobile phones for learning’. The teachers’, principals’ and educationalists’ fears of the possible risk of class disruption by permitting students to bring their mobile phones to the classroom (recently mobile phones have been banned in Sri Lankan schools) was overcome by organizing a loaned set of mobile phones to be considered as belonging to the school. For this study, the mobile phones were loaned by a national mobile phone company. Sri Lankan teachers’ and students’ competence in using mobile phone cameras was first investigated. A survey of 152 teachers from the Central Province of Sri Lanka, selected using a stratified sample to represent the range of schools there, revealed that the mobile phone camera function is hardly used for classroom teaching and learning. In contrast, Power and Thomas (2006) reported that over 90% of primary school literacy and science teachers in South Africa’s Eastern Cape Province and in Cairo, Egypt had used mobile phone cameras to take photos and share them with others (pupils and others) as part of their professional practice.

As the teachers were not at all familiar with the use of mobile phones for teaching, hands-on training opportunities were provided. Then two professional workshops (planning for and reviewing mobile phone use in teaching respectively) and structured using an approach based on Shulman’s (1987) findings on different aspects of teachers’ pedagogy, were carried out. A group of 20 teachers was purposefully selected from their survey results for further interviews and workshop participation. The workshops were conducted partly to provide continuing professional development for teachers and partly as the first author’s PhD research to find out how teachers viewed the different attributes and functions of the mobile phone that could be used in Sri Lankan classrooms for science teaching and learning.

Data were collected using the aforementioned survey, interviews, and observations recorded during the professional development workshops and are used to discuss teachers’ attitudes to and perceptions about their competencies of using mobile phones for teaching and learning. Further data collected from observation of subsequent lessons in the classroom were examined to identify the potential and evidence for using mobile phone cameras in science teaching and learning in Sri Lanka. The study reported in this paper is based on a detailed analysis of planning, teaching and evaluation that occurred during one of these lessons, one that focused on student use of mobile phone cameras. Prior to the participation of teachers and students in this study the researchers obtained permission officially from the Director of Education office (Central Province, Sri Lanka). Similarly, before participating in interviews and lesson observations consent forms were signed by all the relevant parties.

It was quickly identified that teachers recognized the potential of mobile phone camera for teaching and learning. For example, 143 out of the 152 teachers originally surveyed agreed with the statement ‘I believe images/photos facilitate science teaching and learning as they can bring information from the outside world to the classroom’. Further the teachers’ competence in using mobile cameras, obtained from the survey and shown in Figure 1, indicated that, whilst teachers were unfamiliar with the use of the mobile phone for teaching activities, introducing the use of mobile phone camera to classroom teaching would be feasible.
From the survey, it was found that the teachers recognised the potential of using a camera in teaching and learning. However, only 9% of teachers had used a digital camera in their science teaching and learning. This may be due to the lack of availability of digital cameras in schools as the survey results showed that the availability of cameras in schools was only 3.9%. However, the high penetration of mobile phones in Sri Lanka (Figure 2) and high use by youngsters (first author’s observation) suggest that students are well acquainted with mobile phone use. The teacher’s ability to use the camera function of the mobile phone, students’ ability to use mobile phones, and the availability of cheap phones suggested that it was worth exploring the use of the mobile phone camera for teaching and learning science in Sri Lanka.

**METHODOLOGY**

The methodological approach of this study is purely qualitative and carried out as a case study, which is used to investigate in detail the possible use of mobile phone cameras for science teaching and learning, in a sample science lesson. The lesson was designed during the professional development workshop described earlier and implemented in a Sri Lankan school. Eighteen teachers from different schools (of the Central Province) with varying levels of experience participated in the workshop. Of the 18 teachers, four directly contributed to this particular lesson development while the others provided critical input to refine the lesson. More details on the workshop (planning and reviewing) can be found in Yatigammana Ekanayake (2009). One week after the planning workshop, the lesson was implemented with forty students in a girls’ school. Prior to the lesson, all the students in the class were informed about the proposed research and their consent for video recording the lesson was obtained.

Even though the mobile phone is recognized as a ubiquitous device, which can support autonomous learning, a group activity had to be selected for this study mainly due to insufficient numbers of loaned mobile phones. However, this provided opportunities for collaboration over the range of new learning activities offered by the use of the mobile phone cameras. This paper reports the observations made during the design and implementation stages of the lesson, the views of students selected at opportunity after the lesson and the teacher’s views, which were collected during the second post-lesson professional development workshop.

The topic of the selected lesson was ‘Investigating the mutual relationships between organisms and the environment - analysing the environment biologically’ taken from the grade 11 science curriculum in Sri Lanka. The time duration of the lesson was 80 minutes.
Figure 2. Mobile phone use as a percentage of 2008 estimated population Sources: Squares (Samarajiva, 2008), Diamonds (Telecoms, 2009)

The lesson was implemented according to the following structure planned during the initial workshop:

- **Engagement:** First, the teacher asked two simple questions to test students’ prior knowledge. Then a Photostory, which described the organisation levels of an ecosystem, was shown. This was to link the lesson with what the students had already learnt in the previous grades. After that, the teacher gave a briefing on the concepts of individual, population, community and ecosystem using the example pictures from the Photostory.

- **Lesson development:** There were four groups of students. Different roles, such as group leader, assistant leader, developer, assistant developers, writers and assistant writers were assigned to each member of the group. Each group was provided with two mobile phones and was assigned a specific location in the school garden. A file containing a worksheet and instructions was given to the group leaders. The teacher gave a briefing on the activity and reminded the groups of the responsibilities and role of each player and asked that the worksheet be completed during the allocated time period. Further, students were asked to capture five pictures to support their activity using the mobile phone camera. As groups, the students visited the four assigned places and were actively engaged in taking images and completing the worksheet while referring the pictures they captured (Figure 3).

After the allocated time students came back to the classroom and each group sent the 5 images taken from their assigned places to the teacher’s computer using Bluetooth. Then each group presented their findings based on the worksheet while displaying to the class the pictures that they sent to the teacher’s computer. After each presentation, the teacher gave a briefing reiterating the main points.

- **Evaluation:** Based on their completed worksheets and presentations the teacher assessed the students’ learning in their groups.

**Data Collection**

The data for the above case study was collected using observations, interviews and field notes. Observation was the main data collection method, which was used to gather students’ and teacher’s voices and activities as both video and audio data. Further, field notes were taken while acting as participant observer.
interviews were conducted with five students selected at random to probe more deeply about the lesson.

**Data Analysis**

The collected data was analysed using thematic analysis techniques with the support of NVivo8 qualitative data analysis software. First, field notes were transcribed and uploaded. Then the video and audio files were also uploaded, transcribed, and translated. After reading the transcribed field notes, viewing video files and listening to audio files a set of codes were derived and ‘free nodes’ were developed to represent these codes. The free nodes were planning, implementation, evaluation, participation, interactions, and achievement of goals. Next, using these ‘free nodes’, the transcribed files were sliced into meaningful segments. All the text segments in each free node were read again and the salient and common themes were identified. The two most salient themes were, ‘mobile phone camera supported the teaching’ and ‘mobile phone camera supported student learning’.

**FINDINGS AND DISCUSSION**

The use of mobile phone cameras for the selected lesson supported both teaching and learning processes. From the two themes identified, the support of mobile phones for teaching will be discussed first and then the support for learning will be discussed.

**The Mobile Phone Camera Supported Teaching**

According to Shulman (1987) what the teacher does in the teaching process is to add different flavors to some form of text to develop students’ knowledge, skill and attitudes. In this particular study, in a variation on the flavours described by Shulman (1987), the teacher used mobile phones during each of the three lesson stages.

**Planning Stage of the Lesson**

Good planning is essential for the success of a lesson (Parkinson, 2004). During the post-lesson Reviewing Workshop the teacher reported...
using the mobile phone camera for two purposes during the planning stage of this lesson. One was to create a Photostory including images that represented the organisation levels of an ecosystem. He captured some images from the school garden and uploaded them to his computer to create the Photostory. In this instance the teacher used the mobile phone camera to represent the relevant scientific concept in an alternative way so as to make the desired representation for the students (Shulman, 1987).

The second purpose was using these images to create PowerPoint slides in order to assign the four locations of the school garden for the planned outdoor activities previously discussed. Each slide included three pictures (Figure 4) that were taken from one location of the school garden using the teacher’s mobile phone camera. During the lesson implementation, the teacher asked the students to identify the location by viewing the slide and by asking questions. The use of these images clearly evoked an interest, even curiosity among the students.

These two observations revealed that the camera function of the mobile phone supported the teacher’s pedagogical actions during lesson planning.

**Lesson Implementation**

During the lesson implementation we noticed that mobile phone camera supported the teacher in attracting students’ attention towards the lesson which is crucial at the beginning of a lesson (Parkinson, 2005). The teacher did this by asking questions based on students’ prior knowledge and while relating to students’ familiar images included in the Photostory. The number of hands raised to answer the teacher’s questions reflected the students’ immediate engagement in the lesson.

After showing the Photostory and having a whole group discussion, the teacher integrated the mobile phone camera as a learning tool into the students’ learning activity. As a consequence of this student centered instructional approach, the teacher could enhance students’ active participation while providing them with opportunities to contribute to the lesson development. The teacher stated how his approach supported him to implement the lesson successfully as follows.

*Actually, I have been teaching this lesson for five years. I have used the overhead projector and the multimedia projector to show photograph*
examples of different locations (captured by me or downloaded from the internet) based on my viewpoints. Sometimes these images are not familiar to students and therefore they were not fully engaged in the lesson. However, in this lesson students brought the images of mutual relationships from what they had observed, understood and experienced from the school environment. Therefore, it was easy to construct the lesson inside the classroom with active student participation.

Further, the teaching approach that was based on small group activities helped to make learning meaningful and effective by enhancing opportunities for student-student interactions and by increasing students’ active participation. It is important to note that the teacher managed to plan the lesson this way due to the potential provided by the mobile phone camera.

**Evaluation**

Shulman (1987) proposed three aspects to the evaluation stage of teaching: checking for students’ understanding during interactive teaching, testing student understanding at the end of lessons and evaluating one’s own performance and adjusting for experience. Even though the teacher observed here did not use the mobile phone camera to check students’ learning directly during interactive teaching, during the post lesson Review Workshop he explained the support of the mobile phone camera as he evaluated students’ learning as follows:

**During this lesson, I evaluate students learning as groups based on completed worksheet and group presentation. In terms of the group presentations, I considered the images they captured and sent to my computer. In this process, I considered the fact that the relevance of images reflects the students understanding of the concepts.**

**Mobile Phone Camera Supported Student Learning**

In this lesson the teacher reported that students found more opportunities than usual in their science lessons to actively participate in their learning activity as the use of mobile phone cameras increased the range of group activities, the number of conversations amongst the group members, with the teacher and with technological devices, and the number of roles available to be assigned to students (for example during the learning activity two roles as photographer and assistant photographer were added to the group roles).

At the beginning of the learning activity, each group tried to clarify the tasks assigned to them by reading and discussing the worksheet given to the group leader. During this process, there were conversations with one another (Figure 5) including asking questions about the activities and about the images that they should take. The ones who had understood the activity gave better explanations. In these ways, the conversations supported everyone in understanding the task and starting the activity as a group.

Next, students tried to identify the relationships seen amongst living organisms and the environment in their assigned location to obtain the most relevant photographs and to gather information to complete the worksheet. This was done by examining the environment individually or in pairs as assigned by the respective group leader. Once a member found something, it was shown to other group members and discussed.

Whilst there were different roles assigned to group members in terms of their responsibilities regarding the mobile phone use, each member of the group supported (while fulfilling their own responsibilities) selecting the best possible observation (image or video) to capture using their group’s mobile phones. A student stated that
We did not gather in one place. We went all over the location to which we were assigned and tried to obtain information to complete the worksheet as well as to capture photographs of good examples to show the mutual relationships between organisms and the environment. My role was assistant writer. However as discussed earlier, I also tried to find the required information not only to complete the worksheet but also to find good examples. For example, I found a spider and its web on a leaf. I showed it to the developer and helped to capture that.

Student interactions relating to this, such as suggesting better options (e.g., showing good leaves, asking to zoom and changing the orientation) or through actions (removing other branches that covered the object required to be captured) were observed. The following excerpt provides evidence for these interactions.

Student 1: I found a spider web under this leaf
Student 2: Can you see a spider too?
Student 3: mm..difficult to see

Student 4: Let me see. Ah I got it. spider is more towards the edge of the leaf. Can you see now?
Student 2: Yes.. I’ll take a picture

Student 3: Can’t you zoom more? Because if we can get this picture with the spider, the web and the part of the leaf that would be ideal
Student 2: Yes I agree.. good idea

In addition, during the learning activities, there were conversations to share students’ technical skills and knowledge. The following dialogue shows how one student shared her experience:

Student 1: Please remember to save the picture
Student 2: Yes, I think I saved it
Student 1: Are you sure?
Student 3: Press back button. Then it will be automatically saved
After collecting the information they came to the classroom and completed the worksheets while referring to the pictures they had already taken (Figure 6). During this activity, the sharing of ideas as well as arguing on certain points and coming to an agreement were a common observation. While completing the worksheet, the developer and assistant developer selected the images to be sent to the teacher’s computer. They showed these images to the group to confirm whether the selected images supported their findings. Here, selecting the most relevant five images was seen as a collaborative process where there were conversations among group members. The selected images were sent to the teacher’s computer using Bluetooth. The mobile phone images appeared to be acting as a shared platform supporting opportunities for conversational learning as described by Sharples (2003).

After completing the writing task during the allocated time, the group leader and assistant group leader of each group presented their findings to the class. While they were presenting they displayed the pictures that were already sent to the teacher’s computer (which was connected to the multimedia projector) to the rest of the class to support their findings. During an informal interview after the lesson, one student said that she could easily understand other groups’ presentations as they displayed the images while they were presenting their findings. After each presentation, the teacher briefed the students on the important points of the lesson while referring to the images in the presentation. Thus this learning environment provided an effective and meaningful learning experience by expanding learning beyond the four walls of the classroom, enabling interactions in the real world and bringing these new interactions back into the classroom as proposed by van’t Hooft and Swan (2007).

It was found that the mobile phone camera enhanced the effectiveness of students’ learning in four further ways: promoting their observational skills, creating opportunities for conversational learning, revision and enabling authentic learning activities. Considering the development of students’ observational skills, the students reported that using the mobile phones had widened the opportunities to develop these key science skills (Hartnell-Young & Heym,
One student said that they had to use “a different eye” (the researchers understood this as meaning she has to be watchful and carefully examine) to observe the environment in the process of capturing images of relationships between the organisms and the environment. She also said that this led her “to see unknown, interesting and amazing things” that are found in the environment. When the teacher probed the student asking, “what unknown and amazing things you saw”, she explained as follows:

There was a pond in our assigned location. We were carefully trying to see what was happening there and captured a number of photographs. We saw there were tadpoles. They were eating a plant. While we were trying to get a good image, I saw ‘kaneiyan’ (type of a fish) have built their habitat by drilling a hole into a plant. It was amazing. I showed it to the others.

Another student who participated in the lesson said that their teacher’s effort to use mobile phones to capture the outside world as saved pictures in the mobile phone was timely because they could use a new technology in science learning. This is similar to the findings of a study reported by Sharples et al. (2007) where the students captured images using mobile phone cameras during a museum visit and send them to a server for later use in the classroom.

Further, she mentioned that if mobile phones are not used, they have to imagine the things when the teacher was describing them. In addition to this, another student who participated in the same lesson mentioned that due to the use of the mobile phone camera to capture the relevant images (of relationships between the organism and environment) they could see the school garden from a different viewpoint.

The teacher who conducted the lesson reported that the teacher-student and student–student conversations had increased as a consequence of the images taken by the mobile phone cameras. For example when students were engaging in learning activities, the student-student conversations increased as they were trying to select the best picture for their learning activity. During the Review Workshop, the teacher reported his views on the students’ collaboration as follows:

…and after coming to the classroom I mean when the students were completing the worksheet, they all worked together. Before completing each section of the worksheet, they shared their ideas and decided what to write. Then the writer wrote them on the worksheet. Further, two students were busy with selecting photographs to be sent to the teacher’s computer. Before sending them, they obtained the opinions of other members to select the best photographs.

Two types of student-teacher conversations were observed when the students used the mobile phone cameras during their learning activity. One example was when sending the information (that students had) to the teacher’s computer prior to their presentation. The other common conversation was when getting the teacher’s help to solve the problems that the students had encountered when they were using mobile phones in learning activities. For example, two students contacted the teacher due to the problem of insufficient memory on their phone. However, this did not affect the learning activity, as the teacher was quick to delete some previously saved video files (which were not related to this activity). Thus, the images taken from the mobile phone camera again created a shared platform or ‘conversation learning space’ as postulated by O’Malley et al. (2005) around which learning conversations were taking place among students in a group, between them and the mobile devices, between groups and between teacher and students. Sharples (2003) adds that a mobile learning device can assist conversational learning by integrating learning descriptions across different locations and by holding the results of learning actions for later retrieval and reflection. The students also noted this with one reporting that as they had used mobile phone cameras during their lesson they could easily help absentees to understand the lesson they had missed as the observations had been captured. One student noted:
The captured images and filled worksheet would be good learning resources for absentees. They could look at them and ask questions from fellow students who could easily explain these to them.

During one presentation, a student expressed her view on the use of mobile phone camera as:

Today our science lesson was different. We used the mobile phone camera to capture images of the mutual relationships between organisms and the environment and brought the samples from the school garden into the classroom. This was a different experience. We could see the relationships in the real world. We studied them; we discussed about them and captured the relevant images. After that we completed the worksheet, discussed, and shared our ideas while referring to the pictures and finally we presented our findings to the other groups.

Students had various ideas in favour of the teaching approach, especially on the use of the mobile phone camera. For example, one student stated that

The field activity and the capturing of photographs using the mobile phone camera were very useful. This is different to what we learn from books. We could go to different places, look at examples of different relationships between the organisms and the environment, and capture them using the mobile phone camera. This was a different experience in contrast to the other lessons where we had to imagine certain things that the teacher showed/explained and what is given in a book. The possibility offered by the captured images to examine them in the classroom helped us to learn the relationships more effectively.

**CONCLUSION**

The findings of this case study suggest that the camera function of mobile phones offers a range of possible benefits for science teaching and learning in schools where opportunities arise for students to visit nearby locations. The use of the mobile phone camera helped the teacher’s pedagogical practices relating to lesson planning, implementation and in assessing the students learning. However, it was found that teacher needs to adopt additional pedagogical practices to successfully implement the lesson such as selecting locations for the outside activities that are ‘fit to be taught’ and to familiarize themselves with common issues such as keeping the phones charged and deleting unwanted images to free up memory.

The use of the mobile phone camera not only provided a rationale for students to go into the field and capture the relevant images but was also reported as encouraging student participation, collaboration and understanding of concepts. In the observed lesson there was evidence for increased conversations among students apparently due to the shared platform provided by the images taken from the mobile phone camera thus supporting Sharples (2003) theory as to the importance of conversational learning theory in understanding mobile learning. The images not only added new flavours to the learning activity but also provided additional opportunities for student participation. Indeed the teacher reported students actively participated in this lesson when compared to the previous year where a different teaching approach was used. Both the teacher and students welcomed this approach and many students expressed positive comments on this learning activity.

Despite the fact that Sri Lankan students and teachers are not using mobile phones in an educational context, the data presented here shows a positive perception on their usefulness and underlines their value as an educational tool to support the educational process. The high penetration of mobile phones, teachers’ ability to use their different functions and their cost effectiveness when compared to a still camera, emphasize the fact that the mobile phone camera can be a good choice to be considered
in the teaching and learning of science in Sri Lankan schools.

Our findings derive from the use of mobile phone cameras in one science lesson that was carried out in one Sri Lankan school. Clearly, they are limited in their further generalisation due to the investigation of just one lesson in one school. We suggest that further studies in this area be undertaken. Further research could broaden our understanding of mobile learning opportunities and add to the number and type of effective mobile phone based lesson examples from a range of schools. It would also be valuable to investigate the effectiveness of the use of the mobile phone cameras in this science lesson by comparing this lesson with same lesson conducted using a more traditional approach.

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