Abstract

This research was examining how learning about a specific geographical mechanism (i.e., chine formation) in a fieldtrip might be enhanced with the use of laptops and an interactive multimedia presentation. The research consisted of two parts: first, an observational study during a geography fieldtrip; and second, semi-structured interviews with senior students, who had participated in similar fieldtrips in the previous years. In the field, students were divided into two groups: computer group and control group. Students in each group worked in pairs. The computer group was equipped with laptop computers that showed an interactive multimedia presentation on chine formation during the actual fieldwork. The control group was working without computers. Both groups were observed and their social-behavioural interactions were recorded. This report summarizes the findings from the interviews and from the fieldtrip observations.

Literature Review

The objective of this project was to evaluate technology-enhanced learning in specific field settings. Previous literature pointed out that the increased use of technologies in many aspects of human life fundamentally affects our information processing mechanisms involved for example in learning, thinking or decision-making (Dascal & Dror, 2005). Cognitive technologies became integrated parts of our interactions with the environment not only as passive mechanical tools, but also as actively engaging (or sometimes disengaging) constituents. Technology-enhanced learning can mean far more than just a computer display, where ready-made lines of text lit up in a fixed sequence. In fact, those technologies that are purposely designed to accommodate the needs of the human cognitive system effectively utilize a whole set of other factors ranging from interface design to task-specific training (Dror, 2006). Only a holistic approach that takes
into account human cognition could grant success in terms of developing effective and useful technology-enhanced learning programmes.

As technology infiltrated into our everyday activities, portable devices (i.e., laptops, mobile phones, digital cameras, etc.) accompany us to even remote places, where previously we were let alone to learn and perform on our own. Such mobile technologies are more and more often applied to facilitate the effectiveness of learning outside the classrooms (Fitzpatrick, 1990; Gold et al., 1991). However, there is only little scientific knowledge about how exactly these modern technologies interact with our cognitive system.

Outdoor activities, on-site observations, practical classes and field excursions play an important role in teaching Geography, Earth and Environmental Sciences (GEES) (Munowenyu, 2002). The term fieldwork is implied for “any structured experience that takes students out of the classroom to a situation where what they study is also where they study” (King, 2003, p.47). According to Saveland and Pannell (1975) there have been only very small number of specific empirical investigations into fieldwork. Despite the lack of substantial scientific testing on this form of education, fieldwork is believed to involve a wide range of cognitive processes and skills from both the teachers and from the students (Gold et al., 1991). Therefore it is essential to put GEES fieldwork under thorough scientific investigation in order to understand the mechanisms of cognitive technologies that operate during this type of learning.

Multiple learning occurs when students are taken out to the field for their studying (Munowenyu, 2002). However, the main objective remains the same during fieldwork as in a classroom setting – that is to promote the understanding of geography to students. Donaldson and Swan (1979) noted that there are no fieldwork-specific objectives as such, only the educational objectives of the science in question (i.e., GEES). According to Munowenyu (2002), in order to assess the value of fieldwork – and any other kind of teaching for that matter – the learning performance should be measured as a form of behavioural flexibility and adaptable skills.

The three main objectives identified in terms of GEES fieldwork are: (1) cognitive - subject specific objectives (e.g., abstract knowledge); (2) transferable/enterprise skills (e.g., data collection skills in the field); and (3) affective - personal development (e.g., entailing the enjoyment of studying Geography) (Gold, 1991; Kent et al., 1997). Foskett (1997) argues that “outdoor education helps in the development of a learner’s intellectual (cognitive) skills, notably subject specific skills (for example, field sketching), wider generic skills (for example, data collection and recording) and intellectual skills (for example, problem-solving)” (p.189). The field is ideal place for achieving these objectives as the teacher has to actively adapt to the outdoor situation and demonstrate the mastery of the abstract knowledge (Objective 1&2). In addition, the uncommon environment provides more opportunities to build social bonds both in the student-teacher and in the student-student interactions (Objective 3).
In fact, a proposition put forward by Gagné and White (1978) suggests that fieldwork improves retention of information and skills through better associations with the socially based episodic memory. In other words, the students remember the material better if they are able to place the abstract knowledge in a social context. However, it is also noted that this form of learning is only effective when students are actively involved in the fieldtrip (Wittrock, 1974).

In an empirical study of geography knowledge acquisition and retention by MacKenzie and White (1982) three groups of students were investigated in fieldtrip situations. The three groups were (1) active excursion group, (2) passive excursion group and (3) a control group without excursion. The active (or ‘processing group’ in the authors’ terminology) excursion condition involved visual, verbal and episodic teaching elements such as photos, maps, small tasks, questionnaires, action-based and skill-specific exercises, etc. The passive (or traditional) excursion condition included presentations by a teacher at the same geographical sites as in the active condition, but the students were only passive observers. In the no excursion condition, students were only learning about coastal formation and other abstract geographical processes in a classroom situation. The three groups were tested little after learning and also 12 weeks later for their knowledge on the material with multiple choice and short answer questions. The results of MacKenzie and White supported Gagné and White’s (1978) theory that fieldwork improves learning and retention of information and skills. The best performance was obtained in the active group and the worst in the no excursion group. The study also showed that although fieldwork in general was leading to better scores, the multimodal presentation (i.e., visual, verbal, episodic) and active engagement (i.e., field exercises and small tasks) of the material facilitated remembering even more than passive observational learning. The results also established that students in the active learning condition were the least affected by forgetting as measured by the scores 12 weeks after the fieldtrip.

Often mentioned difficulty of GEES fieldwork is its complexity, as the learners can be easily overwhelmed by rapidly changing observations within a relative small time scale (Boud, Keough, & Walker, 1985). To overcome the extra cognitive load arising as a result of complex fieldwork situations, Warburton, Higgitt, and Watson (1997) suggested that technology-enhanced learning should be introduced. Other researchers also recommended the use of alternative visualization techniques (e.g., graphical and/or diagrammatic displays) as an efficient method to reduce cognitive load in intellectually complex tasks (Carlson, Chandler, & Sweller, 2003). However, they left no practical suggestions in terms of application of such displays in the field. The present research addresses this question by using laptop computers displaying multimedia learning material during a geography fieldwork excursion.

In fact, computer-based educational technologies have been applied for more than two decades in data analysis, class presentations, modelling, simulations, games and exploratory problem solving environments. Despite this relatively long history of application, very little is known scientifically how effective this type of learning is. However, most authors agree that the field of GEES is very well suited for teaching and learning with computers (Fitzpatrick, 1990; Gold et al., 1991).
A recent survey by Fletcher, France, Moore, and Robinson (2003) investigated how communications and information technology is integrated into the fieldwork education of undergraduate curriculum in GEES. The study differentiated three periods when the use of technology was assessed: pre-fieldwork, during fieldwork and post-fieldwork. The data revealed that prior and after the actual fieldwork desktop computers were applied by far the most (80%), whereas during the excursions laptops, digital cameras and mobile phones were dominating. Interestingly, palmtops or other handheld devices produced no returns at all, neither of the three periods. This latter finding is suggesting that small technological devices are less preferred as the size of their displays are not sufficient enough for visualizing the information in appropriate details.

In terms of the applied software, spreadsheets and PowerPoint presentations were used most dominantly throughout the fieldwork. However, while spreadsheets are popular after the excursion, presentations are seen mostly during the actual fieldwork. Fletcher et al. (2003) noted that although computer-based technologies are getting more and more popular in teaching GEES, the devices should more actively engage students in their learning experience. With the use of multimedia and certain web based applications the danger of passive teaching can be avoided. The latter, web technologies are especially able to integrate data collected in the field into their existing knowledge and data structures. Examples of this can be virtual recreation of outdoor environments, especially if those are of dangerous or distant to visit.

To summarize previous literature on the use of technology in teaching GEES during fieldwork the following points can be made:

- GEES fieldwork involves a wide range of cognitive technologies
- technological devices should be fitted to the human cognitive system
- multiple learning takes place (abstract knowledge / skills / personal levels)
- social aspect is important as learners consolidate episodic memory information
- students need to be actively engaged in learning
- applied technologies should involve multimedia visualizations and interactive presentations
Methodology

Fieldtrip Excursion

Thirteen\(^1\) first year undergraduate university students (8 male, 5 female) were taken to the Shepherd’s chine at the South coast of the Isle of Wight (Hampshire, UK) within the framework of their compulsory fieldtrip unit (see Figure 1).

![Image of fieldwork scenery around the Shepherd’s chine at the South coast of the Isle of Wight, Hampshire, UK.]

Figure 1. The fieldwork scenery around the Shepherd’s chine at the South coast of the Isle of Wight, Hampshire, UK.

First, as the students arrived, they were taken to a small orientation tour around the site by a senior member of the team. At this stage, they were not given any description about the geographical processes that they had to observe. After the tour, they arrived to the observational point, which was a relatively sheltered area, in the middle of the chine.

The leader of the fieldtrip introduced the task and split the students into two: a computer group and a control group. In addition, the students within the groups were divided into pairs, in which they had to work together. The computer group had three laptop computers to work with – one for each pair. These machines were placed into three white plastic boxes in order to reduce reflections from the sunshine (see Figure 2).

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\(^1\) This number only reflects those participants, who I was observing during the fieldtrip. (T.M.)
The laptops stayed in their places at all times, consequently, the computer group had to stay close to that point. However, there was no written or verbal instruction saying that they could not walk around to explore the chine.

The paper handouts – different for the two groups – that included all the questions were distributed at this point and the work begun. The control group worked approximately 10 metres away from the computer group. There was one observer for each group, who unintrusively made notes of the behaviour and social interactions within the student pairs.

Qualitative Interviews

As part of the project, senior GEES students, who had done a fieldtrip in their previous years, were recruited to take part in short, semi-structured, qualitative interview sessions. The rationale for such interviews was to understand the students’ own point of view on fieldtrips in general and also to ask their opinion on the possible use of technology in the field. A separate ethical approval was obtained from the Ethics Board of the School of Psychology, University of Southampton (Appendix I).

Given the exploratory and qualitative approach of this analysis, only two senior (Year 3) undergraduate geography students (1 male, 1 female) were interviewed. The interviews took place in a quite laboratory room at the School of Psychology, University of Southampton. Each session lasted not longer than 30 minutes and the interviews were recorded.

Ten questions formed the basis of the semi-structured interviews (Appendix II). However, in order to maintain a relaxed and natural environment some flexibility was allowed in the sequence of the interview.
Questionnaires
[Paula!]

Results

The observations during the fieldtrip and from the qualitative interviews are presented here as notes. A synthetic summary with the qualitative interviews is discussed in the conclusion section.

Fieldtrip Observations

Computer Group in the morning (started at 10.20 am)

- 6 participants, 3 pairs (Group 1; Group 2 & Group 3); 5 female, 1 male
- They looked at the computer screens on the ground immediately, without looking at the chines or around the site. In comparison, the other group seemed to look at the landscape first. As a result of the positioning of the computers, participants actually faced backwards to the chine.
- Group 1: looked very briefly around after Question 1, but focused more on the screen and their papers.
- All the groups seemed to be afraid to turn away from the computers and explore the site more thoroughly.
- Group 2 was very immersed into the computer presentation and didn’t look away from it at first.
- There was no communication within the pairs during the video presentation.
- Group 1 was less interested in the computer and looked more on their papers and the site. They chatted more as well than the other two groups. A comment by them was:
  - ‘Is it not playing?’ [however, they did not seem to be concerned about the presentation much]
- Group 2 focused on the screen intensively. One student (male) is designated to operate the computer. He seems experienced and confident with computers. He often explains and summarizes what the video/browser shows. They went back-and-forth in the video. Revised their answers with the corresponding sections.
- Group 3 was so immersed into the computer that they only looked up to see the chine after 20 minutes. However, after that they paid more attention to the site than the computer. It looked like they serially completed the task: first the computer, then the site observation.
- Group 1 & Group 2 interacted with the computer all the time. They made comments like:
  - ‘We could replay that bit, I guess’;
  - ‘Let’s see this again’; [Group 2 agreed to go back to the beginning to revise Question 1]
- Group 1, however, often seemed puzzled with operating the computer:
  - ‘Oh, no! What have I done now?’ [when clicked on the Start menu accidentally.]
- Group 1 equally seemed lost within the physical environment, as they once said:
  - ‘Hang on! Are there 2 chines?’
- The controlling student (male) in Group 2 suggested to look around at 10.40, when they were at Question 4.
- It was very cold & windy at the site. Computer group was seemingly attached to their positions, whereas students in the paper group wandered around. The other group finished much earlier than the computer group.

**Control Group in the afternoon (started at 1.45pm)**

- 7 participants, 3 pairs (Group A; Group B; & Group C); all 7 were males; Group C was made up of 3 participants
- All 3 groups spread around the site and didn’t stay in one place.
- Group C stands on an edge with view to the river. They’re actively discussing what they see around themselves. Discussions were accompanied with wide gestures. They were actively pointing to places. They were pretty slow with writing and spent less time to write down their observations.
- Group B was constantly referencing to drawn images on the handout. They were pointing to the papers’ images and than to the real world places & directions. A lot of conversation was going on.
- Group A was flipping back-and-forth through pages quickly. The members of the pair were working pretty independently from each other. Discussions were less frequent.
- Group B stood up and looked around at 2.05pm. They walked around the river. They said:
  - ‘Look [points] it widens down there!’ [After that they sat back to the same location and discussed what they called ‘climate climax’ in relation to the chine.]
  - ‘Now imagine how it was 8000 years ago! The chine was expanded like... this [shows with hands an expansion]. Just think how it looked like!’
- Group A stood up and followed Group B (2.07pm). They walked around in similar, but smaller circle as the other group. It was evident that they copied the behaviour of the other 2 students, who seemed older than themselves.
- Group C sitting down at the same location as before on the edge. However, now (2.15pm) they viewed much less than before, and focused on the paper questions rather. They said:
  - ‘We’re kindda struggling with the last Question.’
- Nevertheless, Group C was joking a lot, and they had intensive communication. There was a central person, who stood up, while the other two were still sitting and listened to him.
Post-Observation Questions

After the fieldwork at the chine, some brief questions were asked from the students. This intended to directly target the students’ opinion on the use of technology in the field. An example question was:

Assistant: - So, how did you find working with laptops here on site?

Student (from Group 1; morning group): - Well, was good, but could have done it in the classroom. That case we could have just focused on the chine.

Student (from Group C; afternoon group): - Was cool, we enjoyed being out here. It’s a great view, so we stayed rather here.

Student (from Group B; afternoon group): - Good, just it’s so cold. We were imagining how the chine [pointing around] became.

Qualitative Interviews

For the sake of clarity and briefness, only some general notes and excerpts from the interview scripts are reported here. An interpretation of these interviews will be discussed together with the fieldwork observations in the conclusion section.

Senior Undergraduate Student 1

Female, third year undergraduate geography student. She spent one week in Berlin (Germany) as part of her studies on a geography fieldtrip in 2005.

Q1: - Tell me a few words about your last geography fieldwork experience!
   - “Everyone wants more [fieldtrips].”
   - “Very nice to be in small groups and with the lecturers. […] You’d just don’t get that much of contact hours with the lecturers otherwise. […] Also it’s not just the lecturers, but also doing the groupworks with the others.”
   - “You can pick up a lot of skills: groupwork skills, presentation skills, and a lot of things like that.”

Q2: - How important do you feel these fieldtrips overall in terms of your learning?
   - “It depends on if you’re talking about learning module materials or if you’re talking about learning skills. For the first one, it’s easier to do once you’ve done all the theory. So, it does help. But what helps more is the skills that you get.”
   - “For the skills, it’s extremely useful.”

Q3: - What are the main positive and main negative aspects of the fieldwork?
   - “Main positive aspect were – in no particular order [she laughs] – that we’re getting to know people on the course more; doing groupwork; learning how to present stuff; having the time with lecturers; and just putting theory into practice.”
“Also positive is that the actual chance to talk back [to lecturers], cause obviously at lectures, you’re just talked at. And lot less pressured.”

“Negative is that they cost money. And that it’s time cost, but it’s hugely outweighed by the benefits.”

Q4: - How would you make these fieldtrips more effective?
- “Improve the structure of the fieldtrip.”
- “Whole point of fieldtrip is to do things. So, we’re given the theory and then we had to go out and do it.”
- “Use other sources of visual aids.”
- “I would just make it more time-pressured.”

Q5: - How did you find the use of technological devices (i.e., digital cameras) in the field?
- “Well, they told us how to use the camera as a tool for research. I think that was very interesting. And as I had done a course on photography, it was something that I enjoy… which is quite a good way to learn.”
- “We didn’t have access to computers for the whole week. But what the lecturers did before the fieldtrip was that they used computers with projectors, basically, to just go through the theory. So I guess that was quite useful for that.”
- “Also we looked at photographs on the screen beforehand, which is useful.”

Q6: - How effective do you think these technological devices are in terms of learning?
- “I don’t think that they’re critical.”
- “Nowadays the lecturers are the ones, who become so dependent on them.”
- “Want to know that they aren’t a waste of money… of our tuition fees.”
- “They are not pointless. So they’re useful, but they aren’t necessary.”

Q11: - How did working with the others affected your learning?
- “It does challenge your thoughts and it also challenges other people and yourself.”
- “We joked all around the whole week with each other.”
- “Also, we knew that all [project] topics were a bit airy-fairy. But it helped that we could decide together which one to choose.”

**Senior Undergraduate Student 2**

Male, third year undergraduate geography student. He was on a fieldtrip in the New Forest (Hampshire, UK) in 2006.

Q1: Tell me a few words about your last geography fieldwork experience!
- “We were given very limited guidance. And that was a slight problem.”
- “I do physical geography. I love being in the field. I enjoyed the fieldtrip. I love the outdoors. I love fieldtrips in that respect. I enjoyed it, but it was complicated and hard work. It’s a good way to make good relationships with other students. It’s good teambuilding experience.”
Q2: How important do you feel these fieldtrips are in terms of your learning?
- “I think it’s very important. I don’t think that anyone can learn these sorts of techniques without being out in the field.”
- “A definite bonus.”

Q3: What are the main positive/negative aspects of these fieldworks?
- “As geography is quite an unsocial course, because we only spend a few hours together a week. So fieldwork is a good way to get to know other people.”
- “It’s good for learning techniques.”
- “As there is no perfect dataset out there – it’s a negative thing, but also a positive as it helps your critical thinking of the things.”

Q4: How would you make these fieldtrips more effective?
- “Better organisation needed.” [no mentioning of technologies]

Q6: How effective do you think technological devices are in terms of learning in the fieldwork situation?
- “Generally, the use of technology is extremely useful in learning.”
- “For example, the use of videos would be better. I can’t remember when was the last time when we were shown any videos during a lecture or elsewhere. Videos are great to show processes or illustrate sceneries.”
- “They’re great for post-data collection analyses.”

Q7: If you were the coordinator of the course, how would you improve these courses. Say you could introduce new devices, or anything that you may like.
- “Encourage people to bring cameras and take photos. You could check your data with ‘em. […] Photographs are the most important [technological] things.”
- “I don’t really think that laptops would be that effective. They’d rather be effective to use them before and do everything before you go out the field, but not in the field.”
- “You need a backup paper-copy anyway.”
- “But they can be useful in terms of long term data collection.”

Q11: How did working with others affect your learning?
- “Lot of decisions to be made in the groups. Quite interesting.”
- “Just good for getting on with people. Having fun. Decisions are important. Trying to argue with others.”

Questionnaire Data
[Paula!]
Conclusion

This project was investigating the use of technology-enhanced learning in a geography fieldwork environment from a holistic-cognitive approach. The research involved an observational study in a fieldwork excursion and semi-structured interviews with senior GEES students.

Four main themes emerged overall from the whole of the research. These are the categories that were most commonly mentioned in the interviews and most frequently observed during the fieldtrip:

- attentional focus
- communication / social learning
- technological expertise
- spatial presence

Attentional focus

This label was used for those occasions, when the students were actively engaged in an interaction with an object of their environment (e.g., laptop screens, physical scenery, paper notes, etc.). As attention is an essential element of learning, it is important to see how did the students split up their attentional spans.

Technical tools require a certain amount of cognitive capacities to be spent on their operation. Efficient system designs are the ones that adjust their user interfaces and operations to the needs of the human cognitive system. Students in the computer group of this study seemed to be able to immerse in the multimedia presentation on their laptops while they were in the field. They spent significant time interacting with the computer (i.e., playing, pausing, replaying videos; searching for information; matching abstract information with the reality around them). Although initially it seemed that students in this group focused more on their computers at the expense of the physical observations, later on (in varied times, but not later than 20 minutes after beginning) all students turned more to the actual real world scenery. The control group was actively engaged in the physical activities from the beginning of their work. They spent less time writing notes and more time exploring their environment and interacting with other students.

This observation shows that students were able to turn their attention to multimedia presentations on laptops during an outdoor fieldtrip. They did not get distracted by the complex unfamiliar scenery and they were also able to focus on the interactive information appearing on their laptop screens.

As a disadvantage, the use of computers decreased the time spent on observations in the real world. In addition, part of the students’ cognitive efforts were necessarily utilized for operating the equipment, which could have been used for the understanding the material. However, this cost of computer use is outweighed by the benefit of skill learning, which
is considered equally important by both previous literature (Gold et al., 1991; Kent et al., 1997) and by the interviewed senior students.

**Communication / Social Learning**

Communication is amongst the most important means of learning and teaching. Several observations were made in this study when technology either invoked or repressed social interactions between students. Pairs of the *computer group* were less actively discussing topics verbally and there were often long periods of silence when the video was on. Only students, who were less focused in the computer demonstrations (e.g., Group 1) chatted throughout their fieldwork. Also, the students were often talking about how to use the computer, rather than about the material itself. In contrast, the *control group* was more actively engaged in debates and discussions. Verbal communications in this group were often accompanied with wide gestures and pointing. A good example of this was when Group B acted out how the chines were formed. Such intensive communication was only observed in the control group.

As the interviewed senior students often emphasised, they regarded the social learning as one of the most important element of a fieldwork. Students are able to develop and practice their communicational and interpersonal skills with both their peers and with the lecturers. As Senior UG Student 1 remarked: “… **positive is that the actual chance to talk back** [to lecturers], **cause obviously at lectures, you’re just talked at.**” They also pointed out that teamwork aided their decision-making processes, which led to commonly formulated and accepted opinions. It is a highly valuable skill in terms of their future professional carrier.

As students could not see each other’s work in the *computer group*, there was only very limited possibility for social learning in this group. These pairs were more isolated in terms of social interactions. The *control group*, on the other hand, remained more or less together, despite the fact that the students worked in pairs. For example, Group A followed and directly copied the activities of Group B. In addition, some between group chatting was also observed, but only in the control group.

These findings suggest that the communication aspect of technology-enhanced learning should be further improved. It could involve more frequent pauses or instructions to the users to discuss the just learnt material with their fellow students. Another method recommended by Fletcher et al. (2003) is the use of even more interactive web-based technologies that allows real time written or even oral communication with other computer users over the internet.

**Technological Expertise**

As with any cognitive technologies, it is a highly desirable aim to fit the technology to the learners (Dror & Shaikh, 2005). Although the student population in this study was not pre-screened in terms of their computer user abilities, their similar educational and social background assured that they have at least the required basic skills. The observations in
the computer group confirmed this expectation, as there were only some minor difficulties operating the computers (e.g., Group 1), but in general, the multimedia software proved to be well functional in student-computer interactions.

Nevertheless, technology expertise had a specific role in social group formation. As it was seen in Group 2, a male student took full control of the laptop and he acted as a group leader. This suggests that individuals with greater experience with computers and consequently with a higher level of self-confidence might benefit more from technology-enhanced learning. Such persons often take the leadership in groups and engage more in the learning process, while less skilled others might stay more passively in the background.

According to senior students, the use of mobile computers are not critical for fieldworks. Although they agreed that their application might be useful, but they preferred computers to be used as a preparatory and analytic tools for their works. In addition, they raised some concerns with regards to the costs of such facilities (e.g., “Want to know that they aren’t a waste of money… of our tuition fees.” ). This is a realistic concern as fieldtrips – even without additional technology – could already be extremely costly.

There was one aspect, nevertheless, which both interviewee mentioned: the use of visualization aids (i.e., digital cameras, video presentations). This view is in accordance with the commonly shared idea that visualization (together with its viewing properties, like timing or ordering) plays a key role in teaching by conceptualising and communicating the abstract materials. As Student 2 expressed it: “Videos are great to show processes or illustrate sceneries.” or “[I would] encourage people to bring cameras and take photos.” As cognitive load theory (Bunch & Lloyd, 2006) predicts it, technologically more advanced students might again benefit more from visualizations on a computer screen. Expert students’ are better in handling increased extraneous cognitive load from complex multimedia presentations and from 3D animations.

A feasible way to minimise individual differences based on technological expertise is to familiarize learners with the multimedia tools prior to the actual learning experience. In this way, even inexperienced users could develop basic strategies to handle new information once they are taken out to the field. Once again, this recommendation is in line with a holistic-cognitive approach to fit cognitive technologies to the available technical tools.

Spatial Presence
Previously, Gagné and White (1978) argued that the reason why students remember information better after a fieldwork experience is due to the fact that their episodic memory is engaged. Therefore, students need to get personally involved in activities during a fieldtrip. The interviewed Senior Student 2 puts it this way: “I don’t think that anyone can learn these sorts of techniques without being out in the field.” Consequently, presence – as being actively or physically present – is an important factor. However, the level of presence can vary widely depending on the learner’s own involvement.
One aspect of this spatial presence is exploratory activity. In other words, how much space is the learner willing to move around and explore? Our own research into the psychology of spatial cognition showed that the relative size of the exploratory area is predictive to the knowledge acquisition about that particular space (Makany, Dror, & Redhead, 2006). The computer group in the present study spent most of their times close to their laptops without moving around the site. In contrast, the control group wandered in a relatively wide area of the field. Although this observation within itself is not enough to make definite claims about the levels of acquired knowledge, it may well be the case that the prior (computer) group had formed only a limited representation of the spatial area, while the latter (control) group managed to obtain a more flexible one. Alternatively, if the two groups show no significant difference in their mental representations of the field than it can be concluded that the applied multimedia technology makes learners capable to reduce their physical efforts while managing to maintain an efficiently high learning benefit.

As far as spatial presence concerns, students found being in the field an enjoyable and useful experience (e.g., post-observation interviewee: “Was cool, we enjoyed being out here. It’s a great view here.”). In future technology-enhanced learning projects, an explicit effort should be made to make students leave their fixed positions and explore more remote parts of the field as well.

**Summary and Limitations**

This project was an exploratory pilot research and more work is needed to validate these findings. Nevertheless, practical observations from GEES fieldworks and senior students’ opinions should always form the basis for any further research. The four emerged themes (attentional focus, communication, technological expertise, spatial presence) discussed here are useful constituents for understanding and designing any technology-enhanced fieldworks. They provide insights into how the human cognitive system is able to interact with multimedia technologies. Such holistic-cognitive approach is necessary in order to take factors from all sides of the cognitive spectrum of the mind and make them work effectively with advanced learning and teaching technologies.
References

Appendices

Appendix I. – Ethical Approval for the Qualitative Interviews

Dear Tamas,

Re:  

The above titled application was approved by the School of Psychology Ethics Committee on 24 April 2007.

Should you require any further information, please do not hesitate in contacting me. Please quote reference ST/04/03.

Best wishes,

Kathryn

Miss Kathryn Smith
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Appendix II. – Semi-Structured Interview Questions

1. Tell me a few words about your last geography fieldwork experience!
2. How important do you feel these fieldworks are in terms of your learning?
3. What are the main/positive/negative aspects of these fieldworks?
4. How would you make these fieldtrips more effective?
5. What is your opinion on the use of technological devices (i.e., laptop computers) in fieldwork situations?
6. How effective do you think these technological devices are in terms of learning in a fieldwork situation?
7. If you were the coordinator of these fieldtrips, how would you (if at all) introduce such technological devices?
8. What could be the advantages/disadvantages of such technologies?
9. Up to what extend would you present information on these devices in the field?
10. What kind of information (if anything at all) would you present?