Teaching Communication Technology in Primary School

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Abstract: The deep conceptual understanding of technology will become evermore important in the future. As the world becomes more technical there will be an increased need for those who build and author the technology. Technology education in primary schools may give a good starting point to ensure future availability of the technologically capable individuals. In addition, the use of mobile terminals will become more common in education. Mobile terminals are flexible to use and they enable real time and place independence. Nonetheless the usability of wireless terminals is usually poor, which disturbs the learning processes. Thus, one way to enhance mLearning is to raise the usability of mobile terminals. It is important, however, to study what kind of methods we can use to teach the usage of mobile phones, because in the future we can adapt these methods to terminals that will be used in mobile learning environments.
In the utilisation of mobile phones it is important to recognise that learning to use mobile phone is not the same process for all. Individuals have different types of previous cognitions that influence the way they use mobile phones. In this research two theory-based teaching phases were completed and compared. The first phase was based on the Finnish curriculum and the second one was based on the analogy between technology and human concepts. Both phases were carried out in a primary school, but they would be suitable to other levels of education as well. In this paper the usefulness of the analogies in teaching information and communication technologies is evaluated. In addition, the usability of Nokia 7110 mobile phone is evaluated. Surprisingly, analogies did not support learning. There were no significant difference found between performance of subjects of the analogy and the curriculum phases. Researchers located several obstacles in the user interface that need improvement. As a conclusion, a lot of work on the usability of the user-interface needs to be completed before mobile terminals can be effectively adapted as a part of education.

Keywords: analogy, communication technology, mLearning, mobile phone.

Περίληψη: Η σημασία της βαθύτερης κατανόησης της τεχνολογίας θα αυξηθεί στο μέλλον. Καθώς ο κόσμος αυξάνει την εξάρτησή του από την τεχνολογία θα υπάρχει αύξηση της ζήτησης σε ανθρώπους που σχεδιάζουν, κατασκευάζουν, και προγραμματίζουν τα τεχνολογικά αντικείμενα. Η τεχνολογική εκπαίδευση (ως αντικείμενο) στα δημοτικά σχολεία μπορεί να δράσει σαν ένα καλό σημείο εκκίνησης ώστε να εξασφαλίσει την μελλοντική ύπαρξη τέτοιων ατόμων με τεχνολογικές ικανότητες. Επιπλέον, η χρήση κινητών τερματικών στην εκπαίδευση θα αυξηθεί στο μέλλον. Τα κινητά τερματικά είναι ευπροσάρμοστα στην χρήση τους, και προσφέρουν πλήρη απεξάρτηση ως προς τον χρόνο και τον τόπο χρήσης τους. Παρά ταύτα, τα κινητά τερματικά υστερούν χρηστικά, κάτι που διαταράσσει την διαδικασία μάθησης. Συνεπώς, ένας τρόπος για να επιβοηθηθεί η κινητή μάθηση (mLearning) είναι να αυξηθεί η χρηστικότητα των κινητών συσκευών. Είναι, άρα, σημαντικό να μελετήσουμε σήμερα τις μεθόδους που μπορούμε να χρησιμοποιήσουνε για να διδάξουμε την χρήση των κινητών τηλεφώνων, καθότι θα μπορέσουμε έτσι στο μέλλον να προσαρμόσουμε αυτές τις μεθόδους διδασκαλίας σε μελλοντικές τερματικές συσκευές που θα χρησιμοποιηθούν σε περιβάλλοντα κινητής μάθησης
Είναι σημαντικό να αντιληφθούμε ότι η διαδικασία εκμάθησης της χρήσης κινητών τηλεφώνων δεν είναι κοινή σε όλους. Πρότερη γνώση στους χρήστες επηρεάζει τον τρόπο που τα χρησιμοποιούν. Στην παρούσα έρευνα συγκρίνονται δύο διαφορετικές μέθοδοι διδασκαλίας (βασισμένοι σε θεωρίες) ύστερα από δοκιμή στο σχολείο. Η πρώτη μέθοδος είναι βασισμένη στο αναλυτικό πρόγραμμα των δημοτικών σχολείων της Φιλανδίας, ενώ η δεύτερη βασίζεται στην αναλογία μεταξύ ανθρωπίνων εννοιών και τεχνολογίας. Αν και η δοκιμή έγινε σε παιδιά δημοτικού, θα ήταν κατάλληλη και για άλλες βαθμίδες της εκπαίδευσης. Στην παρούσα εργασία εξετάζεται, ομοίως, η αποδοτικότητα της χρήσης τέτοιων αναλογιών για την διδασκαλία της τεχνολογίας πληροφορικής και επικοινωνιών (ICT), και παραδόξως εμφανίζεται ότι δεν υποστηρίζουν την μάθηση με έναν βαθύτερο τρόπο. Επιπρόσθετα, αποτιμάται η χρηστικότητα της φορητής συσκευής Nokia 7110, για την οποία οι ερευνητές εντόπισαν διάφορα εμπόδια που χρειάζεται να βελτιωθούν. Συμπερασματικά, χρειάζεται να γίνουν πολλές περαιτέρω έρευνες ευχρηστίας ως προς την διασύνδεση των κινητών συσκευών με τους χρήστες, πριν τα κινητά τερματικά λάβουν την θέση που τους πρέπει ως αναπόσπαστο τμήμα στης εκπαιδευτικής διαδικασίας.

Introduction

Analogies make abstract concepts concrete and easier to understand. An analogy explicitly compares the structures of two domains. Therefore, ideas can be transferred from a familiar concept to an unfamiliar one. The familiar concept is called anchor and the unfamiliar concept target. There are three basic demands for drawing an analogy: 1) students must understand the structure of the used anchor, 2) students must knowledge similarities between anchor and target in the intended ways and 3) students must be able to transfer similarities from anchor to target. (Clement 1993; Holland et al. 1986.) Alexander et al. (1987) investigated whether 4-5 year-old children (n = 20) can profit from the use of analogies in learning geometry. The study shows that some children were able to use analogies in learning geometry. Glynn (1995) has developed the Teaching-with-Analogies (TWA) model that is the most useful analogical teaching method in classroom. TWA-model consists of six operations:

1) introducing target concept

2) cue retrieval of analog concept
3) identifying relevant features of anchor and target
4) mapping similarities between anchor and target
5) identicating where analogy breaks down
6) drawing conclusions

The order in which these six operations are carried out can vary. At first the use of TWA-model is teacher orientated but the goal is that students will be able to use analogies independently in learning and problem solving. (Glynn et al. 1995).
In this study, two teaching phases have been created and completed. The first phase is based on the Finnish curriculum and the second one is based on the analogy between technology and human concepts (TWA-model). The phases were carried out in the primary school but they are suitable for other levels of education as well.

Research methods

The classes that took part in the experiment were chosen in terms of judgement sampling. Two randomised experimental groups, the analogy group (n=20) and the official Finnish curriculum group (n=20), were formed from fourth and fifth graders of the Rauma training school. The control group (n=20) was formed from fourth and fifth graders of Nanus primary school. The experiment consisted of three lesssons of 45 minutes on the use of ***Nokia 7110 WAP*** mobile phone. The students of experimental groups worked in pairs and each pair had one mobile phone to use. In the first lesson pupils worked out tasks dealing with the basic functions of the mobile phone such as sending messages and changing the settings. The second and third lesson consisted of one single complex task. Pupils were asked to plan a holiday trip for they family with the help of WAP services. They searched for and selected possible overnight accommodation and planed spare time activities. Finally, pupils explained their holiday plans to the rest of the class. The goal of the analogical teaching phase was to perceive the menu structure more concretely with the help of the structural similarity between the mobile phone and a block of flats. In curriculum condition the importance of prior knowledge of technological devices is emphasised, because such aid as in analogy condition is not presented.
The test instrument consisted of four tasks. The first two tasks measured the use of mobile phones basic functions; sending a message to Aku (task 1) and changing the time of mobile phones clock (task 2). The last two tasks measured the use of WAP services; correcting possible mistakes in connection settings of the banking WAP services (task 3), and finding out what is the time difference between Finland and Japan (task 4). The method that was used in collecting the data was structured observation. The data was observed from videotape by two independent observers. The researchers measured the time used per each task and counted the number of mistakes made in performing each task. For each task to be completed successfully, a "correct path" of commands on the telephone device should be kept (these have a tree-like structure). A mistake was registered when participants quit the right path while performing a task or if participants hesitated and took a step backwards while they still kept on the right path.
In addition the mistakes were classified into three categories: 1) structure mistakes, 2) quick search mistakes and 3) functional mistakes. A structure mistake is defined as one made when a subject went to irrelevant submenu while performing a task. A quick-search mistake was registered when a subject was in a right submenu but pressed quick search button instead of ***navi-roller*** (a feature in ***Nokia 7110*** phone) or vice versa. A functional mistake is the one made while in the relevant submenu but it was not a quick-search mistake.

Results and discussion

When comparing the effectiveness of the teaching phases the results of analogy group and curriculum group were compared to the results of control group. The difference between the mean of solved tasks per group was very significant ($p < 0.001$). In the future, mobile phones will resemble computers more and more and the differences between these two will be blurred. The palm computers and third generation mobile phones demand new skills from the users. At some point the average users will have difficulties in absorbing new changes and in adopting new features and, therefore, teaching in some form or another will be needed.
Figure 1 illustrates that curriculum group solved more tasks than analogy group. On the other hand, analogy group made less mistakes and used less time in solving the problems than curriculum group. There were no significant differences in the mean of solved tasks, the mean of mistakes, or the mean of the duration of solved tasks between the experimental groups ($p > .05$).

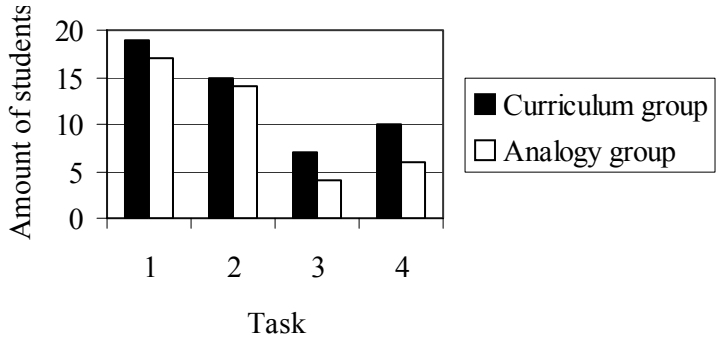

Figure 1: Curriculum group's and Analogy group's successful completion of tasks

Curriculum group made less structural mistakes than analogy group but there were no significant difference ($p > 0.05$). Both groups made equal numbers quick search mistakes and functional mistakes. A conclusion is that curriculum group understood the menu structure of the mobile phone better than the analogy group. The analogy used did not support learning of the mobile phones menu structure. For analogy condition group, the time used in practical training with the mobile phones was limited by the TWA model based teaching. The researchers estimated that the difference between the experimental groups in the amount of practical training time was approximately five to ten minutes per lesson. Under these results it seems that the time used in practical training with the mobile phones is more significant to the understanding of the menu structure than the teaching method used.

The experimental groups were combined and then divided into three subgroups on the basis of school performance: good (n=10), average (n=20), poor (n=10). In Figure 2 we can observe that there were no significant differences in the average tasks solved, between school performance groups ($p > 0.05$). When the groups were compared in terms of time used to perform the tasks and, also, the number of mistakes made while performing these tasks, no significant difference was found ($p > 0.05$). This result is contradicting slightly with the Dyrenfurth`s (1991) theory of development of the technological literacy. According to Dyrenfurth the development of technological literacy is based on basic literature. In this study good school performance did not appear to guarantee success in learning the use of mobile phone.

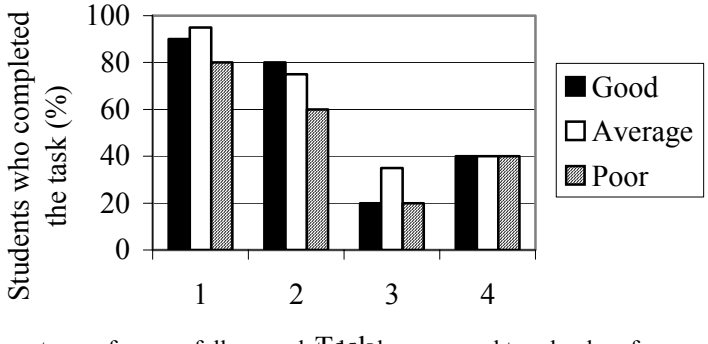

Figure 2: Percentages of successfully completed tasks compared to school performance

On the other hand, the maturity of pupils enhanced their understanding, something which supported Dyrenfurth´s theory. Figure 3 illustrates that fifth graders completed more tasks than fourth graders. The difference of solved tasks between fifth and fourth graders was very significant ($p < 0.001$). When the time used in solving the tasks was compared between fourth and fifth graders, the difference was found to be significant ($p<0.05$). But when the number of mistakes made in solved tasks was compared, no significant difference was found.

As a result of mapping the preferred paths in the mobile phones menu structure as selected by participants, the problem points of the menu structure were located. On the basis of these results some assumptions can be made on the need for improvement of the user interface. In fact, there were several obstacles in the user interface of the tested mobile phone that need improvement. First of all, the Navi-Roller confuses users and they prefer to use it even in the tasks that could be done more easily with the other buttons. This may be the consequence of the fact that people are used to work on graphical user interfaces. Such subjects who used the Navi-Roller needed visual elements to support their interaction with the mobile phone.

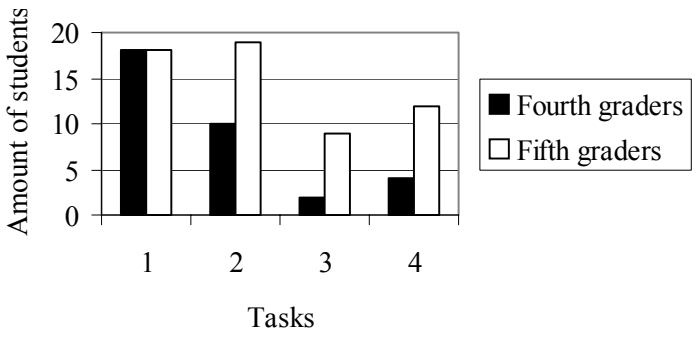

Figure 3: Fourth and fifth graders successfully completed tasks

Visually directed subjects did not care that the use of the Navi Roller was time consuming. The most important thing for them was the visibility of the actions. Secondly, the inconsistency of the Navi-Roller in relation to and the shortcut buttons caused some problems. Participants did not understand the logical difference between these buttons, which made the navigation confusing. These results reveal that the user interface tested needs improvement. In this suggested change, the user-perspective of a child-user should be taken into account to a much greater extend than it has been up to now. On the other hand, WAP services need improvement as well. The navigating structures were found to be especially hard to understand. Without any kind of teaching, these obstacles were significantly harder to be overcome by the user himself.

Conclusion

It is clear that there is a need for development for mobile services and mobile terminals before they are widely approved as a part of education. In the future we have to consider how can we utilize mobile terminals in education. Mobility offers us great possibilities in the way of time and place independence. Nonetheless, a key question in applying mobile terminals to education is usability and the easiness of usage. Poor usability disturbs the learning processes, because the energy of users is directed towards the use of terminals instead of learning through the use of these devises. Thus, one way to enhance mLearning is to raise the usability of mobile terminals.

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