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ABSTRACT

This paper describes some of the features of Information Communication Technology (ICT) and its uses in the teaching-learning process in elementary schools. In most schools, it is difficult for ICT to be used effectively in the teaching-learning process. The author observed many classes using ICT in elementary schools. Qualitative data, such as interviews with teachers and observation of student conversations and behaviors were analyzed. The research findings were based on ethnographic case studies and are summarized as statements. The findings were summarized and are presented as a causal relation graph. The main results were: (1) Basic computer operating skills, such as typewriting depend largely on the classroom teacher's attitude and computer literacy; (2) most computer operation skills, such as file saving, and design skills, such as designing and developing a homepage were mastered through reciprocal teaching and modeling among children; (3) the teacher's advice helps children to search and access information related to their topics. It was further found that ability to access topic relevant information was the result of a comprehensive understanding of the information domain, rather than operational skills; (4) learning motivation was highly promoted by collaborative and competitive group activities; (5) integration of synchronized systems, such as videoconferencing into classes requires professional technical support. (Contains 15 references and 2 figures.) (Author/AEF)

Qualitative Analysis of Information Communication Technology Use on Teaching-Learning Process

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Qualitative Analysis of Information Communication Technology Use on Teaching-Learning Process

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Abstract: This paper describes some of the features of Information Communication Technology (ICT) and its uses in the teaching-learning process in elementary schools. A number of articles have addressed various issues concerning the many difficulties of how to integrate ICT into the school curriculum. In most schools, it is difficult for ICT to be used effectively in the teaching-learning process. The author participated and observed many classes using ICT in elementary schools. Qualitative data such as interviews with teachers and observation of student conversations and behaviors were analyzed. The research findings were based on ethnographic case studies and are summarized as statements. The findings were summarized and are presented as a causal relation graph. The main results were: (1) Basic computer operating skills such as type writing depends largely on the classroom teacher's attitude and computer literacy. (2) Most computer operation skills such as file saving, and design skills such as designing and developing a homepage were mastered through reciprocal teaching and modeling among children. (3) Teacher's advice helps children to search and access information related to their topics and it was further found that to access topic relevant information was the result of a comprehensive understanding of the information domain rather than operational skills. (4) Learning motivation was highly promoted by collaborative and competitive group activities. (5) Integration of synchronized system such as videoconference into classes' needs professional technical support.

Introduction

There are many articles addressing the difficulties facing those who wish to integrate Information Communication Technology (ICT) into schod curriculums. Tebbutt, M. (1999) highlights that there are various influences on the process of implementing ICT in science: the infrastructure for ICT in science, the philosophy for ICT in the school/department, and the external influences on philosophy/practice (refs. [1]). Lawson, T. and Comber, C. (1999) have also identified four factors: teachers' attitudes prior to the innovation, the role of the ICT coordinator, the attitude of senior management and the existence of adequate support and training (refs. [2]). Ertmer, P.A. has discussed two kinds of barriers on technology integration (refs. [3]), and some articles have identified that it is not easy to integrate ICT into school curriculums (refs [4],[5]), as Selwyn, N. describes ICT can be a headache for teachers (refs.[6]). Collis, B., Peters, O. and Pals, N. further detail (refs.[7]), many factors that can influence an individual's decision to make or not make use of some form of ICT in his or her learning-related activities. They highlight the four most important factors, the 4-E model, as being environmental factors, effectiveness, ease of use and personal engagement. This model was tested using statistical analysis using the questionnaire method. The author has also been engaged in research concerning the use of ICT in schools such as project study, in-service teacher training and so on (refs.[8],[9]).

In order to further investigate the factors that affect the integration of ICT in schools an ethnographic study was undertaken where the author participated in actual classes in elementary schools for a one year period (refs [10]). The chosen research approach was based on a partnership between the university and schools, which has been reported as an effective approach (refs.[10],[11]). Almost all data was gathered through interviews, informal conversations, observation of classes, meetings and so on

Research objectives and methodology

The purpose of this paper was to find some features of ICT use in practical classes and to derive findings useful to teachers and educators in aiding ICT integration into classes. In order to conduct the research, the author visited

two elementary schools and observed 15 classes for a period of one year. The author recorded the scenes, teachers' student conversations and the behavior of classes in field notes, pictures and videotapes, which were selected based upon the author's impressions.

In order to find the definitive variables that affect the use of ICT in classes, the author adopted the following methodology.

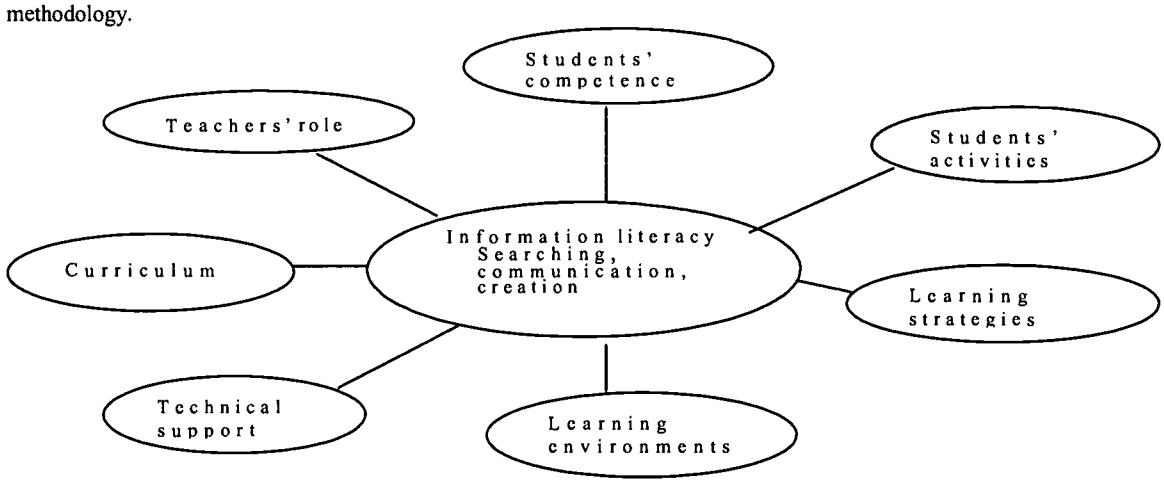

Figure 1. Configuration of large-scale variables as assumption

1. To list large-scale variables (as assumptions)

- Large-scale variables (shown as ovals) are assumed variables and were elicited based from researchers own experiences, their pedagogical view and their view of the learning environment (See Figure 1).

2. Qualitative data collection

- Data collection was conducted based upon qualitative research methodology. Data was collected by observational participation of actual classes; observation of teacher's talk, students' talk and behaviors, and interviews with teachers and students.
- Most of the data was recorded using video, pictures and notes. Lesson plans, teaching materials, the configuration of the computers in the classroom, the atmosphere of the classroom and social relations between students and teachers were recorded. These factors were often found to play an important role in the success of lessons. However, it is difficult to record inner factors such as human relations or teacher's classroom management competency through observations and interviews, even though these factors are important.

3. To pick up definitive keywords through interpretation of qualitative data

- Keywords were added to these data. By observing pictures and videotapes, reading notes and interviews' records, researchers were able to think of many keywords corresponding to the classroom scenes that had been recorded. These are ranged from simple facts to more meaningful findings. These keywords leading to meaningful findings are defined as 'definitive keywords' in this paper and were added to the casual relation graph as sub-variables (rectangle in shape).
- Researchers picked up definitive keywords, which were selected based upon their impression and interpretation of data.

4. To find a relation between large-scale variables and keywords

- Researchers linked these definitive keywords to the large-scale variables based upon their judgment. Because definitive keywords are crucial, important keywords, these can be related to large-scale variables in most cases.
- Keywords were added to the large-scale variables. All variables could be listed by adding definitive keywords to the large-scale variables.

5. To express some findings as statements and to produce a causal relation graph

- By analyzing the data generated by the observational study, researchers were not only able to identify keywords but also identify key features of the class. Researchers attempted to investigate the reason why

teachers' and students' talk occurred, tried to extract background theory and models connected to these activities and tried to find new features of the class by comparing it to other classes.

- The extracted findings were expressed as statements these were added to our graph with causal connections being drawn to signify the relationship between one issue and another and specific examples of the observations listed below being denoted as dotted rectangles (See Figure 2).

Findings based on the observation of teachers and student activities.

Twelve findings are summarized and presented as the following statements.

(1) Keeping and memorizing a password is difficult for children. **Example:** A teacher comments "Some children often forget their own passwords, therefore requesting children to change their passwords for protecting security is impossible. So, we introduced a password-card and asked the children to keep the card."

(2) Children's keyboard typewriting skills were affected by the classroom teachers' aptitude.

A variety of skills were found amongst the children from high-level skills such as blind touch-typing to the low level skills such as one fingered-typing. The development of these skills seemed mainly dependent on the frequency of access to computers for these children. **Example:** A teachers comments "There is some evidence showing the reason why children's typewriting skills are so different. Children in the class, of a teacher that often uses the computer room are generally more skillful in typewriting. On the other hand, children of teachers that do not use the computer room often are not as good at typewriting. And there is also appears to be a difference between boys and girls.

(3) A teacher's advice appears to work most effectively when talking to children individually (directly by face-to-face communication).

It is often difficult for a teacher to communicate individually with a child during a class. However, in the computer room the teacher is able to talk directly to each child face-to-face. It provides satisfaction to both the teacher and the children; it therefore works effectively from the point of view of an instructional methodology. **Example:** When children encountered unfamiliar material/procedures such as operations, messages or instructions from the computer, he/she asks questions to teacher, who is walking around the computer room. A teacher comments, "I was satisfied to communicate with children directly face-to face

(4) Children learn mainly by observing contents displayed on the other students' screen; it is interpreted as the modeling effect.

Children show their interests when they encounter content or information different from their own thinking. When they have an interest in the information on the screen, they observe it for a much longer period of time. Through peer observations, they appear to learn a lot from each other; a type of modeling learning environment is produced. **Example:** When children find the content or information different from their own, they observe the screen for a much longer period of time. Children say, " This mail is much longer than the one I sent, so I am reading the mail, and thinking how to write more sentences."

(5) Reciprocal teaching will naturally happen, when they encounter the unknown.

When children encounter the unknown or find some questions, they naturally begin to talk together in order to solve the problem. And they exchange their ideas and products; this is considered to be a type of reciprocal teaching. **Example:** When children encountered the unknown, they asked the teacher or their classroom peers. A girl asked another child how to make a report and learnt by observing another child's product and through the exchange of ideas.

(6) Children learn more by accessing the homepages made by older children.

Children learn more by accessing the products made by children in the upper grade than in the same grade. The lesson plans that were designed to connect children to different grade children worked effectively. It appears that in these situations learning is promoted through an effect known as the zone of proximal development (refs.[13],[14]). **Example:** Children accessed the homepages made by children in the upper grade, and they said "How wonderful this report is, I would like to know how to make it."

(7) On collaborative working in the classroom, the group leader's role and leadership skills including intelligence are important and crucial for leading the group through to success.

It is known that the leader's role is very important not only for group work in schools but also in general office

work. Expert teachers, who are experienced users and instructors of ICT education, talked of the importance of the above-described findings. **Example:** Children producing a report through a group working activity. A child, the leader of the group, says "Be careful when saving, because we must make the file name easy to access and easily recognized by our members." A teacher remarks, " The outcome of group work often depends on the leader's power and character."

(8) Comparing and observing other group's work through a computer network brings competitive feelings to group members, and a competitive willingness promotes children's incentives towards producing a better performance.

The computer network enables children to access and observe other groups' work and performance; it leads to group members' exhibiting competitive feeling and willingness. Sometimes it is more effective to use group work to produce better products. Children learn a lot of techniques and superior design methods through group competition. **Example:** Through accessing and observing other group's work, children can compare and evaluate their own performance. Group members say, "Let's introduce more sophisticated techniques so that we can compete with the other groups."

(9) When group members combine the individual work made separately into one product at final stage, children show a lot of satisfaction.

Collaborative learning makes children produce a more superior product than individual learning. It also brings deep satisfaction to children especially when combining their individual pieces of work into one product at the final stage. It is also important from a pedagogical point of view. The computer network system enables to realize these learning activities. **Example:** Group members are combining individual work made separately into one product. They watch enthusiastically the screen displaying their product. They say "Oh, great. Let's revise here and add another picture"

(10) Technical support is needed especially when using synchronized telecommunication systems such as a videoconference system.

Most classroom teachers are not computer network experts; therefore technical problems that may occur may not be able to be dealt with by the teacher. Team-teaching such as the classroom teacher coupled with computer experts such as computer teacher or technical assistant is much more effective when conducting a class using complicated systems. To remove the classroom teacher's fear is essential. **Example:** A class using a videoconference system when a technical trouble occurred. Classroom teacher comments, "I cannot do anything, because I 'm not computer network expert. We don't have enough time to check as to how this problem occurred." When later asked about their feelings about working with technical equipment in the classroom one teacher remarked, "My fear disappears when team teaching together with the technical assistants".

(11) Accessing desirable sites using search engines with keyword inputs is not easy for children it takes time and requires domain knowledge.

Most children would like to retrieve desirable sites using search engine with keyword inputs, but in many cases they are unsuccessful with their attempts. In order to get desirable information, children must have domain knowledge related to the topics they are searching for, not only operational skills such as how to use a search engine. Without domain knowledge, they often failed to access desirable information. In addition, it is often not easy for children to remember suitable keywords for retrieving information, because these keywords are often closely connected to the domain knowledge. Scaffoldings by teacher or other students' having more domain knowledge are required. **Example:** From the observation of children's activities in retrieving a site using search engines the following was found. Children that had been attempting to access topic specific sites for a long period of time abandoned their attempts to try and retrieve information using a search engine.

(12) Using a variety of resources enables children to search out information more effectively.

There are many learning resources such as the Internet, CD-ROM, newspapers, books, videotapes and so on. When children search for topic related or make reports a variety of resources that holds relevant material should be made available to them. Information on the Internet is not always reliable as is well known. At present a combination approach is required which would allow children to use the Internet as well as other resources in order to ensure an effective learning environment. **Example:** When children are told to produce reports as their assignments, they often go to search for additional information. As resources for investigation they can use the

Internet, CD-ROM, newspapers, books in the library, and construct a report according to their teachers' recommendations.

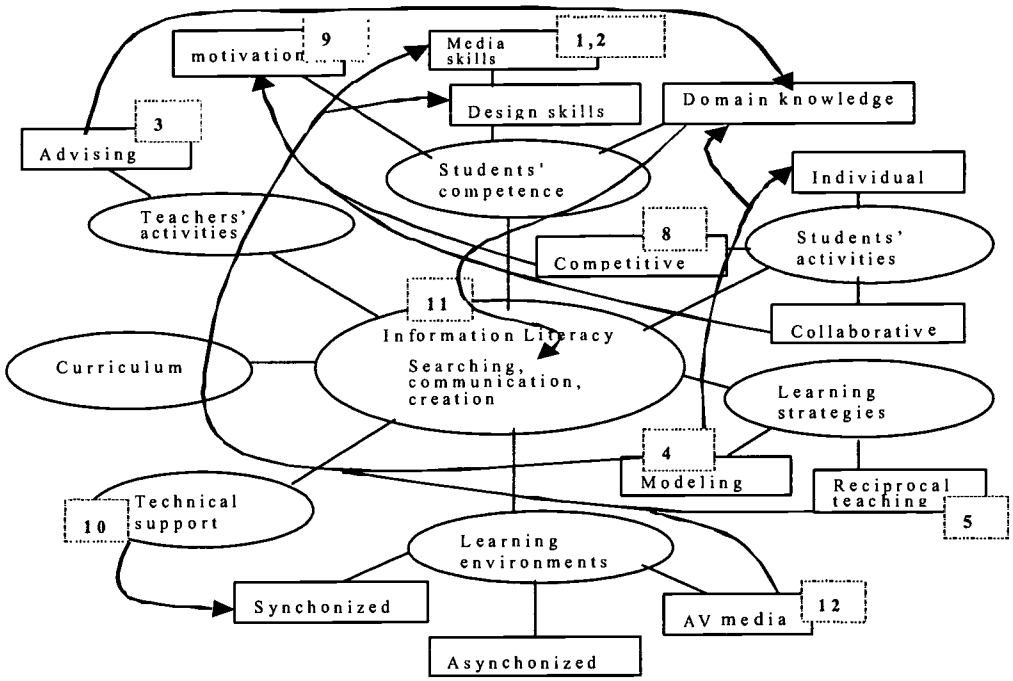

Figure 2. Causal relation graph based on qualitative data analysis
Oval- assumed large-scale variables. rectangle- sub variables

Conclusion

The twelve findings described above are represented as a causal relation graph shown in Figure.2 The important findings from pedagogical view point can be summarized as the following statements.

(1) Basic computer operating skills such as type writing often depend on the classroom teacher's attitude and computer literacy level.

(2) Most computer operation skills such as file saving, and design skills such as homepage making are mastered through reciprocal teaching and modeling among children.

(3) Teacher's advice helps children to search and access information related to their topics, moreover it was found that the access of topic related effective information is closely tied to domain knowledge a child has rather than operational skills.

(4) Learning motivation is highly promoted by collaborative and competitive group activities.

(5) Integration of synchronized systems such as videoconferencing in classes needs professional technical support.

From the pedagogical view, reciprocal teaching and modeling among children (2), and teachers ' advice (3) seems to be more important than other findings, as it effectively highlights the different roles of novice and expert users of ICT in classes. In order to integrate ICT into classes, ICT literacy such as type writing skills, file operation skills, design skills, and a competent understanding of the learning domain are required. Integration of ICT literacy and domain understanding is essential in promoting ICT education in schools. Traditional teaching methodology is mainly based on the teacher's knowledge and their teaching strategy regarding how to transmit their expert knowledge using authorized teaching materials. However, ICT literacy can be acquired by reciprocal teaching and modeling among children without the teachers' assistance. In the classroom, there are often some children that are competent computer users because they have access to and often use a computer in their own home. These children play an important role in the transmission of skills to other children through cooperative activities. Collaborative learning among children was found to be most effective in the domain of computer skills ' acquisition. This finding can be interpreted by using the concept of Vygotsky 's zone of proximal development, a

concept that has previously been noted as playing an important role inof ICT education (refs.[14],[15]).
Most children do however fail to access suitable Web sites. This suggests that information literacy or the ability to search for information, utilization, representation and so on are closely related to the child's knowledge of the each specific information domain. The teacher as an expert of each domain can play the important role in cultivating the child's ability to strengthen their information gathering skills. It can be concluded that information literacy or capability cannot be separated from domain knowledge, and that information capability needs to be acquired through subject learning such as cross-curriculum through teacher guided assistance, while computer operation skills can be acquired through peer teaching and modeling from other children through collaborative work sessions.

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