Strategic Use of Computers for Constructing Effective Studies: A Pilot Study
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Abstract

SUCCESS is a project that proposes an approach to improving the academic learning of secondary Normal Technical (NT) students in Singapore through the strategic use of computers in the school curriculum. Capitalising on the NT students' interest in using the computer, an inquiry is being carried out in participating neighbourhood schools to develop instructional strategies (Chen & Oei, 1996) enabling tools (Looi, et al, 1996) in English, Maths, Science and Computer Applications to bring about more effective learning and higher academic achievement. This paper describes a pilot project conducted in a school which involves students doing a survey-based project on some aspects of shopping and consumers' choice, and analysing and presenting their findings using the computer.

Keywords: Constructivist learning, Project-based learning, Mind Tools,
Process Writing

Introduction

Strategic Use of Computers for Constructing Effective Studies (SUCCESS) is a project that proposes an approach to improving the academic learning of secondary Normal Technical (NT) students in Singapore through the strategic use of computers in the school curriculum. The proposed learning approach is underpinned by constructivist, social cognition, and cooperative learning principles and theories (Brown, et al, 1991; Chaiklin & Lave, 1993; McCarthey & McMahon; Bershon; Nelson-Le Gall, 1992; Johnson & Johnson, 1989; Vygotsky, 1978). SUCCESS proposes the use of computers as a tool and a system for integrating curricular studies through an integrative, active and deep approach to learning. Its focus is not just on specific subject area but linking curricular subjects and concerns with the real world of work. Real life experiences, learning and work practices are viewed as interlocking human activities that complement each other rather than in conflict with each other.

Recent local studies on the NT students have shown that their favourite subject is Computer Applications which is also the subject they have performed best (Chang, et al, 1995). Capitalising on this motivating factor, an inquiry is being carried out in participating neighbourhood schools to develop instructional strategies (Chen and Oei, 1996) and enabling tools (Looi, et al, 1996) in English, Maths, Science and Computer Applications to bring about more effective learning and higher academic achievement.

This paper describes a pilot project conducted in a secondary school which involves Secondary Three Normal Technical students doing a survey-based project on selected aspects of marketing and consumers' choice, and analysing and presenting their findings using the computer. Altogether 21 students and two teachers were involved over a period of two weeks at the end of the Fourth Term of 1996.

Objectives of the SUCCESS Inquiry

(1) To understand the processes through which computer-based tools can be used in schools across the curriculum based on socio-constructivist learning theories;
(2) To assess the effectiveness and difficulties of the above usage in different learning contexts in Singapore;
(3) To investigate the necessary preparation for teachers to conduct lessons using computer mediated collaborative learning environments and for students to develop the necessary skills for the social construction of knowledge; and
(4) To design and develop a computer-mediated learning tool suitable for integrating school subjects in the local context.

Project SUCCESS is aimed at initiating 'situated learning' - a socio-constructivist approach to learning and teaching in classrooms which have employed computer tools and systems to solve real world educational problems. The originality of this study is two-fold: the target learners, the Normal Technical (NT) students in a sample of neighbourhood schools (i.e. schools receiving pupils from the neighbourhood without selection) in Singapore, and a pedagogic approach which insists on looking at learning from the learners' perspective by using computer tools to organize their knowledge and solving real life problems.

The project seeks a holistic approach to students' learning particularly in problem solving, not just in subject areas such as English language and Mathematics within the school curriculum. It also tries to connect students' learning to work-related problems using technology-enhanced tools and systems and to use alternative evaluation methods beyond that of traditional paper and pencil tests. Because of this integration, the anticipated viability of the project and improved learning outcomes of NT students are high. The prospects of transfer and implementation among higher achievers such as those in the Normal Academic and Express streams are very promising. The possibility of integrating the IT Master Plan for Education with some of strategies identified seem also highly feasible. Follow-up studies may focus on how to overcome the identified difficulties, revise parts of the school curriculum and teaching methods, and identify ways to transfer to similar learning contexts not only in Singapore but also other countries with similar types of neighbourhood schools and students.

The ultimate outcome is not only some models of situated learning and successful examples of integrating computer applications with school
curricular subjects but also computer-based tools for those teachers who might be interested in trying out collaborative learning in their own classrooms based on the strategic use of computers in schools.

Methodology Design

The design of the study is the mixed-methodology design advocated by Creswell (1994). The research will mix aspects of the qualitative and quantitative paradigm at all or many of the methodological steps in the design. This mixed-methodology is preferred throughout the various stages of the inquiry from the introduction, to the literature review and theory use, and in the research questions for a number of reasons. In the first instance, the purpose of this study is not to simply try out socio-constructivist approach to learning and to determine whether it is effective in upgrading students' learning outcome but also to find out which model of technology-enhanced situated learning will best work for what type of classroom with what kind of students and teachers. A quantitative research design, on the one hand, will not give us the in-depth insights into what is happening in the teaching-learning process in schools. A qualitative inquiry design on the other hand will not give us conclusive answers to the effectiveness of the use of computer tools to integrate the study of English and Mathematics, and the extent of impact on the students' self-concept and interpersonal relationship based on the situated collaborative learning approach. A mixed-methodology design perhaps best mirrors the research process of working back and forth between inductive and deductive models of thinking in this research study.

The mixed-methodology design will also accommodate many sources and types of data collected for the study. This process of triangulation is expected to strengthen the rigour of the research and open opportunities for the school teachers to do some action research if time permits.

Major steps of the study include:

1. Establishing the Team: to negotiate with the pilot schools to make arrangement for introducing the new pedagogic approach based on socio-constructivist theories and the use of a few selected computer software to the school teachers and the principals informally as well as in training workshops. It is planned that each school will send five subject teachers to work on the Project. A needs assessment of the participating schools will be conducted at the beginning of the project.

2. Teacher Training: to expose teachers to a deeper understanding of how computer tools and the collaborative learning environments can be used for teaching, and to build up rapport between the researchers and the teachers.

3. Needs Assessment I: to understand how computer-based tools and computer-mediated collaborative learning environments can be used in the curriculum, starting with English Language. The researchers will assist in lesson planning, curriculum materials development, and in setting up the communication network infrastructure.

4. Needs Assessment II: to extend the strategic use of computer-mediated learning environments to include problem solving in mathematics and to other subjects in the curriculum.

5. Prototype pilot study: to pilot the prototype and other computer tools in the four schools and to investigate the quality of learning attained.

6. Prototype modifications: to improve user-interface requirements and system functions based on our findings.

7. Development of actual system: to develop the actual system based on prototype and to improve its functions where necessary.

8. Development of instructional materials: to develop instructional materials to be used with the computer-based tools.

9. Conduct of research studies: to conduct qualitative and quantitative research studies based on the computer-mediated learning environment developed.

10. Transfer to other sites: to consider the possibilities of transferring experiences gained to other neighbourhood schools and to the other academic streams of students.

The Subjects

Normal Technical students from a neighbourhood school will be involved in the study. The reason for the choice of NT students is two-fold. First, all NT students take Computer Applications as a subject. Based on the reports of school teachers, this is their favourite subject and the only subject they have done well in the past two years. We would like to capitalise on this motivation to promote their learning in the other subjects such as English language and Mathematics. Second, NT students have been observed to have enjoyed more hands-on activities rather than learning abstract concepts. They are also found to prefer learning in groups rather than engage in independent learning. If NT
students benefit from this socio-constructivist approach to learning based on computer-mediated tools and collaborative learning environments, it is more likely that all the other academically inclined students will also be motivated to do well using this pedagogic strategy. Through such a bottom-up approach, there seems to be great potentials for generalising its application throughout the entire school system in Singapore.

Status of SUCCESS

The main SUCCESS study will be conducted over the next three years. The work that has been done so far includes:

1) Conducting two workshops for teachers and principals of four potential participating schools in April and June 1996;
2) Negotiating for entry into the potential schools through school visits in 1996;
3) Planning and implementing a pilot project in Katong Convent Secondary School from July-October 1996.

The two workshops conducted provided the researchers some grounded data about the potential schools as well as opportunities to share the objectives of SUCCESS with principals and teachers from the four schools. Four or five teachers from each school, the principal and/or vice principal were invited to the workshops. During the First Workshop, the team from each school did a brainstorming session and then shared with the researchers and the other school teams their IT (information technology) vision and mission for their schools as well as some implementation plans. In the Second Workshop, the researcher-lecturers introduced the Constructivist approach to learning with the computer as a tool for integrating curricular subjects such as English, Maths and Science. Some mock-up lessons that integrate English language learning with Science and Computer Applications learning were presented in simulated classroom situations with the researcher-lecturers as teachers and the school participants as NT students.

The participating teachers found the sessions interesting but were very skeptical that the NT students could understand what was going on if the same content and learning strategies were presented to them. They were not convinced that IT could be taught in as an integrative tool. They could only think of IT as a subject and the syllabus should be covered to meet examination requirements. However, under the prompting of the principals and HOD English, they were prepared to start linking English language with Computer Applications in process writing beginning July 1996.

In the July Term, English teachers of three of the schools started to ask their CA colleagues to get the students to type their English assignments using Microsoft Word. One school asked its students to use the Page Maker to prepare A School Newsletter on Healthy Living: Food and Exercises. The principal of one of the schools, Katong Convent, started an action research by teaching the NT3 students herself two periods of Enrichment studies a week. During the lessons, she suggested that the NT students write journals and compositions about themselves, their interests, hopes and career aspirations. All were given the option to write using the computer or using conventional pen and paper. From their writing, some significant findings about the students emerged. The researchers were surprised to find the high aspiration of the students in wanting to succeed in academic learning. Some of the students even wrote that they wished they could be given a chance to be considered for the Cambridge 'O' Level Examinations.

From the Workshops and the preliminary findings, it was clear that there were many constraints and obstacles to implementing SUCCESS in the schools based on the current education, school and IT infrastructure. For example, most schools have one or two computer labs which are shared by all the classes requiring the use of computers, and not just NT classes. Also class periods are still in chunks of 30 or 35 minutes each which makes it difficult to do project-based or collaborating learning work. Katong Convent is fortunate with only one NT class for each of the three levels and most of the other streams do not have regular use of the computer as a tool. Therefore the NT students have been given the privilege to almost monopolise the use of the two computer laboratories in the school. Under the leadership of the principal, the NT students also enjoy the privilege of being taught by the same teacher for English Language and Computer Applications.

In order for the researchers to have a better understanding of what
might be possible in a school, a pilot project of very short duration was proposed to one of the schools. The results of this pilot project will guide us in the planning of the main study.

Pilot Study in Katong Convent Secondary School

A pilot project was conducted in a Normal Technical class in Katong Convent Secondary School. This study was two weeks in duration. 21 students participated in the study and were grouped into 4 groups of 6, 7, 5 and 3 students each. The English cum CA teacher had an initial session with them to discuss the topic of shopping. She then worked with each group of students to negotiate and agree on a research question. The students are required to plan for their research, produce a survey form, conduct the survey, and analyse the results. They are expected to use MS Word to support them in their planning, analysis and writing. At the end of the two weeks, each group will produce a report and make a presentation to the other groups as well as teachers in the school.

Setting

This study took place in a computer laboratory of the secondary school. The project was carried out after the school's final examinations. The girls were permitted to use the computer lab every morning for this project. In this way, availability of computer resources did not pose a problem. The teacher planned a full schedule for the two weeks.

Subjects

The girls that participated in the study were all students from the Normal Technical Secondary Three Class. Their age range from 15 to 18 years old.

Teaching and Research Strategies

The project started with the teacher giving a briefing of what the project is about, doing brainstorming of a topic discussion with the students, and finally working with each group to decide on the group's research question. The interdisciplinary nature comes from the research questions: students will choose a question that is personally meaningful to them.

Two researchers came in the first few sessions to teach:

Journal writing: We reviewed the writing of journals with the students. The girls have been writing journals under the direction of their principal in a separate project. The girls learned to differentiate diary writing from journal writing, composition writing from report writing.

Outlining: the girls have been taught MS Word in the Computer Programming and Applications course but not do outlining. We taught the students the use of outlining in the planning and writing processes.

List Gaming: we taught the students the concept of epistemic games as structures for organizing knowledge. The students are expected to use these games to help organize their knowledge in their research. The girls also did hands-on practice using the outline function in MS Word as well as learn from a list-game tutor which teaches the constraints and moves of the List Game [Looi et al, 1996].

Data Gathering and Analysis

A qualitative study method was used for gathering and analysing the findings. The students were observed closely over the period of the project. Their previous journals, compositions and personal reflections were analysed by Oei and Chen throughout the second half of 1996. The girls were very enthusiastic throughout the pilot project. They chose their own research topics and questions, conducted the surveys in supermarkets, wet markets, shopping centres and shops in Katong and in the Orchard Road Area.

The topics chosen by the groups are:
Who frequents the supermarket and wet market?
Are branded cosmetics better than non-branded cosmetics?
Are you paying for the brand or quality?
Why do teenagers prefer silver to gold?

The students designed their own questionnaires consisting of five or more questions. They produced outlines for their reports based on the questions, though it turns out that they actually did not use these outlines to write their reports. Apparently, the teacher did not
The reports produced by the four groups represented the final stage in the writing process for the students. Microsoft Word and Power Point were used to produce the reports. They were very colourful and artistically done even though grammatical errors are found in the reports, they were evidence of very creative and original work done by NT students in solving real life problems.

Lessons Learned From The Pilot Project

Students' motivation. Students showed high level of enthusiasm in this project. They were doing research on a topic in which they were personally interested in.

Structures for supporting planning, organizing and creating knowledge. There were signs that the practice of journal writing using an outline structure and the List Game did help the students to better organize their thoughts. For example, the items in their outlines do not meet the criteria of a list initially, but after being taught the List Game and the constraints of a good list, they produced better outlines subsequently.

Group work. One of the groups made these remarks in their report: "Not only did it turn out to be just a whole lot of fun while working, but it brought us closer together and we learned to tolerate with each other needs and wants as well. We are happy that we are given this opportunity to socialize with other people.”

Learning on their own. Two of the groups of students wanted to use the graphing function in MS Word or PowerPoint to present the results of their survey. They have not been taught previously how to draw graphs. They plunged straight into graphing, asked a few questions, and within the hour were able to produce some bar charts.

Boosting self-confidence. The same group remarked: "This experience will help us a lot in our lives next time when we go out to work. I feel very happy and excited to have this chance to build up our skills and also that because then school is finally taking note that we should be given second chances to prove ourselves that we can do as well as the other pupils in other streams."

Laffey & Gibney (1996) suggest five metafunctions as a potential beginning point for building an assessment model of student-centered projects. The students' performance in this pilot study could be assessed in terms of these metafunctions:

- Resourcefulness: The students demonstrated this in preparing their survey forms, going out to places like the supermarkets and shopping centres and conducting their survey, and using graphing functions to depict their results - all on their own initiatives.
- Reflection: Self-reflection and self-assessment were not mentioned to the students. The students did not do much reflection on their work. Subsequent studies in the SUCCESS project will have to highlight this aspect as we believe that self-assessment skills make a difference.
- Authentic: The students choose problems which they perceive as personally meaningful.
- Extension: The students did not think about how their work can be continued and extended.
- Connectedness: The students were not yet able to make connections between the project experience and other significant parts of their life of community.

In fairness, this is a very short duration project. The students were not guided to think about extension of computer skills to other subject areas and the connectedness between subjects. If deliberately and systematically guided next year, the students should be able to extend further their skills in using MSWord and Power Point as well as make the connections between the practice of interviews in a survey and the writing of case reports in real work situations.

Concluding Comments

This study was mainly descriptive in nature. Based on the findings, we have a better idea that a project-based cross-subject approach with specific learning objectives is beneficial to the students. This study reaffirms the value of students doing projects by Laffey & Gibney (1996) that:

"Students learn valuable competencies and begin to build a mental model of what it means to do research projects when you are serious about your project and when people take your project seriously." (Italics ours).

It is an example of how Computer Applications can be integrated into the English language curriculum. Computer software, in this instance,
Microsoft Word and Power Points, were used as tools for integration and presentation of ideas and academic learning. Both the hardware and the software, if used purposefully and in a controlled fashion, could achieve significant results that exceeded the expectations of the researchers. The students have learned a great deal about language and computer skills. They have acquired some cooperative learning and social skills. The experience seemed to have raised their confidence and self esteem. If guided properly, the students may develop in areas that are totally unexpected. They have not only been motivated to learn but presented themselves so well that the entire school staff who were present at their presentation were really surprised by the outcome.

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