Interactive Multimedia Collaborative Strategies Employed by Upper Primary School Students: A Case Study

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Abstract

This case study examines the collaborative problem-solving characteristics employed by some upper primary school students during their construction of an interactive multimedia project. The study is set within the constructivist paradigm where students construct their learning and build on their knowledge as their project progresses. The evaluation of the study was also set within the constructivist paradigm, using Fourth Generation Evaluation (4GE) (Guba & Lincoln, 1989). Two groups of students included four students from Year 5 who produced a module on whales, and four from Year 6 who produced a module on dogs. Both groups had access to Authorware 4, Microsoft Word, Works 4 and Photoshop. Six of the students were able to transfer strategies for problem-solving and utilise them while working on multimedia programs. This confirmed that positive transference had taken place for students while working with multimedia programs. Based on the findings it is recommended that problem-solving strategies be provided for multimedia students in primary schools.

Background

In school-based computer technology lessons, some students have difficulty in communicating their needs, their intentions, or the problems they are having with a program, and this often leads to frustration and incomplete assignments. The current literature debate extends beyond why technology should be taught, to how technology should be presented in schools within the curriculum framework. Much of the literature focuses on the pedagogical practices of teachers, the fear of technology and de-skilling, and implementation (see Goldman and Hocking, 1999, 2000). There is little literature on the application of problem-solving strategies used with interactive multimedia technology. This case study was designed to investigate whether collaborative problem-solving strategies could enhance the

learning capabilities of students using interactive multimedia programs.

Since the introduction of the personal computer into classrooms there has been considerable research on its impact on the educational process (Altbach, 1997; Bigum & Green, 1993; Goldman & Hocking, 1999, 2000; Gregoire, Bracewell & Laferriere, 1996; Smith, Curtin & Newman, 1996; Spender, 1994), on the pedagogical implications of computers within education (Anderson, 1998; Carey, 1997; Goldsworthy, 1997; Harrison, 1997; Matos, undated; McCarthy, 1996; Moersch, 1996; Russell & Russell, 1993; Shearman, 1997; Windschitl 1998), and the ethical, equity and economic impact computers have within education (Bigum & Green, 1993; Lewis, 1998; Oppenheimer 1997; Postman 1993; Spender, 1994). However, little research has been conducted on how students use the computer (Cognition and Technology Group at Vanderbilt (CTGV), 1997; Windschitl, 1998). The research, referred to above, focuses mainly on the programs students use and how much time they are spending on the computer, rather than how effectively they are using the facilities offered by the computer.

Children's Difficulties in Computer Classes

This study was conceived from the observation of Year 5 and Year 6 students working on school-based computer projects. The students were being taught various forms of computer skills, including basic keyboard skills, touch-typing, word-processing, publishing, basic graphics construction, using the Internet, navigating between programs, file storage in Windows and "playing" educational computer games. Here, the term "playing" may be considered an understatement since the games loaded onto computers require knowledge in mathematics, science or language, as well as problem-solving capabilities in order for the player to progress through the various stages.

In observing students working on computer projects and games, it was noticed that a number of children had difficulties in completing tasks, verbalising their intentions or discussing the problems they encounter. Whether the problems were technical, academic or social, or when the child was working individually or within a group, some children appeared to lose sight of the objective/s of the task. This had an impact on the students in a number of ways, including unfinished assignments, a disrupted classroom, or a withdrawn, dispirited child, who no longer enjoyed computer-time. After using a program, students often became frustrated and had angry outbursts when they found that they were not able to solve a problem which would allow them to progress to the next level. When students were asked a ques-

tion by the teacher, they frequently knew the correct answer. However, students appeared to be lacking in the skills and strategies necessary for solving a problem when it was presented as a riddle or in puzzle form. Further, when students were working together on a project or game, there was often conflict when they could not agree on an idea or when one student wished to use a different strategy. It then appeared that the failure of the students to complete the tasks was due, in some measure, to their lack of understanding of collaborative problem-solving skills and strategies.

Children's Collaborative Problem-solving

There are many different theories, methods and strategies, which may be implemented to assist children to develop their thinking and problem-solving skills. However, not all of these are easily incorporated into the context of technological problem-solving. Jonassen (1996) believes that when students construct their own representations of what they have learnt then they will develop greater comprehension and recall, and an even greater level of achievement can be reached when individuals work collaboratively. As Dockterman (1997:1) notes;

True co-operative learning involves more than simply putting students into groups. It also involves more than taking turns with a limited resource, like a computer. Collaborative learning succeeds when students within a group really depend on one another.

Students who have access to interactive technology have displayed better organisational skills and greater problem-solving capabilities claims Dwyer (cited by Riley, 1998). Brown and Riley (1997:35) agree, stating that interactive multimedia can open students' thinking to wider scrutiny. This allows them to recognise that knowledge is constantly changing and dynamic. While Quinn, Boesen, Kedziar, Kelmensen, and Moserand (1993) agree that the interactive environment enhances the cognitive problem-solving skills of students, they also warn that the instructional environment is conditional on the understanding of the language. However, this can be overcome by using collaborative problem-solving groups, claim Rada, Michailidis and Wang (1994). They explain that student involvement in collaborative projects promotes an active learning environment where students may learn more effectively.

The learning environment developed through a cohesive collaborative problem-solving group can promote an atmosphere of safety and trust, where students feel that they can safely take risks, make decisions, and persevere with the required tasks (Bennett & Diener,

1997). Cohen (1994) agrees, stating that when students work within groups they are communicating about their assigned tasks. In order to complete these tasks successfully, they need to ask questions, explain, suggest, critique, listen, agree and make joint decisions, as a group. The main tenet for group project work, then, is to provoke good discussions, collaboration and a chance for all to participate (Slavin, 1990). Duffy and Jonassen (cited by Smith-Gratto, 1995) propose that, as well, for any concrete learning to occur, students need to work with realistic problems within realistic contexts. Since problems usually have many aspects, multiple viewpoints should be explored by students in order for them to build networks of related ideas.

Thinking Skills

All the skills used in problem-solving tasks within interactive multimedia require higher-order thinking skills, as shown, for example, in Bloom's Taxonomy (undated) namely knowledge, comprehension, application, analysing, synthesis and evaluation. Although a number of interactive multimedia programs require the use of higher-order thinking skills, it does not mean that only gifted students can operate within a collaborative interactive multimedia group. Boser, Palmer and Daugherty (1998) agree stating that students can further develop their higher-level cognitive skills by participating in technological activities which are group- and problem-centred. Troxclair et al., (1996) found that most students improved their written and communication skills when they worked on a collaborative multimedia project. This was verified by Cunningham, Angeli, Morton and Cunningham (1998) in their study using interactive multimedia programs to build literacy skills in 22 primary school students. Their research showed that the students not only improved their literacy skills, but also improved their communication, problem-solving and teamwork skills. The latter findings of the research were not initially sought after. Nevertheless, the results were so evident that the students were able to affirm the findings.

Teamwork skills are a necessary part of the framework of technology education (Barak & Maymon, 1998), not only because there is usually a shortage of computers, mainly due to the poor student-to-computer ratio within most schools (see Goldman & Hocking, 1999, 2000), but they also assist students in learning to work with and support others. Goldman (1997) asserts that one of the most important principles of teaching is to stimulate active involvement in learning with the use of technology to facilitate this learning.

When students are motivated and actively engaged in learning, teachers can encourage them toward more productive activities

(Slavin, 1990), although teachers are warned that their students will not necessarily have developed group and problem-solving skills (Cohen 1994; de Bono 1992, Baker and Baker 1994). As de Bono (1992:42) notes, 'the skills of creative thinking . . . have to be learned directly in their own right'.

Programs which are designed for thinking and problem-solving skill development often involve only learning strategies for remembering things, such as acronyms or acrostics (Cognition and Technology Group [CTGV], 1997). It is considered by CTGV (1997) that appropriate problem-solving skills should incorporate strategies for breaking problems into parts, working backwards, as well as incorporating creative skills, brainstorming and abstract and lateral thinking which should lead to defining and achieving the group's objectives.

Constructivist Paradigm

Constructivists view the learner as an active participant, building knowledge founded on his/her own individual experiences, where the individual gains an understanding of the new experiences through relating it to previous experiences (Smith-Gratto, 1995; Jonassen, 1996). Smith-Gratto (1995) states that constructivism is ideal when working with multimedia technology, as the students are able to learn programs, use the programs and solve the problems which occur, thus constructing new meaning to their knowledge of multimedia technology (Jonassen, 1996).

Fourth Generation Evaluation (4GE)

Conventional forms of evaluation tend to look for some form of verification of a hypothesis, to quantify (or qualify) some scientific theory, to prove links to certain behaviours, or have value laden judgments (Guba & Lincoln, 1989; Rubin & Babbie, 1993; Best & Kahn, 1998). Therefore, conventional forms of evaluation are not appropriate to use with a constructivist paradigm. Guba and Lincoln (1989:70) state that 'constructions represent the efforts of people to make sense out of their situations'. Essentially, we are constructions of our own experiences and constructions are also shared, usually within a cultural context. The nature of construction depends on two things: the range or scope of the information and the constructor's capability of coping with that information (Guba & Lincoln, 1989:71). Group members, as well as being self-assessing, are capable of assessing the task-related performance of other members in their group, notes Sullivan and Reno (1999). Therefore, the participant in a study graduates from the position of client, to subject, to stakeholder, as s/he brings her/his knowledge and experience into the evaluation process (Guba &

Lincoln, 1989; Stake, 1995; Jonassen, 1996). Accordingly, as evaluation is a collaborative process and all participants are stakeholders in the research, it creates the ideal setting for a collaborative working environment (Guba & Lincoln, 1989).

Method

This study aimed to examine the characteristics of the collaborative problem-solving skills used by some upper primary school students while they developed their interactive multimedia project. The case study was undertaken, with the students working in two groups, one from Year 5, one from Year 6, each containing four participants. Each group was required to design and develop an interactive multimedia project. For the project the students used Windows 98, Word 7, Authorware 4 a multimedia scripting program developed by Macromedia, Microsoft Word for drafting of text, Works 4 for the construction of graphics, and Photoshop for importing photos and developing backgrounds. In order to enhance the collaboration and problem-solving skills of the groups, preparatory collaborative exercises were undertaken. Students were introduced to two forms of problem-solving techniques, de Bono's six hats and Jonassen's Mindtools, which enabled them to choose how they would solve the problem.

Sample

For the purposes of this case study, it was necessary that students had moderate-level prior problem-solving instruction, interactive multimedia programming and multimedia project experience. Therefore, a purposive/judgmental sample was used (Rubin & Babbie, 1993; Fetterman, 1998). Two groups of four children (N=8) were selected from two Year 5 and 6 classes in a small private school located on the New South Wales/Queensland border. There was an equal gender mix of two males and two females (n=4) in each group.

The students selected had been assessed as having moderate level computer experience in program navigation which they gained through previous computer education classes conducted at the school. They had all played interactive educational computer games and had previously used basic windows programs, such as Microsoft Works 4, Word for Windows, and Publisher. All students had been taught computer keyboard and program navigational skills in computer education classes at school, and were considered to be competent both academically and in computer skills. The students selected had no prior training in co-operative learning, nor had they been taught problem-solving techniques until now.

Social Background

All students came from a similar mid-range socio-economic background, attended the same private school and lived within the same lightly urbanised region. One or more of their parents had participated in tertiary education, and eight parents were employed professionals. All the families had either a computer in their home or access to one outside school hours. All families willingly gave their consent for their child to take part in the study. They also consented to provide family background information and to allow follow-up interviews if necessary. The principal gave consent for this study, conducted during school hours, and viewed it as an advantage for the students to be able to gain new knowledge while contributing to educational research.

Data Collection

The data was gathered via a number of modes, including observations of the students as they worked within their collaborative project groups. Open interviews were conducted with the participating students and their teachers to record their perceptions of the progress being made with the project, group collaboration and the development of problem-solving skills. Some collaborative group problem-solving sessions were videoed to assist with confirmation of the written data gathered during observations. The main principles of the data collection were to use multiple sources of evidence, create a data base on the information gathered, and maintain sequential evidence of the data collection (Yin, 1989).

The data collection continued over two school terms: a period of 17 weeks, with a three week interval of no data collection during the mid-section of the study. Data were gathered from written records of observations, videoed observations and recorded interviews. A follow-up interview with each student took place, where notes were taken. This assisted with triangulation and participant validation. From a constructivist perspective and given that each participant is aware and has a sense of self, then the participant becomes a stakeholder in the study and its validation and evaluation process (Stake, 1998:1). The students are known throughout the study as G (for girl) 1 and 2, and B (for boy) 1 and 2. To distinguish between the Year 5 and 6 groups, the Year 6 cohort have a 6 prefixed to their code (e.g. 6G1 for Year 6, girl 1), and the Year 5 have a 5 (e.g. 5G1).

Group Observation and Interviews

The collaborative problem-solving characteristics of the students were observed as they worked cooperatively in developing their interactive multimedia project. Students were required to develop storyboards to design the flow of their project. They used computerised

recording equipment for audio, which was stored as wave files. Midi sound files were also used for music and sound effects, however, these had to be converted to wave files, as Authorware does not accommodate midi sound files. The students were interviewed individually and within their group about the problem-solving skills they utilised during the preparatory group problem-solving activities, and then during the building of the interactive multimedia project.

Confidentiality

Confidentiality was a concern, particularly so that the trusting bond built between participants should remain intact. It was therefore decided that all interviews, whether individual or group, were to be confidential (Rubin & Babbie, 1993) so that a sense of security could be maintained, and so that students would feel safe to share with the rest of the group (Best & Kahn, 1998).

The Setting and Equipment

The study was conducted in the computer lab in the small private community school. The lab is in an ante-room connected to a classroom used by Year 4 students. Although the room is small, it accommodated the two groups comfortably on the carpet area when they worked on problem-solving activities. The computers used were IBM compatible clones, with a large memory and RAM capacity comparable with the latest in available hardware. Scanning equipment and the Internet were also used for downloading graphics and information for the projects. Windows' sound recorder was available, but because the monitors did not have built-in microphones it was necessary to fit a portable microphone for the sound recording.

Procedure

All the students in each group were of similar age, about 10 or 11 years. They had been classmates during the past year. They worked individually or as part of their group. Each group was responsible for their own project and accountable to each other for their input to the group. The groups were informed that group consensus must take place with any decisions made, and as they were all stakeholders in this information-input then they were responsible for the decisions made by their group.

Each week the groups retired to the computer lab for three sessions. Two sessions were used for preparatory collaborative problem-solving skills instruction, development and activities (See Goldman & Krause, 2001). One session per week was dedicated to training the students in computer programs which they would use in the construction of their project. However, all members of both groups were

informed that they could meet and discuss their project at any time they wished, and that they did not have to wait until they were having a group session to do so.

During the course of the study the groups decided that they would have “peer experts” within their group, so the tasks could be divided, and each group hopefully would thus work more effectively. These experts were assigned to different tasks which required gaining knowledge in different program areas. The experts were then taught the required programs so they could then share their knowledge whilst working with their group.

Results

The Construction of the Multimedia Projects

It was decided, by consensus of both groups, that the projects being constructed were to be of educational value for other students to use. The two groups discussed the age appropriateness of topics and what Year levels they would be directed at. Both groups agreed it would be easier for them to construct an interactive multimedia project for grades younger than Year 4. They based this on the assumption that if they were constructing the projects for their own year levels, then they would be under scrutiny from their peers, and they wished to avoid that; which is telling indeed. The groups decided that Year 5 would aim their project at Years K-1, while Year 6 would aim theirs at Years 2 to 3.

The Year 5 Multimedia Project on Whales

The construction of this project was undertaken in stages. The group decided first to collect all the data possible (sic) on whales. They collected statistics on whales, pictures were scanned, and other graphics were downloaded from the Internet. They then met and eliminated information they thought would be inappropriate or too mature for their audience’s year level. Since the project was to be educational, the group decided that the material contained in the program would also be informative and entertaining. 5B1 aimed for a fun program, where the interactor would be able to use miniature whale navigational buttons and click on pictures depicting the sub-topics in the program. The group chose to write the sub-topic labels in question form, rather than just to use title labels. These sub-topics were labelled on top of matching graphics and made into roll-over hotspot buttons, which changed colour when the user rolled over them. This made it easier for the user to identify the entrance to a new section, and the user knew that they just had to click to enter.

Some of the sub-topics and their button graphics were as follows;

Sub-topic label	button graphic used
What do whales eat?	party food
Where do whales live?	a house
How big is a whale?	a big whale and a little whale juxtaposed

The group also chose to use voice-overs in all sections of the project. The music was converted midi music accessed from the Internet. It was a mixture of Disney's 'Under the Sea' and other synthesised music which "sounded bubbly". The group also entered whalesongs and other marine noises. The sounds were appropriate for the audience age level, as were the graphics. However, there were large amounts of text, which contained words that a K-1 level student would not be able to comprehend. The Year 5 group justified this by arguing that it was an educational program, and would therefore normally be used with a supervising teacher who would be able to read the text aloud, and explain the meanings to the children.

The Year 6 Multimedia Project on Dogs

The project constructed by the Year 6 group was on the subject of dogs. A group discussion revealed that since the topic of dogs covered a broad spectrum they would need to refine it a little. The group decided that students in Years 2 to 3 would be the target audience for their project. The group also decided that they would include information which, they thought, would be useful to children of that age group. They included sub-topics such as different breeds of dogs, how to choose a dog as a pet, and how to care for a pet, including registration and de-sexing.

The Year 6 group then realised that these sub-topics would also include subsets of information. With the use of a flow chart they were able to work out where to place the information and how to present it. They also decided on the type of information that they would include, and how it would be presented. The group agreed to use a lot of graphics with roll-over hot spots, which were then linked to text boxes or voice-over information. They also included pictures of dogs, loaded as buttons, to guide the user to the information about that breed of dog. The Year 6 group worked on developing some age-appropriate characters to guide the user through the program. These characters were prominent as "back", "next" "quit" and 'information/instruction' but-

tons.

The Year 6 group gathered a great deal of information on different breeds of dogs from a number of sources which included the Internet, Encyclopaedias, books on dogs, and information from the local City Councils, veterinarians, the Royal Society for the Prevention of Cruelty to Animals and the Animal Welfare League in the Gold Coast/Tweed area. Consequently, the group members found they needed to edit some of the information, by selecting what they wanted to include and to exclude. This led to periods of disagreements and dissatisfaction for some of the group members, as different members wished to include different types of dogs. However, each time there was conflict, the group utilised their de Bono 6 Hat method of problem-solving and they arrived at a consensus.

A great deal of time and effort was put into the selection and construction of what the group felt was the appropriate background, the title screen, the buttons, and menu banners. The group constantly used the Photoshop program to adjust colours, sizes, shapes and the blending and overlaying of graphics. The final result was a soft-coloured background with puppy paw-prints, a super-dog was used for the information/instruction button, a puppy pointing to the left for the "back" button, and to the right for the "next" buttons. The tail-end of a puppy was the exit button. The buttons on the main menu leading to the sub-topics were three-level, roll-over highlighted, and loaded with voice over instructions.

The roll-over highlights were changed slightly to distinguish between the active and inactive area of the page, and some of the highlights were changed so that the character on the button appeared to be animated. For example the "Caring for Dogs" button had a graphic of a dog's head in the inactive position. However, when it was rolled over and in the highlighted position, the mouth of the dog opened to display the title of the section, and a voice-over announced the section contents. When the mouse was quickly rolled over this button, the dog looked as if it was opening and closing its mouth. The children were delighted to have created this "animation". This small button involved complex knowledge of how to use the Photoshop program and also how to load the graphics in the correct order so that the roll-over worked in the correct manner. This called for high level multimedia programming skills and a high level of understanding of the Photoshop program tools and manipulatives, and also a high level of collaboration from group members.

Discussion

Group Dynamics—Year 5

The development of the interactive multimedia projects brought a shift in the group dynamics, especially in the Year 5 group. While 5G1 was one of the main participants in the activities, she often withdrew from the group in the early stages of the project construction. 5G1 reported that she just wanted to “get her work done”. However, she also stated that she had no intention of consulting with the other group members about her tasks. 5G1 often displayed individualistic tendencies, which could possibly be attributed to her need for recognition, as this need was not being met elsewhere in her life. She also exhibited a strong competitive trait and believed that all the members of her group were competing to “get their work done first”. This perception was not shared by the other members of the group.

5B1 was an excellent collaborative worker and was able to consult with others in the problem-solving process. At times, 5B1 had difficulty in navigating through the Authorware program. However, he would ask the researcher for assistance and B1 would then be able to accomplish what he had wanted to achieve. 5B1 worked closely with 5B2. They continually discussed how they would present the information, and were precise in the construction of the program’s details. 5B1 and 5B2 would include 5G2 in all their discussion and decision-making. These three members would often try to engage 5G1 into these discussions, but to no avail, until the group realised that they really needed her collaboration to load the graphics in the correct size and order. It was only after a number of accusations and an outburst by 5G2 that 5G1 agreed to look at the program and see how the graphics should be presented. 5G1 took quite some time to admit that there was a problem fitting a “whale” button four centimetres long into a space of two centimetres, while also noting that her navigational buttons were not matching in colour, nor of the same proportion. After looking at the graphics after they had been placed into the Authorware program, she relented and asked for input from the Year 6 group. The Year 6 members, working on the computer next to the year 5 group, gave the Year 5 group some excellent suggestions and assistance. This was the first time that the two groups had worked collaboratively. Until that stage the Year 5 viewed the year 6 group as their competitors, and would not take any suggestions from them, nor would allow them to discuss their project or see their work.

The Year 5 group was not able to achieve cohesiveness during the course of the study. Although 5G1 did eventually collaborate with the other group members on the graphics designs, she still had difficulty in coping with other people’s suggestions. She stated that she felt she

was the artistic member of the group and therefore should have expert status. When it was explained to her, during a group discussion, that expert status in collaborative group work meant that the expert was the one who *shared* her/his knowledge with the rest of the group, she revealed that she was unwilling to do that. 5B1 and 5B2 coped quite well through all the conflict and they continued to work collaboratively to achieve their goals. However, 5G2 was unable to cope with the conflict and she spent her time moving between the role of instigator and victim. She lacked interpersonal skills, in not being able to display any of the problem-solving techniques used in the preparatory activities, and she eventually withdrew from the group.

Group Dynamics—Year 6

The Year 6 group's project was of a professional standard. 6B1 and 6G1 were the main constructors. There was never any question of gender differences or bias involved at any stage of their project. In fact, when the experts were being decided for the groups, 6G1 was nominated for the programmer's position. However, she stated that she would prefer to do the graphics, if that were agreeable with the other members. 6B1 then took the programmer position only after he had confirmed with 6G1 that she was sure of her decision. The Year 6 group progressed with their tasks collaboratively. Although 6G1 or 6B1 were inventive and forthcoming with their ideas, neither displayed any individualistic behaviours. 6B2 was always attentive during the construction of the project, and, was willing to learn. This supports Stemler's (1997) approach, stating that multimedia is a learning process rather than a technological tool.

The Year 6 group always discussed their problems with all the group members present and ensured that they reached a consensual agreement on all matters. 6B1, 6G1 and 6B2 displayed capabilities in the areas of interpersonal and intrapersonal skills. Even when 6G2 was trying to provoke conflict with the other members, the group remained cohesive. The group chose to acknowledge 6G2's behaviour, labelled it and informed her that her behaviour was not benefiting the group's efforts, and hoped that she would deal with her issues. 6G2 chose not to conform to the group's norms and withdrew. During discussions about the progress of the project, and the group, the three remaining members of the Year 6 group were supportive of each other and no one took part in any put-downs or blaming others for problems. This was found to be an admirable quality, in these young students, especially in light of the conflicts that were being generated by 6G2. The other group members remained loyal and tried to be supportive throughout. This was in accordance with the findings of Gagnon and Collay (1995) and Jonassen (1996) who believe that when

constructing knowledge, through developing their own projects and problem-solving, children will develop greater comprehension and recall.

Collaborative Problem-solving Characteristics and Choice

Six out of the eight students could confidently use the strategies of de Bono's Six Hat thinking during exercises. However, not all students could employ these strategies and techniques when faced with a problem during the construction of the multimedia project. It is doubtful that this was due to a lack of positive transference, as all students had showed that they had the knowledge. During discussion, the students related that sometimes they "just forgot" to use any of the learned techniques, and sometimes they chose not to because they were "mad at someone". Once again value judgments and responsibility for one's own actions were prominent (Johnson and Johnson, 1997). During such discussion, a number of interesting pieces of information were gathered which assisted in linking the issues of conflict within the groups.

5G1 and 6G2, who were often the instigators of conflict within their group, became close friends. 6G2 stated that she didn't like the "attention that 6G1 received from the boys in the group" and she "didn't like the way 6G1 and 6B1 were always working together". This confirms that some students responded or behaved in a group according to their own beliefs, values and needs. 6G2 displayed a lack of intrapersonal and interpersonal abilities. It became evident during the course of the study that 6G2 was only focused on meeting her own needs. She was unable to share her needs with the rest of the group, as she was too embarrassed and felt she would risk rejection from 6G1 and the other members of the group if she made her feelings known. She did not make any attempt to use the problem-solving strategies. Unfortunately, for 6G2, this led to frustration, negative behaviour and withdrawal. The Year 6 group had continually tried to include her in their discussions, but 6G2 eventually withdrew from the group.

6B1, 6B2 and 6G1 agreed that without the knowledge of using the problem-solving techniques, they would not have been able to find solutions to some of the problems which arose. 6B1 identified the useful ways in which the Six Hats could be used to find solutions. For example the group often used brainstorming to find ideas for graphics and buttons. Then, they would use the Six Hats to make a selection from those ideas. The Year 6 group also used this method to analyse the construction development. The group members would look at the project and discuss each screen using the Six Hats (what's good; what's bad; what could be changed; how can it be improved). The Year

6 group stated that by using this method they were able to scrutinise their own work individually and collectively with the group, and not “get upset” when negative comments were made about the work.

Using Multimedia Programs

A sub-set of findings in this case study revealed that four of the students accomplished a very high level of achievement while working on the multimedia programs. 5G1 was able to effectively manipulate graphics in the Photoshop program, and she often used this program for computer art as she explained that it allowed her a greater choice of options than the basic paintbrush programs. 6G1 also developed an excellent understanding of the Photoshop program and became adept in overlaying graphics and text, and reshaping images.

5B1 was comfortable using the Authorware program and was able to link the framework with navigational commands. The knowledge he gained through the study was remarkable. He was able to flow through the navigational processes of the Authorware program with ease. He constructed complex buttons and hot-spots within the framework of the project. 6B1 also learned basics of the Photoshop program from 6G1. Likewise, 6G1 became a capable Authorware programmer. Through 6B1’s instruction she was able to move through the different levels of the project’s framework, load graphics and manipulate the contents within the Authorware program.

An Interest in Hardware

Another sub-set of findings was that four of the students, two from Year 5 and two from Year 6 gained a growing interest in the different functions of computer hardware. Through discussions with these students they revealed that they had recognised the different specialty parts within the computer, and how those parts are needed for the different programs used. For example, they realised that a sound card was necessary for the production of sound. The students, during the project, had thus developed a greater understanding of the working of a computer and how programs were implemented through the computer. This also led to better problem-solving capabilities when a problem arose with the computer. During the course of this study these students were appointed as school computer monitors within the school, as they were able to trouble-shoot problems, disassemble, move and reassemble computers when required; a serendipitous outcome.

Conclusion

This study showed conclusively that when students use appropriate problem-solving strategies, while working with interactive multime-

dia programs, they are able to work collaboratively and more effectively in the construction of their knowledge. Six of the eight students were able to transfer their knowledge of problem-solving strategies and utilise it while working on multimedia programs. This confirmed that positive transference had taken place for students to employ problem-solving techniques while working with multimedia programs.

The use of collaborative problem-solving strategies while using multimedia programs has enabled these students to work effectively as a group and as individual members within their group. The students' construction of knowledge enabled them to use the problem-solving strategies while working in other areas, such as research, developing a flow chart and writing text-based information.

Even though the Year 5 group could not be characterised as cohesive, two members displayed excellent collaborative group skills. A variable, year level, which was not included in this study, is that the Year 6 group worked more effectively than the Year 5 group, however, they have had an extra year of computer tuition. It was surmised that since all the Year 5 students had received training in basic computers, and they had played interactive games, that this would counteract any conflict in data variables. It may well have been that the lower level of maturity for the Year 5 group may have been a variable of greater influence. If this study were to be replicated it is suggested that two groups of students be selected from the same grade and class to address this query.

Finally, the projects were effective from the viewpoint that there was positive transference of the collaborative problem-solving skills into interactive multimedia development. Based on the outcomes here, it is recommended that problem-solving techniques be taught to all children working with multimedia programs, enabling them to find ways of making informed decisions, including being informed that their personal values and experiences can impact upon their group behaviour and the choices they make. The constructivist paradigm was used and the students displayed effective concrete learning as they were facing real problems in the context of real demands on what they were developing, and what they had to produce as a group. To assist students in developing a solid learning process, the results of this study suggest that teachers need to implement a constructivist paradigm when incorporating computers into the curriculum. By utilising interactive multimedia programs, the teachers and students can access, create and develop a learning process, which will help construct knowledge, recall and comprehension. There is no doubt that

interactive multimedia is neither just a toy nor a tool; it is an excellent learning asset and when properly utilised can assist in promoting learning skills for students.

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