Collaboration and Learning with Logo: Does Gender Make a Difference?

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Abstract

The present study represented the final in a series of five which explored the performance of children in Logo tasks while they worked in one of three gender pairs (girl, boy or boy/ girl). Differences in performance based on the gender of the pair had been apparent in the early studies when specific types of tasks were presented as initial experiences in the new domain. The present study analysed the strategies and interactions of 30 pairs of children (mean age 7 years 3 months) in relation to three sets of tasks. The children worked with the screen version of Logo (LCSI) in tasks that required them to make accurate copies of given (Logo) figures and to direct the turtle up a path to a destination The results revealed that when the copy task was presented first and followed by the track task there were no significant differences in performance in terms of accuracy or efficiency of moves made in order to reach the end of the path. This was a contrast to previous findings when the track task had been presented first. The current research illustrated that performance was moderated by the type of strategies that were deployed and the nature of the collaboration of the pairs.

Keywords — Learning with computers, gender, performance with Logo.

1. Introduction

Recently there has been an increase in pressure on early childhood educators from parents and administrators to incorporate computers and other forms of technology into early learning environments. Yet the information that is available to early childhood educators pertaining to the perceived benefits to learning, of the new information technologies, and indeed, descriptions of how they can be used in early childhood settings, is scarce. Thus, it is not surprising to find that most are still sceptical that the financial outlay is not matched by the perceived educational benefits. Early childhood settings are characterised by active exploration, talk and collaborative learning partnerships. The computer is often viewed as being developmentally inappropriate for young children because their applications focus on the two dimensional and abstract concepts, programs that encourage individual participation and thus no opportunity for social interactions and engagements that can foster language and cognition. The present research sought to provide information to early childhood educators pertaining to learning with technology and to highlight some of the ways in which teachers and learners can facilitate cognitive and social aspects of learning, within a specific computer environment; Logo.

In most of the studies of young children exploring with Logo, their performance, whether working individually, in pairs or small groups, has been described and related to either specific methodological issues pertaining to curriculum and teaching (e.g Hawkins, Homolsky & Heide, 1984; Noss, 1984;) or to cognitive theories of learning (e.g. Clements & Nastasi, 1985, 1988; Webb, 1982, 1984). Only a limited number of these studies have considered performance with reference to the gender composition of pairs, small group or indeed individuals. (e.g Gunterman & Tovar, 1987; Hoyles and Sutherland, 1989; Hughes, Brackenridge, Bibby & Greenhough, 1988)

Hoyles and Sutherland (1989) noted differences in the programming styles of boys and girls and also differences related to the nature of the collaboration and attitudes while working. However, at the end of a three year project found no gender differences related to the student's ability to use the ideas of structured programming when working on a well defined task, the ideas of a variable and either a top-down or bottom-up approach to planning. They also indicated that a girl was "more likely to share her problem with her partner, her representation of the problem, and her ideas for problem solving." (p. 171). They provided

useful advice about the dangers of coming to quick and superficial conclusions about supposed gender differences on the basis of short term performance and warned against the use of slogans such as "Girls do not plan and boys do not collaborate in their computer work or boys are better than girls in programming" (p. 177) They enforced the idea that statements need to reflect the context in which the activities have occurred and to consider development over a series of tasks and time.

Studies that preceded the present research (Yelland, 1989, 1993, 1994a, 1994b) revealed that young children's (6 and 7 years) performance in Logo tasks was moderated by factors such as the task structure, the style of interaction in dyads and personality characteristics that affected the way in which the problem was solved. The results of these studies also indicated that performance was differentiated according to different levels of operation to task solution which were the result of a number of features, such as comprehension of the task requirements, the selection of appropriate strategies for solution and the application of selected executive processes. The use of such processes ensured a more effective level of task solution that reflected a greater level of sophistication in the application of problem-solving skills. The studies highlighted qualitatively different levels of performance, ranging from naive to knowledgeable, that were distinguished according to the types of processes that were deployed in the problem-solving context, and the influence and application of prior knowledge relevant to task solution. The studies also indicated that performances were differentiated on the basis of gender according to specific criteria and related to certain types of tasks. However, with experience in the domain and with changes in tasks design and presentation, such differences disappeared. They also highlighted that collaborations varied according to the gender composition of the pair in initial experiences in a new domain with specific types of tasks. Girl pairs frequently sought more information from each other and used verbal strategies to work through their problem-solving. This was contrasted with the style of interaction of boy and boy/ girl pairs who tended to make more independent moves and talk often centred on disagreements rather than clarification of ideas and strategies.

2. Method

2.1. Sample
The children who participated in the study were 60 children in Year 2 of a State Primary School in a suburb of the city of Brisbane. The mean age of the children was 7 years and 3 months. All of the children had used a computer in the school context and ten had a computer at home. None of the children had previous experience with Logo.

2.2. Procedure
The study took place over a period of 6 weeks in the third term of a four term school year. There were four main sets of events that constituted the research design: the pre observation activities, the preliminary activities, the copy tasks and the path task.

Pre-observation activities
The pre-observation activities were designed to obtain information about the children's previous experience with computers and their abilities in mathematical operations.

Playing Turtle
Before the children attempted the activities on the computer, we "played turtle" in the playground. The children participated in activities that required them to give and follow directions, such as moving forward or back and turning left and right in order to reach specific points.

Preliminary Activities
The children were introduced to the Apple IIe computer and a one key version of LCSI Logo. Each session was videotaped so that an accurate record of the children's performance could be obtained and was later transcribed for the data analysis. In the initial session the children were introduced to the four basic commands together with various input numbers and "housekeeping" commands were demonstrated (rub out, home, clearscreen, space bar, pen up, pen down). They were then given the opportunity to play and explore with these commands for 10 minutes.

In the first three activities the turtle had to be directed so that it would face a tree. The moves that would achieve this were turns of R 90 (or L 270), R 40 (L 320) and L 120 (R 60). Next, the turtle was placed 100 steps away from (a drawing of) a tree and had to be directed to it. No turns were necessary in order to achieve this. Then, the children had to direct the turtle up a path consisting of two right angles and three "stretches". The optimal moves to complete this task were: F 60, R 90, F 70, L 90, F 40. Finally the children had to try and make an accurate copy of three items each of which had two sides of 50 turtle steps, the first was a right angle, the second an obtuse angle (130°), and the third and acute angle (60°)

Copy tasks
The children were presented with two items to copy: a flag and a house. As with the copy task items in the preliminary tasks they were told that they has to make the turtle draw the items as carefully as possible, so that they would look like the picture on their screen.

In scoring each of the items it was apparent that the number of moves made to complete the first five (preliminary) items were appropriate together with a record of the time taken and the number of moves that were made off the path. However, in the copy tasks it was evident that this was not appropriate since accuracy of the copy made was more important than the amount of moves made. Thus, a scoring system that was developed in previous research was used. A score was obtained for the length and angle based on the deviation from the perfect copy. For any combination of moves that produced the desired length of the segment and the (total) correct amount of turn to produce the angle, the inaccuracy score was zero. A score of one was given for deviations from these parameters for each unit that the deviation varied from the desired amount.

Path task

In the path task the turtle had to be directed up the path to the baker's shop, situated at the end of the path. The path consisted of five "stretches" and four turns. The following instructions were given:

1. "You have to take the turtle up the path to the bakery, so that it is just in front of the door, in as few moves as possible." This instruction was then confirmed.

2. "You have to stay on the path. If the turtle goes off the path you have to try and get it back on the path as soon as possible."

3. "I want you to work together to do this and help each other. You can talk to each other and it may help to think about when you played turtle in the playground."

Analysis of interaction

In a previous study (Yelland, 1994b) categories of interaction were generated in order to attempt to characterise the nature of problem-solving strategies that the pairs of children engaged in. These were incorporated into the present study and in the initial analyses only the behaviour for the path task were to be transcribed and coded according to the following categories in order for a comparison to be made with the previous work. The categories were:

1. asking for information/explanation
2. offering information/explanation
3. agreeing with the information/explanation
4. disagreeing with information/explanation
5. ignoring the information/explanation
6. deferring to the information/explanation
7. asking for a proposal
8. offering a proposal
9. agreeing with the proposal
10. disagreeing with the proposal

11. ignoring the proposal
12. deferring to the proposal
13. making supportive comments
14. making non supportive comments
15. independent moves
16. tension release
17. non task or incoherent language.

These categories catered for all the behaviour that was recorded on videotape and transcribed in order to facilitate analysis. Categories 3 to 6 and 9 to 12 reflect *immediate responses* to the offer of information or explanation, and the offer of a proposal respectively.

3. Results and Discussion

3.1. Preliminary Tasks
The mean scores and standard deviations for the number of moves made, time taken, and inaccuracy scores for each of the preliminary task items for each of the gender pairs were subjected to a one way ANNOVA in order determine if there was a significant difference between the groups on these parameters. No significant group differences were found on any of the items. This was a contrast to previous research which had found differences on the simple path (two right angles) and the time taken to complete all of the items that comprised the preliminary activities.

3.2. Copy tasks
Mean inaccuracy scores, standard deviations for the length and turn aspects of the copy tasks were calculated for each group (girls, boys and boy/girl). Again a one way ANNOVA was applied to the data to determine if there were any significant differences between the gender pairs on each of the two items, but none were evident.

3.3. Path task
Finally, the mean scores and standard deviations for the number of moves, the time taken and the number of errors (moves off path) made in order to complete the task were determined. No significant differences between the groups were found on this data when the ANNOVA was administered.

3.4. Analysis of interaction
The interactions for the path task were coded by using the transcription from the video in conjunction with watching the videotaped session. A colleague verified the coding for three pairs, one of each gender, by categorising each interaction on the transcript. It was vital to conduct the validation in this way so that there was inter-rater agreement on each type of behaviour. When this was done the number of interactions that differed were counted and converted to a percentage of the total number. The level of inter-rater agreement was 87%.

An ANOVA was conducted on the data and this revealed significant differences on four of the variables. Newman-Keuls post hoc analysis showed that the differences were between the girl pairs and both the boy and boy/ girl pairs with respect to the frequency of:

- offers of information / explanation ($p < 0.01$)

- asking for proposals ($p < 0.01$)

- offering proposals ($p < 0.001$)

- agreeing with proposals ($p < 0.01$)

In the path task the girls engaged in these forms of interactions more frequently than the other pairs. This represents a similar pattern of behaviour that was found in the previous study when the path task was presented to the children before the copy tasks and when there were significant differences in performance between the girls and the other pairs in terms of the efficiency of moves and the time taken to complete the task.

4. Conclusions

Thus, the study highlighted that the nature and sequence of task presentation as well as the type of variables that are considered as being measures of performance are important when describing the nature of performance in Logo tasks. Previous research (Hughes et al, 1988) had suggested that the performance of girls in Logo tasks were inferior to that of boy or boy/ girl pairs in terms of task completion and reaction to problem situations. In an attempt to explain this occurrence, the studies which began this series attempted to sequence Logo activities so that an explanation of performance over time and tasks could be generated. The results revealed that if performance was only considered in terms of efficiency of moves and time taken then indeed the performance of girls and boys was different, but only for track type tasks as initial experiences in a new problem-solving domain. Such differences disappeared over time and when performance was viewed in terms of accuracy there were no significant differences between the gender pairs even though the girl pairs often made more accurate copies of simple items with Logo. Previous research (Yelland 1994a, 1994b) indicated that in initial experiences with Logo affective processes seemed to moderate the performance of girl pairs as well as the lack of metastrategic processes (Davidson & Sternberg, 1985). In the present study this was not apparent and the reason seems to be related to the sequencing of the tasks, whereby the copy tasks were presented to the children before the path task.

The research underscores the need to observe and describe young children's problem-solving behaviour in a variety of task types and over a reasonable period of time before coming to hasty conclusion that differences in performance based on gender are apparent or not. In the present series of studies it was evident that what distinguished performance was the application of metastrategic processes. The most salient feature was the nature of the discussions that took place before a move was decided upon. The most effective moves reflected an awareness of mathematical processes together with metastrategies such as monitoring progress effectively, responding to feedback from the system, reflection and discussion. This was evident in conversations prior to moves being made such as:

 gg1:   What shall I do first?
gg2:   Well..... I think that it's about 50 forward.
gg1:   Yes.... no .....wait....do you think it's half of what we did when we went to the tree, 'cos that was 100.
gg2:   I'm not sure what do you think?
gg1:   we don't want to go off the path....so let's try 40 to be safe
gg2:   Ok! so just type f d space 4 0

The move is completed

gg2:   Oh it needs to be more.... how much do you think? I think 20 more.
gg1:   Ok f d space 20. (move entered and completed)
gg1   There ......now we have to turn, It's left isn't it?

Other pairs who were less efficient, in terms of number of moves made and the amount of time taken, often just proceeded with each move and slowly "edged" their way up the path or conversely went off the path and had considerable trouble getting back on again because they did not reflect on how they had directed the turtle into such a position.

The research also indicated that the Logo environment is a rich problem-solving environment in which young children can work collaboratively and engage in metacognitive activity that is characterised by a strong engagement with the tasks set. Future work can now concentrate on the nature of learning with Logo and attempt to describe the ways in which Logo experiences could be developed so that all children have the opportunity to participate in rich learning environments characterised by active participation and construction of ideas.

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