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Collaborative Interactions of Normal Children and Children with Learning Difficulties (LD) in a Mediated Computer Pre School Classroom: A Pilot Study

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Abstract

A pilot study was conducted to examine the collaborative interactions of children in a mediated computer-learning classroom. This study was also designed to compare the verbal and physical interactions (collaborative interactions) of normal dyads and a mix of normal - LD dyads. 225 preschool children, ranging in age of pre-testing from 5 years 10 months to 6 years 3 months were placed into either normal dyads (collaborative groups) or mixed of normal - LD dyads (non-collaborative groups) and worked on a computer presentation of a storytelling task. The main finding of this pilot study was that the children's verbal interactions (collaborative interactions) and manipulation of the physical materials were mediated by the mode of presentation. There were no significant differences between groups of dyads in the paper presentation of the task among normal dyads. However, in the mixed of normal - LD dyads, normal children dominated both the amount and type of verbal interaction (collaborative-interaction) and the control of the activities on the computer screen. Results were interpreted in terms of processes of social comparison, which appear to be more potent in this situation than any straight forward domination of resources.

Abstrak

Kajian pilot dilakukan untuk memeriksa perkaitan di antara interaksi kolaboratif kanak-kanak pra sekolah di dalam bilik darjah pembelajaran-berkomputer. Kajian ini direkabentuk untuk membandingkan interaksi verbal dan fizikal (interaksi kolaboratif) kumpulan kanak-kanak normal dan kumpulan campuran kanak-kanak normal – kumpulan kesukaran pembelajaran (KP). Seramai 225 kanak-kanak prasekolah di antara berumur 5 tahun 10 bulan hingga 6 tahun 3 bulan ditempatkan berpasangan dengan pasangan normal (kumpulan kolaboratif) atau campuran pasangan normal – KP (kumpulan tidak kolaboratif) dan membuat tugasan bercerita. Dapatan utama kajian pilot ini ialah interaksi verbal (interaksi kolaboratif) dan manipulasi bahan-bahan yang ada digerakkan oleh mod yang dipersembahkan. Tidak terdapat perbezaan sewaktu persembahan tersebut diperhati pada kumpulan normal. Bagaimanapun, pada kumpulan campuran normal-BP, kanak-kanak normal menguasai interaksi verbal (kolaboratif-interaksi) dan aktiviti di skrin komputer. Hasil kajian yang diterjemah mengikut proses perbandingan sosial, menampakkan keutamaan dalam situasi begini dibandingkan penguasaan sumber yang menjurus.

Introduction

Originally intended as a means to provide individualised instruction, the computers are now often used to support collaborative learning (Littleton & Light, 1999). Although there is general enthusiasm for the greater use of the computers, there are also concerns that these changes may exacerbate inequalities and that children with minor learning problems could be disadvantaged when making use of information technology in education (Schildroth & Hatto, 1993; Levy-Shift, & Hoffman, 1985; Littleton, 1996).

Many Learning Difficulties (LD) children attend local public schools (Jabatan Pendidikan Khas, 2002). One intended benefit of placing the children in public schools is to integrate the children with and without disabilities socially (Kaufman, Gottlieb, Agard, & Kukic, 1975). Research on mainstreamed LD children's social integration has examined how much these children interact with their normal peers (Arnold & Tremblay, 1979; Levy-Shift, & Hoffman, 1985) and how well they are accepted by their normal peers (Elser, 1959; Kennedy, Northcott, McCauley, & Williams, 1976). The results of this research inidicate that many LD children interact minimally with their normal peers (Antia, 1982; Arnold & Tremblay, 1979; Levy-Shift, & Hoffman, 1985) and may be less accepted than their normal classmates (Elser, 1959), although not necessarily so (Kennedy & Bruininks, 1974).

In recent years, psychological researchers have become increasingly concerned with the understanding of how children's thinking is shaped by social experience amongst peers and by adult guidance (Rogoff, 1994; Bruner, 1990; Rogoff et aI., 1991; Wertsch, 1991). Building on the work of Vygotsky (e.g. Vygotsky, 1962, originally 1934), such researchers have elaborated a socio-cultural theory of intellectual development in which language has three crucial, integrated functions: cognitive tool which children come to use to process knowledge; as a social or cultural tool for sharing knowledge amongst people; and as a pedagogic tool which one person can use to provide intellectual guidance to another. Sociocultural theorists link these functions with a strong claim: that social experience of language use shapes individual cognition.

Through engagement in dialogues, children gain the psychological benefit of the historical and contemporary experience of their culture. In Vygotsky's (1981) own terms, 'intermental' activity provides a basis for 'intramental' development, in a way and to an extent that is not possible for other species. Sociocultural research has questioned the validity of Piaget's influential theory of cognitive development, which emphasises individual action rather than interaction (e.g. Piaget, 1970); and this has led to criticisms of the progressive

approach to primary education which drew on Piaget's work. However, there has not been any research to show precisely how children's social language experience is related to the development of their ability to use language as a tool for reasoning.

In several studies, a relationship between adult-mediated computer activity and the development of cognitive processes in pre schoolers was found (Clements et aI., 1993; Klein & Nir-Gal, 1992; 1992; Miller & Emihovich, 1986). These studies revealed that children using computers with adult assistance improve cognitive processes such as abstract reasoning, logical thinking and analogical and reflective thinking. However there is still no research evidence clearly delineating the fundamental characteristics of child-child mediation, particularly normal hearing children and conductive hearing loss children as expressed in the context of computer learning environment and the development of specific social skills of young children.

Moreover, several research studies document attempts to increase interaction between LD children and peers. Studies by Antia Kreimeyer (1987,1988), Kreimeyer and Antia (1988), and Rasing and Duker (1992) indicate that teacher-mediated social-skills programmes consistently result in increased levels of positive interaction among LD children. However, little documentation exists of the effectiveness of such interventions on interaction between LD children and their normal counterparts.

In the present study, a 5-level collaborative social skills scheme were introduced hypothesized (Gresham & ElIiott, 1990) and perceived to provide a way of equating the type of tasks presented on a computer and that on paper. The role of the application of a Single Display Groupware (SDG) via the KidPad 1.0 programme in promoting pre schoolers collaborative social interaction was also investigated by comparing the interaction patterns of the Collaborative Group (normal dyads) and the Non-Collaborative Group (mixed of normal - LD dyads).

Method

Participants

There were 225 pre school children, ranging in age of pre-testing from 5 years, 10 months to 6 year, 3 months (M = 5 year, 11 months). At the time of post-testing, 174 children were excluded for analysis for lack of parental consent, leaving a total of 51 children (25 boys and 26 girls). The children attended government pre schools located in Kuala Lumpur and Selangor Darul Ehsan. The parents of 81% of the children in the appropriate age range returned the

consent forms agreeing to their child's in participation. All children in the sample were computer-aware (but not necessarily computer literate) and represented a cross-section of socio economic status.

For some of the children, this study provided an opportunity for them to use computers for the first time a first encounter with computers (although all pre-schools included computers studies in their pre school curriculum). However, a vast majority had gained exposure to computers in some fashion, as determined by the multiple sessions of semi-structured teacher interviews. Nineteen children (37%) had access to a computer at home, spending anywhere between 5 and 120 minutes per week on it (M = 45 minutes). In general, the children were considered to be computer-aware.

Procedure

Prior to pretesting, the computer was left at each centre for one week as a free-play activity with neutral games software, in an attempt to counter some of the novelty effects (Clark, 1985) although, as noted earlier, many of the children already had access to a computer at home. During this time, parents were given a standard consent form and questionnaire. The children whose parents gave consent were then pretested using the Social Skills Rating System: Teacher Form - Pre school Level (SSRS).

In each group, children (of normal dyads and a mixed of normal - LD dyads) received one individual 20 minute session per week, for 12 weeks, with catch-up sessions provided for absentees. In the end, each child completed the full number of sessions, except for two children who moved away during the study, and were not included in subsequent analyses. Both Collaborative Groups and Non-Collaborative Groups (of normal dyads and a mixed of normal-LD dyads) were targeted in alternate weeks, and each child worked his/her way through the allotted task over the first six weeks and then again over the second six weeks.

With the aid of two researchers, both males, and the teachers and teacher assistants, the Control group was run simultaneously with one of the computer groups, in two separate rooms away, from the distractions of the main classroom. In effect, the control group children were not aware that they were missing out 0 computer time. Over the 12 weeks, the two experimenters were counterbalanced over three groups, to control any experimenter effects. Post testing on the Social Skills Rating System: Teacher Form - Pre school Level (SSRS) occurred one week after the end of the treatment.

Results

Analysis of Interaction

During the sessions, the researchers recorded the number of times the task (occurrences of story telling activity) was constructed by each children and this was analysed. The audio-video tape recordings of the interactions were transcribed. The transcripts were analysed for utterance length and type of utterance. Five types of interaction were identified:

1. Proposing - an utterance was classified as proposing when one of the pair suggested something they might do (e.g. paint the paper with specific colour).

   For example,
   Boy A: You use green crayon and I'll use red crayon ...
   An utterance was also classified as proposing if it concerned a decision about how the story should start. For example,

   Boy B: Oohh ... let's make a story about the river, yes, this story is good...

2. Supporting - an utterance was classified as supporting when one pair agreed or encouraged the other's proposal.

   For example,
   Girl A: Um, I think I like it this way...
   Girl B: Yes, I like it that way!

3. Disagreeing: an utterance was classified as disagreeing when one member of the pair disagreed with or discouraged their partner's proposal.

   For example,
   Boy A: That one goes there.
   Boy B: No, it goes here.

4. Seeking information: an utterance was classified as seeking information when one or both members were trying to seek information from the other.

   For example,
   Girl A: What was the colour of the boat, is it green or red?

5. Repetition: an utterance was classified as repetition when one pair merely repeated what his/her partner had said.

   For example,
   Boy A: The clouds are white and blue
   Boy B: The clouds are white and blue

An independent coder performed a reliability check. The coder analysed 35% of the transcripts and agreed with all but three of the utterances.

Interaction Analysis

There was a significant three-way interaction between mode of presentation, performance levels and type of dyads in terms of utterances, $F(1,44) = 15.3$, $P < 0.05$; proposals, $F(1,44) = 17.8$, $P < 0.05$; supportive statements, $F(1,44) = 4.2$, $P < 0.05$; information seeking, $F(1,44) = 6.1$, $P < 0.05$; disagreements, $F(1,44) = 35.2$, $p < 0.05$; and a marginally significant interaction for repetitions, $F(1,44) = 3.7$, $P < 0.1$.

Simple effect analysis revealed that this three-way interaction was due to a significant two-way interaction of learning performances and type of dyads in the computer condition for number of utterances, $F(1,44) = 21.9$, $P < 0.05$; proposals, $F(11,44) = 22.8$, $P < 0.05$; supportive statements, $F(1,44) = 13.0$, $p < 0.05$; information seeking, $F(1,44) = 6.7$, $P < 0.05$; disagreements, $F(1,44) = 36.1$, $P < 0.05$; and a marginally significant interaction effect for repetitions, $F(1,44) = 3.8$, $p < 0.1$. Table 1 shows that there were no significant two-way interaction effects on any of the interaction measures for the paper condition (for all measures F< I).

Table 1 Verbal interaction of the paper presentation of the storytelling task

Children	Normal children		LD children	
	Mixed M(SD)	Same M(SD)	Mixed M(SD)	Same M(SD)
Utterance	34.9 (5.1)	35.3 (6.3)	36.6 (4.8)	34.3 (4.9)
Proposals	12.0 (2.5)	13.8 (3.5)	12.6 (2.8)	13.0 (2.9)
Supportive	5.0 (1.3)	5.7 (1.4)	4.6 (1.4)	4.6 (1.4)
Information seek	5.1 (1.1)	4.4 (1.7)	4.5 (1.6)	4.6 (1.6)
Disagreements	4.8 (1.6)	3.3 (1.5)	5.6 (1.8)	4.5 (1.1)

To investigate the two-way interaction between learning performances and type of dyads in the computer condition, a further simple effect analysis was carried out. Table 2 shows that in the computer condition, normal children in dyads of mix normal- LD, made more utterances, $F(1,22) = 19.6$, $P < 0.05$; more proposals, $F(1,22) = 26.5$, $P < 0.05$; information seeking, $F(1,22) = 7.0$, $P < 0.05$ more disagreements, $F(1,22) = 35.5$, $p < 0.05$; and more repetitions $(1,22) = 10.0$, $p < 0.05$, than normal children in their own groups (dyads of normal children). Also, normal children in dyads of mixed normal – LD dyads made significantly fewer supportive utterances' than normal children in their own groups (dyads of normal children), $F(1,22) = 4.9$, $P<0.05$.

Table 2 Verbal interaction of the computer presentation of the story telling task

Children	Normal children		LD children	
	Mixed M(SD)	Same M(SD)	Mixed M(SD)	Same M(SD)
Utterances	57.0 (8.7)	44.0 (5.7)	36.6 (6.8)	40.7 (3.9)
Proposals	26.3 (4.7)	18.1 (3.1)	12.1 (3.9)	17.3 (2.9)
Supportive	4.9 (1.2)	6.6 (2.0)	6.3 (1.2)	4.6 (1.4)
Information seek	4.0 (1.8)	5.8 (1.4)	4.4 (1.7)	3.5 (1.3)
Disagreements	9.1 (2.7)	4.1 (1.4)	4.5 (2.4)	6.9 (1.7)
Repetitional	2.8 (2.7)	9.5 (2.2)	9.3 (2.4)	8.6 (1.7)

The patterns of the results for LD children was the exact opposite and is shown in Table 2. LD children in dyads of mixed normally hearing – LD, made significantly fewer proposals, $F(1,22) = 13:5$, $p < 0.05$; fewer disagreements, $F(1,22) = 6.6$, $p < 0.05$; and marginally significantly fewer utterances, $F(1,22) = 3.6$, $p = 0.07$, than normal children in their own groups (dyads of normal children). Also, normal children in dyads of mixed normal - LD, made significantly more supportive utterances than normal children in their group (dyads of normal children $F(1,22) = 49.5$, $p < 1.15$.

Manipulation of the Traditional/Physical Material Resources

To investigate the manipulation of the traditional resources in the paper-based condition, a two-way ANOVA was carried out with hearing levels and type of dyads as the factors, and the number of times children construct drawings/ initiate story telling activities, as the dependent measure. There was no significant two-way interaction effect and no significant main effects (see Table 3). To analyse the control of the screen activity during the session a two-way

ANOVA was carried out with hearing levels and type of dyads as the two factors, and amount of time dominating the screen activity as the dependent measure. There was a significant two-way interaction effect between hearing levels and type of dyads. $F(1,44) = 8.1$, $P < 0.05$. To check whether there were any order effects, independent t-tests were carried out with order as the independent variable and the 14 interaction measures as the dependent variables. None of the t-tests was significant.

Table 3 Manipulation of the physical maternal / traditional resources of the story telling task

Children	Normal children		LD children	
	Mixed M(SD)	Same M(SD)	Mixed M(SD)	Same M(SD)
Number of times children initiates/construct story-telling task(s)	11.9 (4.1)	11.6 (3.0)	11.9 (2.5)	11.8 (2.6)
Time dominating the interactive/screen activity (203)	752 (319)	544 (209)	287 (277)	496

Analysis of social skills subscales; Social Skills Rating System stores (SSRS)

To test the specific secondary research questions, a series of ANCOVA was used, along with planned comparisons between groups. The data were first examined to see whether they met the underlying assumptions of ANCOVA. The dependent measures displayed homogeneity of variance between groups. The second assumption of ANCOVA, homogeneity of regression slopes between the dependent variables and their respective covariates, was also met by all measures. The ANCOVAs were initially performed using post-test scores as dependent measures, and respective pre-test scores as covariates. These analyses produced group means of post-test measures adjusted for the effects of post-test scores (Table 4), as well as Mean square error terms essential for subsequent planed comparisons. The resultant ANCOVA using SSRS scores yielded an $F(2, 47) = 8.49$, $p = .001$, (Table 5) and planned comparisons were carried out as described subsequently.

Table 4 1. Group Means and Standard Deviations on the SSRS

Group	Pre	Post	Adjusted'
Control	117.2 (12.9)	117.1 (12.5)	118.6 (12.5)
Collaborative	116.6 (11.5)	120.7 (12.4)	120.8 (12.4)
Non-collaborative	118.5 (15.1)	128.9 (13.3)	121.4 (13.3)
Total	116.7 (13.1)	122.2 (13.5)	122.2 (13.5)

Note: Standard deviations are in parentheses.
*Post-test means adjusted for Pre-test scores.

Tables 5 2. ANCOVA Summary Table for Post-test SSRS Scores

Source of Variance	Sum of Squares	df	Mean Square	F	P
Covariates	6410.7	1	6410.7	154.5	.005
PRE-SSRS	6410.7	1	6410.7	154.5	.005
Main Effects	704.6	2	352.3	8.5	.001
GROUP	104.6	2	352.3	8.5	.001
Explained	7115.3	3	2311.8	57.2	.0005
Residual	1949.8	47	41.5		
Total	9065.1	50	181.3		

The first planned comparisons centered on the use of computers (via KidPad 1.0 program) as a medium of collaborative interactions over traditional resources, comparing the Control Group versus the Non-Collaborative group. Adjusted post-test SSRS scores yielded t (47) obt = 1.02. less than t (47) crit = 2.02. p >.10. Thus, there was no evidence that significant social interactions was promoted more by computer use (KidPad 1.0 program) than by traditional teaching/drawing and story telling resources matched for patterns of interactions. The question of whether KidPad 1.0 program is successful at increasing specific social skills (i.e. collaborative interactions) required the use of a series of ANCOVAs on each of the post test SSRS subscale scores, arranged in a step-down fashion according to the hypothesized skills increased (Cooperation and Self-control were entered first, followed by Assertion, and two Problem Behaviours Subscales-Externalising and Internalising). The subscale scores were entered separately with their respective pretest SSRS covariates, with each step including the addition of the previous post-test SSRS subscale score as a new covariate. For instance, post-test Cooperation used pre-test Cooperation as a covariate the post-test Self-control used pre-test 'Self-control and post-test Cooperation as covariates, and so on. The

adjusted group means and Mean square error term were then used in planned comparisons. The resultant ANCOV As, in order of entry, yielded F(2,47) = 8.39, p<.OI(Cooperation); F(2,46) = .26, p>.l0 (Selfcontrol); F(2,45) = 4.79, p>.05 (Assertion); F(2,44) = .13, p>.l0 (Externalising); F(2,43) = .14, p>.l0 (Internalising); that is, significant effects were found for Cooperation and Assertion only. Planned comparisons were, therefore, carried out for these two variables.

The first planned comparison centered on the use of computers (via KidPad 1.0 program) as a medium of collaborative interactions over traditional resources, comparing the Control Group versus the Non-Collaborative group. Adjusted post-test SSRS scores yielded (47) obt = 1.02, less than (47) crit = 2.02, p>.l0. The second comparison centered on the social skills promoted via the effects of KidPad 1.0 program, comparing the Collaborative group versus Non-collaborative/Control groups combined. Cooperation yielded (47) obt = 4.09, p<.01, and Assertion yielded (47) obt = 3.21, p<.05. The hypothesised increase in Cooperation, as a function of promoted social skills, was therefore found, but the hypothesised increase in Self-control was not. Assertion also increased as a result of the dyadic computer environment, which had not been predicted.

Discussion

The aim of this study was to compare the verbal and physical interactions (collaborative interactions) of normal dyads and a mixed of normal-LD dyads. Because data on cognitive attainments and a comprehensive amount of socio-economic status data were not collected during the observation and experimentation sessions, it is not possible to determine if these results indicate any differences in regards to children's zone of proximal development and their urban and rural environment. However, the main finding of this pilot study was that the children's verbal interaction's (collaborative interactions) and manipulation of the physical materials were mediated by the mode of presentation. When the task was presented on paper (traditional resources/ physical materials), there were no significant differences between groups of dyads. However, in the mixdyad of normal hearing - LD dyads, normal children dominated both the amount and type of verbal interaction (collaborative interactions) and the control of the activity on the computer screen. There were significant differences, both in terms of the amount of the amount of verbal interaction, type of verbal interaction and physical manipulation of the storytelling activity, between the LD children and their normal peers in the mixed normal - LD dyads, compared with children in the normal dyads. Normal children in the mixed dyads made more utterances, more proposals, more information seeking

requests, more disagreements, more repetitions and controlled the interactive activity marginally more, than normal children in the normal dyads. The effect was opposite for the LD children in the mixed dyads: they made fewer utterances, fewer proposals and fewer disagreements, but made more supportive comments than normal children in the normal dyads. LD children in the mixed dyads also controlled the interactive/screen activity less than children from the normal dyads.

These findings are consistent with the perceived expertise/social domination explanation discussed at the beginning of the article.

It is indicated that many LD children minimally with their normal peers, even in a computer learning environment, or throughout traditional paper-based activities. These differences in perceived social domination lead to the asymmetric patterns of interaction. However, in the learning level/category neutral non-computer based task, there are no differences in perceived between normal and those with LDs. It is suggest, in this study that LD children are taking a supportive/minimal interaction role while normal children are adopting a lead role in the mixed dyads, whilst being engaged in a computer-based task. It is possible that the LD children were seen as different because of their communication behaviour or because they were not fully participating members of the classroom social system to which normal children belonged.

With regards to the secondary research questions, the results demonstrate that Single Display Groupware (via KidPad1.0 program) significantly increases a specific social skill, namely Cooperation as hypothesised, but fails to significantly increase Self-Control and Assertion. However, this may have occurred due to some overlap between the two constructs, bearing in mind limits of the construct validity of the subscales, or possibly due transfer of learning. Moreover, there is no evidence in the present results to suggest that social skills can be increased with the Single Display Groupware (SDG) significantly more than traditional resources, although it may be that the Social Skills Rating System (SSRS) was not sensitive enough to demonstrate significant changes, producing a ceiling effect for the majority of the children. A limitation to the study was that, because of the need to accommodate classroom structures and schedules, the authors could not obtain sufficient systematic data on socio-cognitive and detailed academic performances of the children.

Because intact groups of children participated in this study, factors believed to affect interaction were controlled statistically in the analysis; however, this does

not rule out the presence of other uncontrolled factors. Although observation sessions were monitored by audio-video tape, technical difficulties precluded these tapes' use to examine the exact amount of verbal and non-verbal interaction during the sessions. The findings also suffer from the relatively small numbers of groups of children involved, and the effects of situational factors such as the absence of children at key points of data collection. A larger-scale implementation could have provided better data for statistical analysis.

In conclusion, the main finding of this study was that children with LD were found to be prevalent among pre school children in Kuala Lumpur and Selangor Darul Ehsan. Furthermore, the nature of interaction in the mixed normal - LD dyads is mediated by the mode of presentation. To some extent at least, via interaction analysis, it is possible to identify further prevalence of LD among pre school children, via the application of Single Display Groupware (KidPad 1.0 program).

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