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ScienceDirect

Procedia - Social and Behavioral Sciences 140 (2014) 155 – 163

Procedia
Social and Behavioral Sciences

PSYSOC 2013

The Effects of Cooperative and Competitive Games on Classroom Interaction Frequencies

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Abstract

This research looks at the effects of playing cooperative and competitive computer games on pupils' classroom interaction frequency, as an index of their cooperation and engagement in class. It was predicted that students who played a cooperative game would receive higher teacher ratings of classroom interaction frequency, whereas students who played a competitive game would receive lower teacher ratings of classroom interaction frequency. Thirty-two school children with behaviour and learning difficulties played either a cooperative or competitive version of the Wii for a week. The pre- and post-game classroom interaction scores were different for the cooperative and competitive game conditions in the predicted directions. The findings suggest that cooperative games may benefit the social interaction of pupils within the classroom.

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Selection and peer-review under responsibility of the Organizing Committee of PSYSOC 2013.

Keywords: Cooperative, competitive, games, classroom interaction, adolescents

Introduction

Some children experience more challenges compared to typically developing children when it comes to education, and these children are considered as having special educational needs. Teaching and learning methods, such as cooperative learning strategies, have been developed in order to help these children overcome barriers, which may affect their learning, development and behaviour (Mitchell, 2008). It is estimated that children with special needs make up around 10-15% of the school population, experiencing physical, sensory, intellectual and emotional difficulties (Mitchell, 2008). Psychologists and pedagogues have looked at ways of developing education so that

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pupils will fully engage with what it is they are being taught in order to accomplish educational goals that will benefit them later in life (Mitchell, 2008). In order to develop education that adolescents are going to want to engage with, and one that will have a positive effect on their learning, it is important to understand what techniques can be used that will not only benefit the child's learning, but can also benefit the teachers in getting their pupils to engage with their lessons, using easily implementable techniques.

The use of educational games on achievement of learning outcomes has been widely investigated (Mitchell, 2008; Levass, Freitag, Gold & Kassorla, 1965), however, the effect of mainstream games on cooperative behaviour in the classroom, especially for children with learning difficulties, deserves further investigation, as these games are relatively easy to acquire and use as part of educational activities. Considerable evidence suggests that the motivational elements of computer game play might be used to create game-like learning environments (Squire, 2003) that might benefit child development. In line with this, the aim of our study was to investigate whether cooperative computer games can have a positive effect on classroom interaction performance, with a particular focus on classroom interaction frequency as an indicator of social engagement and cooperation, for children with learning disabilities.

In the next sections we will review studies on the effects of cooperative and competitive learning approaches on supporting the learning experience of typically developing children and children with learning disabilities. This is followed by a review of studies that make use of game play to support the learning experience for both groups, concluding with a discussion of potential effects of computer games on children's classroom interaction frequency and the description of our study.

Cooperative learning

When implementing techniques to benefit the learning experience of a child with learning difficulties it is important to consider the best context of learning. This suggested by Mitchell (2008) as being the cooperative learning method. Cooperative learning comprises academic and social learning experiences within the classroom, where children are taught to complete tasks collectively to achieve academic goals (Johnson & Johnson, 1989; Slavin, 1996). Bossert (1988, p225) stated that cooperative learning should be used in all classrooms, as it teaches a skill that is "necessary for the accomplishment of learning activities and it is a general norm that should be learned". Cooperative learning methods used within the classroom are said to promote positive interpersonal relations between the students and with their teacher, and aim to produce motivation to learn within the pupils and enhance self-esteem among students (Slavin, 1996). They support positive social outcomes, including positive inter-group relations and the ability to work collaborating with others as a team (Horner, Carr, Strain, Todd & Reed, 2002). Cooperative learning also considers socially influenced knowledge, which is developed from our environment and others in our environment, as being one of the main influences in a child's life. Therefore, if children are encouraged to work together cooperatively it will enhance their social interaction skills (Mitchell, 2008). There is a growing body of research in education that reports the benefits of working in small cooperative groups of up to four students rather than working individually, which again suggests cooperation should be an essential part of learning (Horner *et al.*, 2002). Mitchell (2008) describes splitting the class into groups, thus creating smaller classes and more teachers, as the more able learners are able to provide support for the less able learners in their group. It is also vital that pupils in a cooperative group contribute equally to the learning experience (Johnson & Johnson, 1989), to reduce the risk of children seeking a free ride on others' efforts, which might occur in a traditional classroom-learning group. In order to achieve a successful outcome for all pupils working within a cooperative learning group, it is important for them all to contribute equally to result in the group being more than the sum of its parts and perform higher academically than they would have on their own.

Green and Rechis's (2006) review of studies on children's ability to negotiate, and the benefits that were involved in adopting such a skill, concluded that cooperation is a critical skill that should be developed in a young child, as it is the basis in understanding social exchange and maintaining social competence. Maintaining social competence allows individuals to achieve the correct balance between meeting their own needs whilst maintaining positive relations with others, which may also have a positive influence on their well being. Learning cooperative behaviour strategies enables children to negotiate with others, and have creative social problem solving strategies whereas children with low social competence have great difficulty working and playing with others according to Green and Rechis (2006).

Cooperative and competitive learning

A review of the effect of cooperative and competitive learning by Johnson, Johnson and Stanne (1999) showed that cooperative methods were found to have a greater effect on academic achievement compared to the competitive

methods. Cooperative learning strategies were also found to result in greater academic achievements when compared with individualistic learning strategies. However, simply placing students into small groups and telling them to cooperate with one another will not ensure they will receive higher achievements or they will have better interpersonal outcomes as pointed out by Putman (1998). To address this issue, Johnson and Johnson (1989), suggested five key elements they believed are required in order for cooperative learning to be successful, which are 1) individual accountability defined as practices used by teachers to establish and maintain student responsibility for appropriate behaviour, 2) engagement and outcomes, 3) positive interdependence defined as each group member learning to depend on the rest of the group whilst working with others to complete the task, 4) positive face to face interactions involving head to head discussions among the group which help develop interpersonal skills through listening, encourage shared decision making, provide personal responsibilities, and teach children to give and receive feedback; and 5) group processing, involving the time allocated to discuss how well the group members achieved their goals and maintained an effective working relationship. The last criterion is also consistent with work by Slavin (1996), which showed that cooperative methods could be an effective method of increasing student achievement, but only if the essential elements of specific group goals and individual accountability are integrated. Other studies compared cooperatively oriented and competitively oriented techniques of discussion (Haines & McKeachie, 1967). The two techniques were compared according to the amount of tension produced by each technique on student performance, and on the effects the techniques had on student satisfaction and recall. Haines and McKeachie (1967) hypothesised that there would be higher tension in the competitive condition than in the cooperative condition due to the competitive condition involving a competitive grading policy. They also hypothesised that the higher tensions in the competitive group would then cause disruptions in the performance in the competitive condition and result in a higher preference and more satisfaction for the cooperative condition. The results supported their predictions: besides lower academic performance, the competitive condition produced greater levels of tension, as there was a lack of relaxed atmosphere and greater feelings of anxiety and uneasiness compared to the cooperative condition.

Further evidence for the benefit of cooperative work on student attitudes is evident in Wheeler and Ryan's (1973) study with 88 fifth and sixth grade pupils. The cooperative group worked together whereas the competitive group worked individually during a social studies class. Tests were given to all participants to measure attitudes and achievements after the conditions were implemented. Results showed that pupils in the cooperative group had rated liking the social studies class more than the participants in the competitive group. They rated enjoying working together, talking with one another and receiving group versus individual grades all higher than the participants in the competitive study; while Wheeler and Ryan found no difference in academic achievement between the two groups, other studies have found such a difference (Haines & McKeachie, 1967; Xin, 1999).

Xin (1999) investigated the effects of computer assisted cooperative learning in academic achievements in maths, for children with and without learning disabilities. One hundred and eighteen 7 year olds, 26 of which had learning disabilities, were involved in the study, with one half being assigned to the cooperative condition and one half to the competitive condition. In the cooperative condition learners are worked at computers in pairs to help and encourage one another. They were compared to the learners in the competitive condition who received whole class instruction and worked at computers individually. The results showed that learners in the cooperative learning group had higher mathematic achievement scores than those in the competitive condition. Their findings suggest that schools should adopt computer assisted cooperative learning as it appears to have a positive impact on a child's learning for both mainstream school and for special education.

The research reviewed suggested that cooperative-learning strategies would benefit children in mainstream education and Xin's study showed that this can also occur in a computer assisted learning context. We will conclude the review with a discussion of studies that investigate the role of game play and social interaction in education.

Game play and social interaction

Green and Rechis's (2006) review on the implementation of cooperative learning strategies in education emphasized the importance of developing necessary social skills for a child's overall development. The ability to positively interact and cooperate with others is a behaviour quality that is necessary in order to develop relationships and successful careers. Bruner (1975) states that the learning of such behaviours is developed through play since to play a game you have to follow certain rules that are in place to achieve a successful outcome. Conforming to these rules will enable children to develop and understand the role of certain behaviours. Kohn (1992) defined a competitive game as one that involves winners and losers, focusing on an individual's success and an opponent's failure, whereas cooperative games require two or more participants for achieving success and thus create interest in

encouraging and assisting others. Using traditional games, Bay-Hintz, Peterson and Quilitch (1994) assessed the effects of competitive and cooperative games on aggressive and cooperative behaviour of 70 children aged 4 and 5 during free play sessions that took place after set play sessions involving a competitive and cooperative game condition. In the competitive game, the children played against one another to establish a winner with a variety of games including musical chairs; in the cooperative game the children worked together to win the game which also used a variety of games, one of which changed the rules of musical chairs to involve the children sharing seats with those in their group. Their results showed that cooperative behaviour increased and aggressive behaviour decreased during the play sessions of children who played cooperative games and the opposite occurring for the children who played competitive games. Bay-Hintz *et al.* (1994) concluded that it is not a particular game that affects behaviour, but whether or not it is organised as a competitive or a cooperative game. Their findings suggest that cooperative games, along with limitations on competitive games in primary schools, may reduce tendencies to respond aggressively and may positively affect future social behaviour.

While considerable work has been conducted on the effects of games in mainstream education (Johnson *et al.*, 1999), little research has considered the effects that commercial games may have on behaviours displayed by children with special educational needs in class. It is estimated that 10% of any society's population experiences some form of disability and of this, 3% are mentally disabled (Kohn, 1992) with 'educable' being defined as mild level of mental disability constituting 88% of all individuals with a mental impairment. To the extent that social skills can effectively be practiced in game play, there is great potential in using games that children may want to engage with voluntarily, especially when they are commercially available (Lovass *et al.*, 1965). Researchers have noted that "video games are not the solution to educational problems", but "the design of a learning environment built on the educational properties of games can be an appropriate way to improve learning." (Mitchell, 2008, p23). Based on the reviewed studies we derive the hypotheses that a game that induces cooperative behaviour in children should also have an effect on cooperative behaviour in classroom interactions, whereas a game that induces competition might result in less cooperative behaviour, potentially associated with reduced interaction frequency. More specifically, the present study will look at the effects of playing cooperative and competitive computer games on classroom interaction frequencies, as an indicator of cooperation and engagement in class, for adolescents with behavioural and learning difficulties. Using a questionnaire, teachers will rate pupils' interaction frequency scores in class before and after they play a computer game. We predict that students playing a cooperative game will receive higher teacher ratings of classroom interaction frequency after playing the cooperative game, based on the findings from Bay-Hintz *et al.* (1994), Haines and McKeachie (1967), Johnson *et al.* (1999) and Wheeler and Ryan (1973). It is also predicted that students playing the competitive game will receive a lower rating of classroom interaction frequency after playing the competitive game, based on the findings from Bay-Hintz *et al.* (1994), Haines and McKeachie (1967), Johnson *et al.* (1999) and Wheeler and Ryan (1973). Whilst this study involves looking at the effects of cooperative and competitive playing methods on cooperative behaviour as in Bay-Hintz *et al.*'s (1994) study, this study considers the effects of playing cooperative and competitive, commercial computer games on classroom interaction frequency for children with a wide range of learning disorders. We are also focusing on the use of commercially available games rather than educational games, due to their wider availability. If our hypotheses are supported then this would suggest that cooperative tasks and games can be implemented within education to result in more cooperation and engagement in class.

Materials and Methods

Design

The measure of interest in the current study was provided by four teachers in the form of questionnaire ratings of pupil classroom interaction frequency before and after (repeated measures) two groups of children played either a cooperative or competitive game on the Wii (between-subjects design).

Participants

A total of 32 pupils took part in this study (30 adolescent boys from ages 13-17 and 2 girls aged 15 and 16) and were recruited from a Scottish residential school through convenience sampling. The study received ethical approval from both the residential School's Ethics Committee and the University of Abertay Dundee's Ethics Committee. In addition, the experimenter received clearance by PVG (Protecting Vulnerable Groups) to work with the adolescents. Four female teachers filled out classroom interaction frequencies for the children in their classes. The range of the pupils' learning disabilities involved Autism Spectrum Disorder, Attention Deficit Disorder, Attention Deficit Hyperactivity Disorder and Oppositional Defiance Disorder.

Materials and apparatus

A Wii and 4 controllers were used in this study. The competitive game used was *Mariokart* by Nintendo (2008); the cooperative game used was *Super Mario* by Nintendo (2009). The Wii was connected up to a Smart Board. The Utrecht Work Engagement Scale– 12 [UWES-11] by Schaufeli, Bakker and Salanova (2006) was used as a template and amended for the engagement/cooperation questionnaire which assessed behaviour related to classroom interaction frequency pre and post-game play. Parents and guardians were contacted and fully informed about the details of the study and that the experiment would be taking place at the school. All children were permitted to take part in the study. An information-consent form was given to pupils informing them that the study was being carried out to assess teaching methods that might enhance levels of engagement in class and that it will involve them playing the Wii. The information-consent form also explained that pupils could withdraw at any time and that all data collected would be anonymous. Teachers were also provided with an information-consent form that explained the purpose and conditions of the study, i.e., to investigate techniques that might be beneficial for teaching. Participants and teachers were fully debriefed as to the purpose of the study after its completion.

Procedure

The residential school allocated the children and teachers numbers to ensure anonymity. Due to professional and legal requirements the configuration of classes was already predetermined. Thus, this study can be considered as having a Quasi- Experimental design as it lacks random allocation of participants to conditions. The eight classes involved in the study consisted of four students at the same level in education (total $n=32$). Four classes were assigned to the cooperative condition and the other four to the competitive condition. Two teachers in each condition completed 16 questionnaires for the pupils before and after play. The teachers were not informed about the game conditions to which their pupils were assigned. All pupils were given a 30 second demonstration on how to use the Wii controllers on the first day of play. In the competitive game (*Mariokart*), pupils raced against each other, so only one pupil could be a winner; in the cooperative condition (*Super Mario*), pupils cooperated with each other in order to complete a game level, e.g., rescuing Princess Peach. Social loafing should have been reduced as every pupil needed to play independently for the team to progress. The play sessions took place at the end of each class and lasted for 10 minutes for each group, supervised by teachers, over the course of five days. The questionnaire ratings of the teachers from before and after the game sessions were compared to test whether there had been an effect of the type of games played on engagement in class.

Results

Cronbach's alpha was calculated on the 12 items of the classroom interaction frequency questionnaire, and it was found to be highly reliable for the pre-game ($\alpha=0.86$) and post-game play session ($\alpha=0.92$). To assess the effect of game condition (cooperative vs. competitive) and time of rating (pre vs. post-game) on the interaction frequency score, the questionnaire ratings provided by teachers were averaged for each pupil (see Figure 1) and analysed using a 2x2 mixed ANOVA with repeated measurements (pre- and post-game). From Figure 1 it can be seen that pupils in the competitive condition had higher classroom interaction frequency scores before playing the Wii (mean 4.07) compared to their score after playing the Wii (mean 3.66); conversely, pupils in the cooperative condition had a lower classroom interaction frequency score before playing the Wii (mean 3.37), and a higher score after playing the Wii (mean 4.13). The ANOVA revealed, that the main effect of game condition was not significant ($F(1,30)=0.18$, $p=0.675$). The main effect of time of rating was also not significant ($F(1,30)=2.02$, $p=0.166$). However, the interaction between game condition and time of rating was significant ($F(1,30)=22.68$, $p<0.001$). Partial $\eta^2=0.43$ (medium effect). Observed power= 1.

Independent and related samples t-tests were conducted to examine where the observed differences lay. The difference in the cooperative condition between pre- and post-game scores was found to be significant ($t(15)=-4.93$, $p<0.001$) with the final scores (4.13) being higher than the first scores (3.37) indicating that playing the cooperative game increased classroom interaction frequency. The difference in the competitive condition between the pre- and post-game scores was found to be significant ($t(15)=2.15$, $p=0.049$) with the final scores (3.66) being lower than the first scores (4.07), indicating that playing the competitive game reduced classroom interaction frequency. The difference in the pre-game score between the cooperative condition and the competitive condition was found to be significant ($t(30)=2.50$, $p<0.018$), with the competitive condition score (4.07) being higher than the cooperative condition score (3.37). The difference in the post-game score between the cooperative condition and the competitive condition was not found to be significant ($t(30)=-1.5$, $p=0.14$).

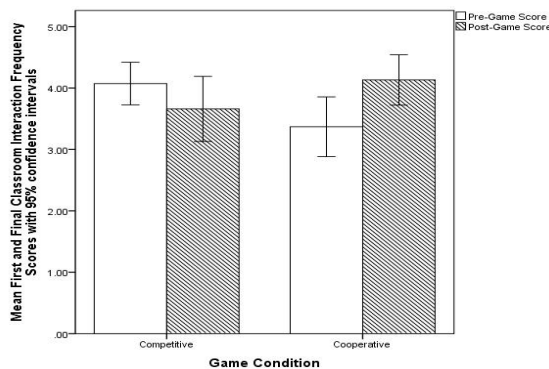


Figure 1. Bar graph showing means and 95% confidence intervals for classroom interaction frequency scores for participants in the cooperative game condition and the competitive game condition pre and post-game.

Discussion

This study investigated the effects of playing cooperative and competitive games on classroom interaction frequencies, as an indicator of cooperation and engagement in class for adolescents with behaviour and learning difficulties, such as Autism Spectrum Disorder, Attention Deficit Disorder, Attention Deficit Hyperactivity Disorder and Oppositional Defiance Disorder. Based on the findings from Bay-Hintz *et al.* (1994), Haines and McKeachie (1967), Johnson *et al.* (1999) and Wheeler and Ryan (1973), it was hypothesised that playing the cooperative game would result in students being rated by teachers as having an increased rating in classroom interaction frequency, whereas playing the competitive game would result in lower ratings of classroom interaction frequency. Consistent with the predictions, the results showed a significant interaction between type of game and time of play. Further analysis showed that the teachers rated the interaction frequency in the cooperative condition significantly higher in interaction frequency after game play compared to before game play. The reverse effect was found for the competitive condition, i.e., interaction frequency scores were rated lower after game play compared to before game play. The difference between the classroom interaction frequency scores given for both the cooperative and the competitive condition before play took place was found to be significant, however, the scores given after the game play were not found to be significant. Thus, pupils' classroom interaction frequency scores became closer after playing the game. The findings suggest that playing cooperative and competitive games do effect cooperation and engagement in class. The questionnaire ratings were found to be consistent before and after game play, respectively, thus they can be considered as reliably portraying the pupils' classroom interaction frequency.

The findings from this study could be explained in terms of effects of social interaction as suggested by research looking at the effects of encouraging cooperative learning methods (Johnson *et al.*, 1999; Green & Rehis, 2006). Bossert (1988), states that cooperative learning methods may promote positive interpersonal relations which could be responsible for the increase in classroom interaction frequency scores. Although it was not measured, pupils playing the cooperative game generally engaged in more conversation compared to the competitive condition, which may have affected results and deserves further study. The findings are consistent with the study by Haines and McKeachie (1967) who reported that using cooperative methods developed less tension within the group and suggested that this method should therefore be used.

It could be argued that encouraging competitive methods also encourages necessary social interaction. It teaches children about rules and turn taking in order for them to develop an understanding about social exchange and to maintain social competence (Lovass *et al.*, 1958; Haines and McKeachie, 1967). Any discussions that take place between the children during the play session, whether they were in the cooperative or the competitive condition, may never have happened if they had not played the game; therefore, this is a reason in itself to promote the use of games within a classroom, as it may encourage the children to develop friendships. However, while this might have been the case in both game conditions, only the cooperative condition yielded higher ratings of interaction frequency.

Playing the Wii may encourage social interaction, which also plays a fundamental role in the development of cognition (Guroglu, van Lieshout, Haselager and Scholte, 2007). The importance of social interactions and

friendships for child development is paramount: according to Guroglu *et al.* (2007), adolescents without friends engage in more delinquency and consume more alcohol, cigarettes and drugs than adolescents with friends. Guroglu *et al.* (2007) conducted an extensive study on preadolescent and adolescent children to establish the effects of friendship in self-reports on social competence. Their findings showed that adolescents without friends experience more problems with concentration, are less hard working, less ambitious, less persistent, more insecure, more anxious, less self-confident and less sociable than adolescents with friends. In addition, Hartup's (1996) findings indicated that being "liked" was related to social competence and that friends provide one another with cognitive and social scaffolding. These studies imply that friendships will benefit children in many ways, thus encouraging situations that may encourage the formation of friendships may be a useful recommendation to schools. Many children leave with educational deficiencies and are either unemployed or experience employment instability (Wheeler & Ryan, 1973). Encouraging social interaction through cooperative games may lead to an increase in the child's academic achievements, boost their confidence and help them develop the necessary social skills needed for the development of creative social problem strategies, which could benefit their future careers (Green & Rechis, 2006).

According to Breakey (2006), applied behaviour analysis was the treatment of choice for Autism Spectrum Disorder and was viewed as the most effective early intervention tool (Lovass *et al.*, 1965). The findings from the present study imply that playing cooperative games could likewise be implemented as a behavioural intervention within teaching. This would involve teachers focusing on behaviours that occur either before or after learners engages in playing the game and how the consequences of these affect their subsequent behaviour. These events are known as the antecedents and the consequences of behaviour. Playing the game could act as a positive reinforcement as it would be a reward for good behaviour in class which would increase the probability of that behaviour reoccurring. Playing the game has to be important, significant or meaningful to the learner at the time for it to work. If the game were to be used all the time, positive reinforcement will become devalued and it will lose its efficiency. Intermittent positive reinforcement should therefore be used. Early research on intermittent reinforcements has suggested that it is an effective strategy for managing behaviours in children, as shown in Long *et al.*'s (1958) study, involving intermittent reinforcement schedules being used to exercise effective control of behaviours in the classroom.

Horner *et al.* (2002) discussed a review of research on behavioural interventions for learners with autism aged 8 and younger and concluded there were grounds for significant optimism as early use of behavioural interventions can result in the reduction of problem behaviours in this group of learners by 80-90% in 50% of the studies reviewed. Their own analysis of nine studies showed that nearly 60% of comparisons reported 90% reductions in problem behaviours. Lovaas *et al.* (1965) note that, when applying behaviour analysis to children, it is extremely important to encourage language, communication, and social skills throughout the programme and to work in a team so that the child is engaged in the approach at all times. Given that game play has been stated to be the most favourite activity of children (Lovass *et al.*, 1965), it appears to have intrinsic self-reinforcing properties, which might be transferable to the classroom situation via generalisation, particularly if the cooperative aspect is emphasized. The enjoyment of the game induced by game experience is critical as evidenced in a study by Johnson and Wu (1992), who produced a game called the tactical language and culture training system. They found that less experienced game players tended to be the ones involved in unproductive behaviours that would not help them meet their learning objectives. This indicates the importance of making sure all participants are fully aware of how to play the game. If participants were not shown how to work the Wii remote, for example, then they may lose interest due to frustration, which could affect the results and the participants' behaviour.

Sensory integration is the process of perceiving sensory information and organisation and interpretation of the information neurologically through both internal and external stimuli (Hartup, 1996). The interpretation and integration of stimuli is key to be able to function within our environment, therefore any stimuli that will arouse this are beneficial to development. Recent studies have shown that children with ADHD preferred less to participate in physical activities, social activities, skill based and formal activities than children without ADHD (Johnson *et al.*, 1999). An educational game could target all of these areas and, if used from an early age, may decrease the likelihood of these activities being refused in the child's future educational environments or social environments. Research also suggests that children suffering from ADHD experience sensory processing difficulties which can affect their social skills, performance, needs and preferences (Johnson *et al.*, 1999). As mentioned earlier (Hartup, 1996), educational games that involve stimulation of multiple senses could be integrated into education to increase exposure to various stimuli and perhaps enhance the neurological links that control sensory processing.

Conclusion

This study found that playing a cooperative game within a classroom setting resulted in higher classroom interaction frequency scores compared to a competitive game. This study therefore suggests that education can benefit from the use of cooperative games to enhance levels of classroom interaction. More research needs to be conducted in this area, as the advancement of digital technology can be exploited to design games (also educational games) that might benefit the social and cognitive development of children with learning disabilities. Future work will have to show how games can be used effectively in the context of education, taking advantage of the intrinsic enjoyment children experience during game play, while still offering a cost-efficient solution to enhance learning outcomes and cooperation in a classroom setting.

Acknowledgements

We would like to thank the teachers and students from the Scottish residential school.

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