Keep it positive: Using student goals and appraisals to inform small group work in science.

By Amanda Woods-McConney, Marold Wosnitza and Kevin Donetta

In teaching science, small group work is often recommended and frequently used. In this study, we asked 130 students about their personal goals and views (appraisals) of small group work in science. We found significant relationships between students' personal goals and their views of doing science in small groups. We discuss the practical implications of our findings for teaching primary science and offer questions that teachers may find useful in identifying students' views of small group work. We also describe how relationships between students' appraisals and goals may have implications for how teachers assign members to small groups in teaching science.

Introduction

Small group learning activities are commonly used in primary schools, especially in primary science. Students learn from one another through talking about science concepts and by working cooperatively on science activities (Henry, Henry & Riddoch, 2006). That is, cooperative group work is seen as an effective strategy for improving achievement, motivation and social interactions in science. Further, the use of small groups in science has regularly been recommended because the strategy is seen as an authentic reflection of the processes of science in the 'real world'. In the Australian setting, *Primary Connections* (Hackling, Peers, & Prain, 2007), a popular and well-received science resource developed for primary school teachers, describes cooperative small group learning as a key element of the teaching and learning process.

Our interest in cooperative learning was inspired by the need for more research on group work in primary science that better informs classroom practice. Specifically, we were interested in the views of upper primary students regarding cooperative learning in science. Cooperative learning has been shown to have a positive impact on the achievement of students (Acar & Tarhan, 2008; Cohen, 1994; Slavin, 1995) and their problem solving (Qin, Johnson, & Johnson, 1995). Also, there is evidence for increased motivation when students study in cooperative learning settings (Slavin, 1995; Palmer, 2007). However, although small group work in primary science is commonly used and the available research suggests many positive implications, anecdotal conversations with teachers and students reflect that it is not always viewed as an effective activity in science lessons. Further, although the use of small groups is 'advocated in science teaching' (Bennett, Hogarth, Lubben, Campbell & Robinson, 2010, p. 72) some of the approaches have not been well researched, and as Bennett and colleagues emphasised, there remains a 'comparative lack of guidance for teachers' (p. 72). We believe that further research can help to provide teachers with the necessary guidance so that they can effectively organise, manage, and promote small group work.

Student goals and appraisals in cooperative group work

One avenue of research that we believe can inform teaching practice, is to better understand what primary science students want from group work (their goals) and how students view (appraise) their group work experiences. This line of inquiry has the potential to provide a better understanding of what motivates students in group work and could help teachers to enhance the effectiveness and benefits of their students' small group experience. The first step a teacher can take to optimise the effectiveness of small group work, is through informed knowledge of how to compose the groups.

In this study, we sought a better understanding of small group work in science, specifically with respect to primary students' personal goals and how they appraise group work in a typical small group setting. From previous research, we know that students' personal goals (learning, performance and well-being) have a major influence on their learning processes and that the academic achievement orientation of successful students can be related to both learning and performance goals (e.g. Ames, 1992; Elliot, 1999; Midgley et al., 1998; Pintrich & Garcia, 1991; Pintrich, 2000). Furthermore, it has been shown that social-emotional goals (e.g., well-being goals) are consistently strong predictors of academic outcomes (Boekaerts, 2002; Wentzel, 1991). This link between students' personal goals and their learning has been well researched for individual, self-directed and classroom settings but most of these studies have been located in high school and university contexts. Much less is known about students' goals in the small group science learning environment, particularly for primary science settings.

Similarly, the majority of studies on how students view group work focuses mainly on high school and university students (Kimmel & Volet, 2010; Wosnitza & Volet, 2009). Few studies examine students' views of small group work in the primary setting. Of these few, one study found that primary students were positive about the small group work setting (Florez & McCaslin, 2008). These students explained that small group work settings can consist of students who support one another's

learning, actively engage in group activities and find small group work experiences meaningful. Although Florez and McCaslin (2008) report positive appraisals, anecdotal discussions with students reflect mixed appraisals of small group work in primary science. In summary, further research is needed to better understand student appraisals of typical small group work in primary science.

Research Purpose

Our purpose in this study was to better understand student goals and appraisals of small group learning in science, in order to provide teachers with the tools they need to enhance the effectiveness and benefits of this commonly used instructional strategy. In particular we sought to answer the following questions:

1. What are students' goals for small group work in primary science?
2. What are students' appraisals of small group work in primary science?
3. Are students' personal goals and appraisals of small group work in science related? If so, how?

Method

Participants

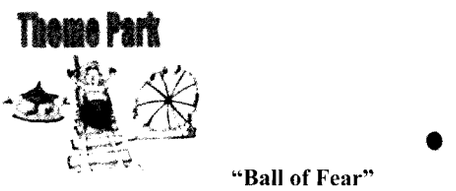
To provide answers to these questions, we worked with one hundred and thirty Year 6 and 7 primary students who volunteered to participate in the study. Students were from five different classes across three different Government primary schools in the Perth Metropolitan area. Students participated by completing a questionnaire about their personal goals and appraisals of small group work prior to a typical science group work activity in which they were about to engage. After students completed the questionnaire, teachers instructed all students to form their small groups. Teachers assigned students to groups using the same procedures they would use if they were not participating in the research study. All teachers used typical science activities that are routinely completed as part of the Year 6 and 7 science curriculum. One of the teachers developed a science task, while the other teachers used small group activities from *Primary Connections* (Hackling, Peers, & Prain, 2007). The teacher-developed science activity is described below as an example of what the students experienced in the study.

A typical science group learning activity

Students investigated how they would design and construct a theme park ride, *Ball of Fear,* as if they were engineers. Specifically, each group used a 500mm length of 40mm PVC pipe and a 25mm diameter marble to investigate the effect of varying tube angles on the distance a ball (the marble) would travel and the effect of varying surface types on ball speed. The main objective was to identify the factors that would help to make a theme park ride go as fast as possible. The details of the scenario are in the outline that was given to the students (see Figure 1).

Each group was encouraged to plan each investigation, pose research questions and state predictions. Students discussed their designs, decided how to gather data and identified independent, dependent or controlled variables. Students also explained how they would conduct a fair test. Student groups went outside the classroom onto the school grounds to complete the investigation. The groups moved to different areas to discuss the design of their investigation and to try out their ideas with the tube and marble on different surfaces such as grass, concrete and carpet. Member roles were not assigned within groups, and this meant that students took turns gathering the data, holding and adjusting the tube and recording data. Throughout the investigation, the teacher visited the groups and asked questions that would prompt ideas and discussion. The task required students to develop conclusions based on the data and relate their findings to what they already knew about kinetic and potential energy. At the end of the task, each group prepared a summary report and presented it to the entire class.

A new Theme Park is going to be built in Western Australia. As manager of *Western Australia Engineering Services,* you have been approached to design and construct the new ride:



"Ball of Fear"

Strap yourself in for the thrill of a lifetime.
Not for the light hearted.

Be hurled down the tube in only a ball.

Brief:

Part of your requirement for the contract is to investigate and report on:

1. The effect of varying tube angles on the distance the ball will travel.
2. The effect of varying surface types on ball speed.

Figure 1: Ball of Fear Student Activity.

Questionnaire

In the first section of our questionnaire, students were asked to rate the importance of specific personal goals when working in small, cooperative groups in science. This section of the questionnaire consisted of twelve items anchored to three types of personal goals:

- Performance goals (e.g. ... to do really well)
- Learning goals (e.g. ... to learn as much new information as possible)
- Well-being goals (e.g. ... that all group members get along with each other)

For these twelve items, students could respond using a four point Likert-type scale that ranged from *Not important at all to Definitely very important.* Of the twelve items in this first part of the questionnaire, four related to students' performance goals, four to learning goals and four to well-being.

In the second section of the questionnaire, students were asked how they viewed their upcoming small group work and whether it held positive or negative implications for their learning. This section of the questionnaire consisted of eight items anchored to two scales of group work appraisal:

- Positive implications (e.g. the group will give me a chance to learn from my group members)
- Negative implications (e.g. It will be hard to reach an agreement with others in this group)

As with the first section of the questionnaire, there were four items related to positive implications and four related to negative implications. Again, students were able to respond to these items using a four point Likert-type scale ranging from *No way* to *Definitely*.

RESULTS

What are students' goals for small group work in primary science?

Overall, the 130 students participating in this study reported that all three types of goals were relevant; no differences were found between boys' and girls' goals for small group work in science. Generally, this finding is consistent with other studies that have shown that students have multiple goals (Linnenbrink & Pintrich, 2001).

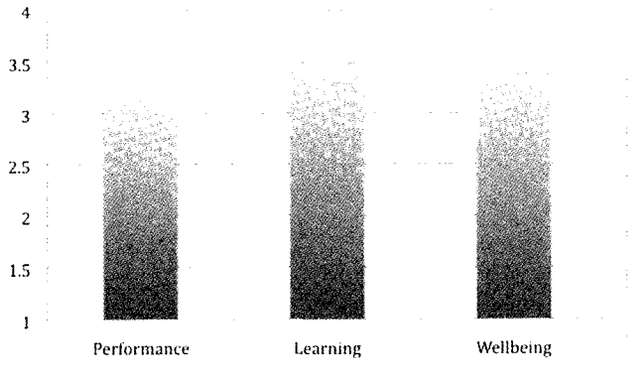


Figure 2: Average rating of Performance, Learning and Well-being goals by Year 6 and 7 students (n=130).

We also investigated whether there were groups of students with distinct or unique goal profiles. To do this, we examined the data using cluster analysis that arranges students into groups where they are most similar to one another and most different from other groups. Clusters (groups) were based on students' ratings of their well-being, learning and performance goals. Three clusters of students emerged from this analysis with all three groups showing relatively high average scores across performance, learning and well-being goals. However, as seen in Figure 3, there were also notable differences in students' goal profiles across the three clusters.

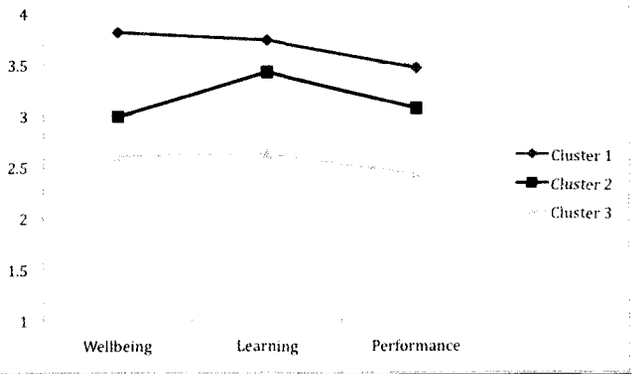


Figure 3: Student Goals Cluster Types.

The first goals cluster, Cluster 1, comprised 71 of the 130 students who participated in the study, the majority of students. These students enter the small group learning situation with goals that are strong across all three areas (well-being, learning and performance). For these students, it is very important to perform well, learn something in the group work, and have fun while engaged in the task. Generally, students in Cluster 1 do not want to feel excluded by the group and would like all members of the group to get along. At the same time, they want to learn something new and to do their best, but learning and performance goals are somewhat less important than getting along with one another.

The second cluster of students comprised 36 students, or about one quarter of the 130 students. Students in Cluster 2 enter the group learning situation with a goal structure focused mostly on learning; having fun and doing well are not as important. These students are not as interested in enjoying the activity or ensuring that everyone in the group feels included. However, they are very motivated to learn as much new information as possible and to help others in the group if they are having trouble understanding the information. This profile differs from the other two clusters in that learning goals are most important.

Only twelve students make up goals Cluster 3. This is a minority but the group is notable because of its relatively weak levels of well-being, learning and performance goals compared to the other two groups. As a whole, these students enter the group learning situation with a goal profile that is weaker in all areas compared to the first and second clusters. As shown in Figure 3, these students rate all goals lower with the least emphasis on performance. Students in Cluster 3 want to be part of a group where everyone feels they can express their opinion but they are not as concerned as students in the other two clusters. While wanting to have fun, these students are also somewhat interested in learning and may help others if they are having trouble learning. To some extent, these students are interested in learning something new with their group members but they are not as motivated to perform. Performance as an individual or as a member of the group is not a high priority and these students are not as committed to helping the group do well or ensuring the group's success. Among the three clusters, on average, students in this group are the least motivated by performance.

Students' appraisals for small group work in primary science

We also investigated how these upper primary students appraised their upcoming small group work in science. Figure 4 shows that, on average, students see considerably more positive than negative implications for their small group work in science. Again, overall, there were no differences in small group work appraisals between boys and girls. This result supports small group work in the typical primary classroom setting and is consistent with the results that Florez and McCaslin found when they investigated primary students' views of group work (2008).

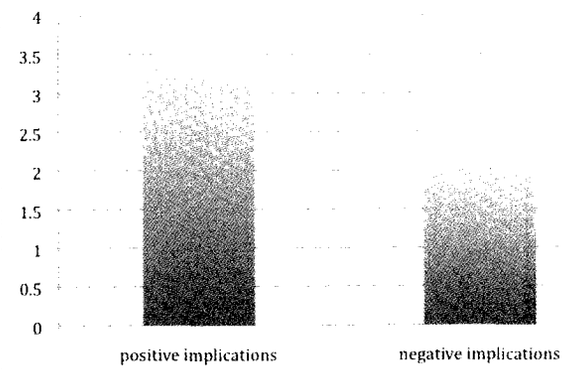


Figure 4: Average rating of the positive and negative implications of small group work in science by Year 6 and 7 students (n=130).

The relationship between students' personal goals and appraisals of small group work in science

We investigated the relationship between primary students' small group work goals and appraisals from two perspectives. Firstly, we examined the overall relationship between each goal type and appraisals, and secondly, we looked at the relationship between student goal profiles (from the cluster analysis) and appraisals. To determine whether or not there was an overall relationship between students' goals and appraisals of small group work in science, we looked for correlations between students' goals and their appraisals. We found moderately strong, positive correlations (ranging from r=0.30 to r= 0.57) between the three goal types (performance, learning and well-being) and the positive implications of group work. We can say, therefore, that students with higher performance goals, learning goals and well-being goals, are on average more likely to view positively the implications of small group work for their learning in science. Of course, this makes both intuitive and practical sense and is likely consistent with what teachers observe anecdotally.

In terms of the negative implications of small group work, there was a weak negative relationship between students' well-being goals and the negative implications of small group work. That is, students who tend to view small group work negatively also tend to rate well-being goals lower. Again, this observed relationship makes practical sense in that a student with a generally negative view of small group work would likely also rate their well-being goals negatively when directed to work in that small group setting.

To examine potential relationships between students' goal profiles (based on our cluster analysis) and appraisals, we conducted between-groups analyses to explore the differences between the three clusters with respect to students' appraisals of the positive and negative implications of group work. We found that membership in a cluster was not a factor in terms of students' appraisals of the negative implications of small group work in science. On the other hand, results for the positive implications were different. Our comparisons indicated that the average positive appraisal scores for students in Cluster 1 were significantly higher than the mean scores for students in Clusters 2 and 3. Additionally, students in Cluster 2 rate the positive implications of small group work in science higher than students in Cluster 3.

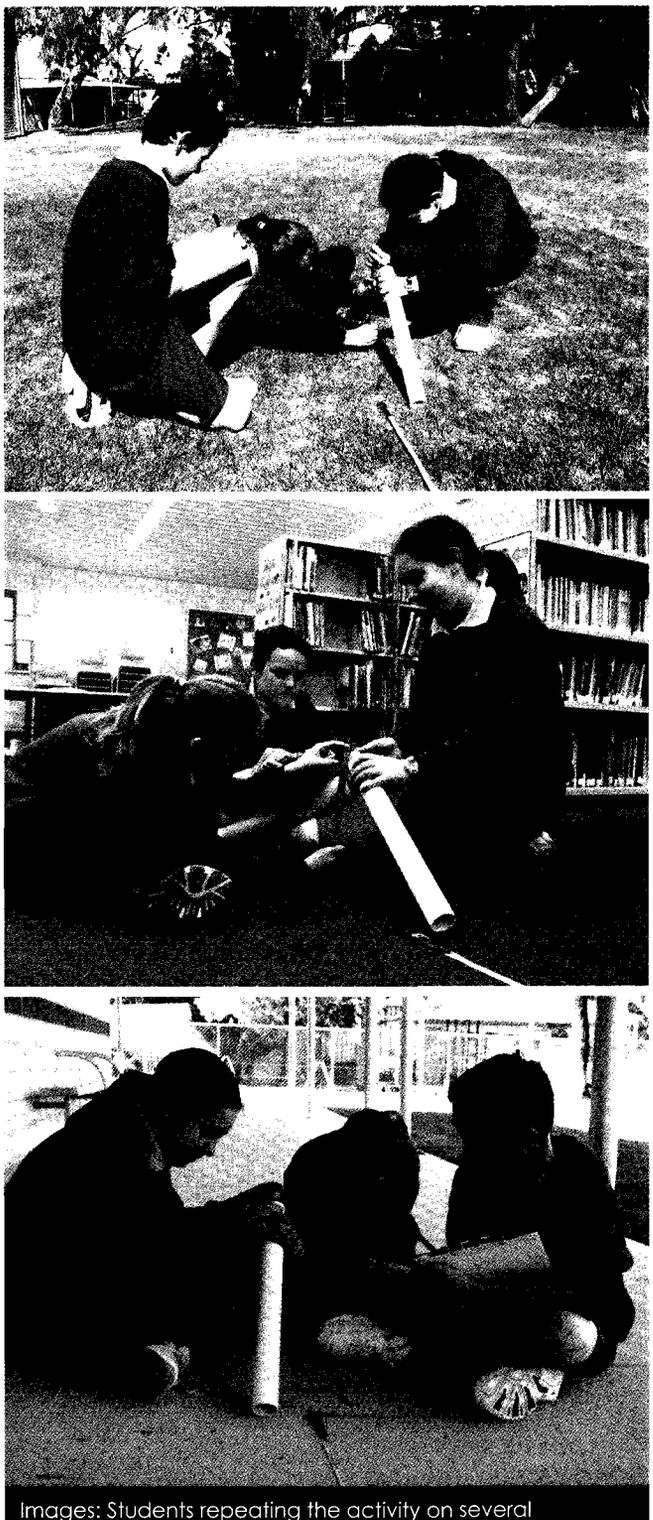
Overall, these results show that upper primary students' level of personal goals are positively related to their appraisals of the positive implications of group work in science. On the other hand, there is little relationship between their appraisal of the negative implications of small group work and primary students' personal goals.

Discussion

How do these results inform the primary teacher in science?

So, what do these findings mean for primary science classroom teachers? Our results reflect generally positive views of upper primary students towards small group work in science. Also, our findings show a positive relationship between students' personal goals and their appraisals of small group work in science. This is especially relevant since research in other school contexts shows a positive relationship between personal goals and students' learning and achievement (Pintrich, 2000). Accordingly, we can aim to ensure that students develop high levels of learning, performance and well-being goals in small group work settings to further enrich student learning and achievement. Furthermore, as science teachers, we can enhance the benefits of small group experiences by explicitly communicating and teaching students about the positive implications of group work in science and by using knowledge about the relationship between goals and appraisals as a tool for organising the membership of small groups.

In terms of group membership, a homogenous group of students who believe that group work in science holds negative implications for their learning is not likely to be effective or beneficial for the small group work setting. Similarly, a homogenous group who



Images: Students repeating the activity on several different surfaces.

are less than positive in their personal learning, well-being and performance goals is also not likely to be effective or beneficial in a small group work setting. These ineffective group compositions can be avoided if teachers have a sense of how their students view group work. In order to identify students' appraisals of group work, teachers could ask students to respond to the following statements:

- I am happy to do this group work with this group of people.
- This group work will give me a chance to learn from my group members.
- This group work is a great chance for everyone to feel included.
- Doing this group work will give me the chance to think about different views which helps me understand more.

Similarly, teachers can use these statements to diagnose students' negative appraisals of group work:

- Doing this work with this group makes me feel nervous.
- Doing this work as a group is a bad idea because people will argue.
- I would try harder if I could do this work on my own.
- It will be hard to reach an agreement with others in this group.

Teachers can use these questions in an informal setting (e.g. on the mat in the normal classroom group setting) to find out how their students view group work. Since appraisals of group work and the personal goals of performance, learning and well-being are related, teachers can also begin to gain a sense of individual student's goal profiles by using these, or similar questions. In other words, if a student has a negative appraisal of group work, they will probably not have highly pronounced levels of learning, performance, and well-being goals in the context of cooperative group work in science. If teachers can measure students' appraisals of small group work and thereby identify students with negative appraisals, they can use this as a tool for better organising the groups and hopefully avoiding ineffective group composition (e.g., homogenous groups of students with negative appraisals of group work).

Identifying students with negative appraisals can also be an effective diagnostic tool. Since there is a relationship between personal goals and appraisals of small group work in science, developing more positive views of cooperative group work may also help to foster the development of more positive personal goals. In other words, the complex, mediated relationship among students' appraisals of group work, their personal goals when working in groups, and their likely learning and achievement further supports the identification of students with negative appraisals of group work. Armed with this diagnostic information, teachers can explicitly communicate the positive implications of small group work in science and provide particular support for students with more negative appraisals. At the same time, however, we contend that there are also benefits for explicitly helping all students develop their positive views of the implications of group work for their learning. In summary, explicit teaching about the positive implications of small group work in science would likely benefit all students and increase the overall effectiveness of this frequently used instructional activity.

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