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Student Perceptions of Peer Assessment in an Action Research Context

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Abstract: A peer assessment method was implemented as part of an action research project where the primary goal was to create constructivist science classrooms. Student reflective writings, which had been created in the process of action research, were analyzed to examine the perceptions of the students concerning the peer assessment method employed in their earth science classrooms. Five perception categories and thirteen statements were developed from the student writings. These indicated that the students appreciated the positive nature of peer assessment and the effects of it as an alternative method for promoting learning. It was also revealed, however, that some students displayed inappropriate behaviors toward peer assessment which led to negative perceptions of the new assessment method. Implications for future use of peer assessment in science classrooms are discussed. Limitations founded in the present study as well as possible solutions are provided.

Keywords: peer assessment, action research, constructivist science classroom, Iowa Chautauqua Program

Introduction

Science education reform movements have emphasized changes in ways of assessing student learning (Appalachia Educational Laboratory [AEL] & Virginia Education Association [VEA], 1992; National Research Council [NRC], 1996; Orpwood, 2001; Yager & McCormack, 1989). As a part of the effort called Science, Technology, and Society (STS), Yager and McCormack (1989) proposed multiple domains for assessment in science education, including concept, process, creativity, attitude, and application domains. Although all these domains combine to reflect the nature of science, traditional assessment focused almost exclusively on the acquisition of pre-determined scientific information. Fundamental improvement in science education, they argued, should occur with conceptualizing science in more domains and with developing and utilizing assessment in each domain. The *National Science Education Standards* (NRC, 1996) have offered an important view of science learning and assessment. The *Standards* state, "assessment and learning are two sides of the same coin" (p.76), and suggest that alternative methods such as performance and portfolio assessments should be used to measure all aspects of science achievement. In addition, constructivism as one of the currently prevailing learning theories requires different implementation of assessment strategies as compared with more traditional approaches. Examples of assessment methods which may exemplify the constructivist perspective include project- and performance-based assessment, student self assessment, and peer assessment (Baxter et al., 1996; Berry, 2003; Duffy & Cunningham, 1996).

This study deals with a peer assessment method which was implemented in a collaborative action research project aimed at improving science classrooms by moving toward more constructivist learning environments. The major goal of the study is to examine the perceptions of students involved in the action research effort concerning peer assessment and to identify implications for better practices of the new assessment method.

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Background

Peer Assessment in the Classroom

One of the functions that assessment serves is as an educational means for enhancing learning and teaching, which has been referred to as the formative purpose of assessment (Black & Wiliam, 1998; Paris, 1998; Shepard, 1995). The formative function can be accomplished when the assessment is connected to learning tasks in which students are currently engaged and implemented in ways that motivate students to improve their classroom practices in the course of learning. If an inquiry-based science learning environment is to be established in the classroom, assessment should be designed formatively on the basis of authentic performances which are required for students to complete their learning processes (Champagne et al., 2000; NRC, 1996, 2000). This notion is also advocated by constructivist theorists, who argue that the purpose of assessment is to facilitate student learning and therefore the assessment should occur as a part of student engagement in the learning process (Berry, 2003; Brooks & Brooks, 1999; Duffy & Cunningham, 1996). Furthermore, constructivist learning environments require that students should assume a primary role in assessing their own learning (Aldridge et al., 2000; Reigeluth, 1999; Taylor et al., 1997; Willis, 2000). In the typical classroom, however, assessment is carried out in order to test if students have successfully stored the information taught by the teacher and/or if students are able to replicate the skills practiced in the previous lessons. It is the teacher who has control over the assessment process, including setting up the objectives and grading student achievement (Lorsbach et al., 1992; Raizen et al., 1989).

Peer assessment, as one example of alternative assessment to the traditional ways, has been used by several researchers in diverse contexts, but mostly in the field of higher education (Hargreaves, 1997; Liu et al., 2002; Sivan, 2000; Sluijsmans et al., 2003). For instance, based on constructivist views, Sluijsmans et al. (2003) employed peer assessment in an elementary teacher preservice program and found that the new method could contribute to the development of reflection skills in the students. Hargreaves (1997) also reported several positive effects of alternative assessment, including peer assessment, on graduates' learning. These effects include enhancing students' communication, motivating and facilitating their learning, and assisting them in thinking. In secondary education, Lin et al. (2002) applied a networked peer assessment method to senior high school students and gained similar levels of satisfaction from the students as compared with those from undergraduates. That is, the high school students considered engagement in peer assessment as worthy and beneficial for their learning.

Although alternative assessment methods such as peer assessment can provide learning benefits, students may feel uncomfortable with the new ways of evaluating their learning. For instance, Herman and Klein (1997) surveyed the perspectives of American middle school students about alternative assessment. The results indicated that the students considered the new methods challenging even though they saw them as more meaningful and more motivating. Sivan (2000) also observed that students' often express reservations concerning the fairness of the method, which was mainly attributed to the students perceived inadequacies as assessors. Nevertheless, Sivan's study is worth noting in that it found a relationship between students' experiences with new assessment methods and their confidence in using them. Therefore, it is recommended that teachers should introduce alternative methods of assessment into their curricula gradually and consistently so that students can develop the ways in which they can take advantage of such methods for their own learning. It is also necessary to involve students in developing assessment tools and to discuss with them procedures for maintaining and improving the process of assessment (Sivan, 2000; Zessoules & Gardenr,

1991). In fact, the implementation of new assessment methods is often accompanied with trial and error by which teachers and students can learn how to use the methods effectively and meaningfully for their teaching and learning (AEL & VEA, 1992). In this sense, a study is needed to examine student perspectives on alternative assessment methods in order to discern implications for better assessment practices in the classroom, especially at the K-12 levels.

Iowa Chautauqua Program and Classroom Action Research

The Iowa Chautauqua Program (ICP) is a science teacher professional development model designed to improve science teaching and learning through studying and practicing STS and constructivist approaches to science education. Since its inception in 1983 with the University of Iowa assuming the role of the main host, the ICP has operated in 17 U.S. states and assisted K-12 science teachers in changing their goals, curricula, and instructional approaches (c.f., Dass, 1996; Eisenhower National Clearinghouse, 1999; Shin & Oh, 2003; Yager et al., 1992). Groups of Korean secondary science teachers have participated in the ICP since 1995 with sponsorship from the Korean government. Vital features of the Korean program were modeled after the U.S. program but altered to accommodate foreign participants. The Iowa program for Korean teachers consists of a four-week long summer workshop and follow-up efforts with the teacher enrollees. In the summer workshop, Korean teachers experience several activities in which they practice STS and constructivist approaches to science teaching and learning. The follow-up efforts include classroom action research projects undertaken through collaboration between the teachers and the Iowa Chautauqua research staff (c.f., Lee, 2001; Shin, 2000).

The 2000 Iowa program for Korean teachers involved collaborative action research with a Korean high school science teacher named Mr. Park (a pseudonym). Mr. Park was one of the earth science teachers who was enrolled in the 2000 workshop and committed to conducting classroom action research over a two-year period. Until participating in the 2000 program, Mr. Park had taught science in a high school in a mid-sized city in Kyonggi-do for 11 years. He was also a Ph. D. student majoring in mineralogy - a field in which he had a master's degree. The collaborative action research with Mr. Park consisted of two consecutive projects, which were called the Year 1 (March 2001~February 2002) and Year 2 (March 2002~February 2003) projects, respectively. The overall goal of Mr. Park's action research was to create constructivist learning environments in his 11^{th} grade earth science classrooms through ongoing implementation of Group Investigation (GI). GI is an inquiry-based, cooperative learning method in which students work together with their peers to pursue inquiry tasks of their own choosing through multiple pathways (Sharan & Sharan, 1989, 1994). Mr. Park's action research employed a GI protocol with three major phases and activities for each phase, which are indicated in Table 1.

While engaging in GI, students explored a variety of inquiry topics of their own choosing in groups. Some of these included "Simulation of the Coriolis effect", "Building a model for volcano eruption", "Space travel", and "Bermuda Triangle Mystery", which were often beyond the scope of the curriculum and textbooks in use. Students used diverse ways to pursue the topics, including experiments, observations, data productions and interpretations, model building, use of computer simulations, and Internet surveys. Thus, GI provided an open learning environment in which students played active roles in their science learning. In addition, the Year 2 project enacted peer assessment among students so that more constructivist features could be incorporated into the practices in Mr. Park's classrooms (see, for more information on the action research with Mr. Park, Oh et al., 2003; Oh & Shin, 2004).

Table 1. Features of the Group Investigation (GI) Method Used in Mr. Parks Classrooms

Phase	Activity
In-class Discussion	- Students are organized into research groups. - Students get together in their groups for discussion. Each group sets an inquiry topic within a given unit and makes a plan for investigation. - During the discussion, group members use their science journals to identify their own problems, questions, or issues and select a topic to study. - The teacher participates in the group discussion. The teachers roles include encouraging students to select authentic topics which can be addressed in multiple ways. - The group discussion may continue out of the class.
Out-of-class Investigation	- Each student group carries out its investigation. - The teacher helps students with their investigations. The teachers roles include presenting sources of information, providing instruments for experiments, and assisting students with difficulties. - Each research group prepares an in-class presentation.
In-class Presentation	- Students in each group present what they did and what they found to the class. - Students may use their journals when presenting their findings, discussing with others, or asking questions. - The teacher and students engage in a variety of classroom discourse. Their communicative roles include querying, exploring, debating, and elaborating. - The teacher and students collaborate on assessment.

Emergence of Peer Assessment in the Action Research Context

Efforts for changing the traditional approach to assessment were made in Mr. Park's action research classrooms in which the GI method was employed to stimulate constructivist science learning. The GI protocol requires that the teacher and students collaborate on evaluation of student inquiry performances. Hence, during the first project year, assessment was based on the teacher's judgments concerning the quality of student investigations and presentations while the students were allowed to participate in the assessment process by providing their opinions about the work of their peers. However, what really happened was that just a few students replied to the questions that the teacher asked about the inquiry performances of other students. This meant that the rest of the class was not actually engaged in the assessment process. In addition, there were some students who were bothered by the idea of being evaluated by the teacher. For example, NJ (pseudonym used to keep the student anonymous), a student involved in the Year 1 project, remarked that the teacher-dominated assessment discouraged effective learning through inquiry. Her statement was:

> I could not participate well in this class. ... This was probably because I was concerned about how I could get a high grade, rather than focusing on what kind of activities I could do with my group members.

Considering such experiences in the initial project, the Year 2 action research project was planned with a more participatory method of assessing student learning, namely peer assessment. A scoring rubric was developed for use by the students as they took on the primary role in assessing the performances of their peers. This study is an ongoing report of the collaborative action research with Mr. Park and addresses the perceptions of the students regarding the peer assessment method implemented in their classrooms.

Methods

Subjects

The subjects for this study were the 11^{th} grade students who were involved in the Year 2 action research project. A total of 65 students from two science tract classes were taught earth science by Mr. Park, and their earth science classrooms were

Table 2. Subjects Involved in the Second Year Classroom Action Research

Code of the class	Number of students		
	Male	Female	Total
2A	27	6	33
2B	28	4	32

selected for the second year project. Earth science was a compulsory subject for these students and each class met with Mr. Park three days per week. Each class was heterogeneous in terms of student academic achievement; however, in both classes the number of females enrolled were out numbered by males enrolled (see Table 2). For GI and peer assessment activities, the students formed their own groups which included four to six members. There were 7 groups in one class (class 2A) and 7 in the other (class 2B).

The Peer Assessment Method Implemented

In peer assessment, students used a scoring guide called a "co-evaluation rubric" to evaluate the performances of their peers. A template of the rubric was developed through discussions between Mr. Park and collaborating researchers; it was then shared with the students before its first use in order that it could be modified by incorporating student ideas. The students were also given opportunities to propose better ways for assessment both in class and at the end of each semester when they wrote about reflections on their learning experience with Mr. Park. Examples of the student ideas that were actually reflected in the assessment practice in Mr. Parks classrooms included:

- Assessors providing reasons for giving a particular score,
- Evaluating the contributions of individual group members and using it complementarily with group evaluation, and
- Removing both the highest and lowest scores when a total score was computed for a group

The rubric used is presented in Table 3. There are four sets of evaluation criteria in the rubric, each of which, with one exception, has three statements indicating standards for student inquiry performances. Examples of the criteria defined in the rubric are "The motive and goal of the inquiry are helpful in understanding earth science", "The method and process of the inquiry are appropriate in achieving the goal of the inquiry", "The group argues by using evidence", and "The group provides suggestions for better inquiry activities." Whenever a student group presented what had been investigated, each of the other groups gave a score based on group discussions regarding how many standards had been satisfied by the group presenting its investigation. For example, score 3 indicated that three standards in a set of evaluation criteria were satisfied by the group. An assessing group was also expected to provide general comments additionally which included justifications of its evaluation. The scores given to a group were added with both the highest and lowest scores abandoned to compute a mean, which in turn became a grade for individual students in the group. That is, all students in a group were supposed to be assigned the same score. However, each members score might be modified according to his or her contribution to the group work, which was evaluated by three different symbols: ○ which refers to 'good', Δ 'normal', and × 'poor'. The results from peer assessment accounted for 20% portion of the year-end achievement scores for students. That is, the year-end achievement score was made in consideration of two semester tests (60%), peer assessment (20%), lab activities and reports (12%), and homework assignments (8%).

In his earth science classrooms where the whole sequence of GI activities was implemented five times during the year, Mr. Park often referred to the evaluation criteria defined in the co-evaluation

Table 3. The Co-evaluation Rubric Used for Peer Assessment

Date:	Members of the presentation group			Evaluation
Presenting Group:				
Assessing Group: (group leader:)				
Presentation Topic:				
The motive and goal of the inquiry are: - Explicit - Original (interesting) - Helpful in understanding earth science	3	2	1	0
The method and process of the inquiry - The method and process of the inquiry are appropriate in achieving the goal of the inquiry. - The group members made a great effort. - The group explains well what they have learned through the method and process of the inquiry.	3	2	1	0
The result of the inquiry and its interpretation - The group reports the inquiry results honestly. - The group argues by using evidence. - The group indicates important results which suit well to the goal of the inquiry.	3	2	1	0
Suggestions for new inquiries - The group provides suggestions for better inquiry activities.			1	0
General Comments:	Total score = ( ) points			

rubric in order to emphasize the kinds of inquiry practices that should be achieved in student investigations and to guide students in completing rubrics and using them for better inquiry. For instance, Mr. Park reminded the students of an evaluation standard by saying:

> As you can learn from the evaluation rubric that I passed out, once you decide on a topic, you are going to study in a way that raises a variety of issues. ... I understand that you won't explore the topic perfectly. ... Then, you better suggest what should be studied further, let's say, a kind of vision for the future (excerpted from the video recordings of Mr. Park's classrooms taped in April, 2002).

Data Collection and Analysis Method

The collaborative efforts with Mr. Park followed the action research process described by Kemmis and McTaggart (1988), which include spirally recurring cycles of planning, action, observation, and reflection. While conducting action research, a group of research participants sharing some concerns about educational practices undertake to develop a plan of action to improve what is already happening, to act to implement the plan, to observe the effects of the action in the context where it occurs, and to reflect on these effects as a basis for further planning (Kemmis and McTaggart, 1988). For the reflection phase which was the moment for group critique, the students involved in Mr. Park's action research were asked to write their reflective ideas about science learning experiences in their classrooms. While the content and form of the writings were open, the students were expected to answer key questions about the methods the class used, including "What aspect(s) of the peer assessment method do you like or dislike?" This question was intended to elicit reflections on the implementation of peer assessment from student perspectives and to incorporate student ideas into a new action research plan.

In this study, students' reflective writings were analyzed to reveal their perceptions of the peer assessment method used in their classrooms.

Although most issues addressed by students in their writings were related to Mr. Park's science lessons, only what was linked directly to the question about peer assessment was considered relevant data for this study. The student writings were created at the end of every semester of the second project year. However, the number of students who responded to the question about peer assessment as well as the number of answers they provided varied depending on the time the writings were created and on the issues addressed in the writings. This led to an analysis of the student writings that was qualitative rather than quantitative. The basic procedure of the analysis was to sort student ideas into groups according to their similarities and to develop a statement that could represent the common idea for each group. As a result, thirteen statements were made as indicators of student perceptions of peer assessment. These statements were shared with Mr. Park as part of feedback from the Iowa Chautauqua research staff in order to establish internal validity. In fact, Mr. Park readily agreed with the ideas indicated because he had already looked at the student writings and reflected on several ideas concerning his action research plans. Finally, the statements were regrouped into five major categories to be reported in this paper. These are: 1) positive nature of peer assessment as perceived by students, 2) positive effects of peer assessment as perceived by students, 3) negative nature of peer assessment due to inappropriate student attitudes, 4) negative effects of peer assessment as perceived by students, and 5) difficulty in implementing peer assessment.

In the following section, student perceptions of peer assessment are presented with verbatim accounts of student writings. Table 4 as well provides a list of the five categories and thirteen statements together with the number of student responses. Because the main purpose of the study was to draw implications for future use of alternative assessment in the science classroom, the two classes involved in the Year 2 action research project were neither separated nor compared statistically. Also, considering males were dominant in the classes, no comparisons in terms of gender were attempted.

Table 4. *Student Perceptions of the Peer Assessment Method Implemented*

Perception Category and Statements	Number of Student N = 62*
1. Positive nature of peer assessment as perceived by students	
- Peer assessment is good since student perspectives are considered.	14 (22.6%)
- Peer assessment is comprehensive since many people ideas are considered.	10 (16.1%)
- Peer assessment is good since it is based on actual performances of students.	3 (4.8%)
2. Positive effects of peer assessment as perceived by students	
- Peer assessment motivates students to engage more actively in learning.	33 (53.2%)
- Peer assessment prompts better student performances.	12 (19.4%)
- Peer assessment encourages interactions and collaborating within a group.	10 (16.1%)
- Peer assessment provides an opportunity for self-reflection.	3 (4.8%)
3. Negative nature of peer assessment due to inappropriate student attitudes	
- Peer assessment is not fair since students judge based on their personal emotions and relations to others.	29 (46.8%)
- Peer assessment is not effective since students do not take it carefully and seriously.	20 (32.3%)
- Peer assessment is not accurate since students do not understand the criteria and follow the guideline very well.	14 (22.6%)
- Peer assessment is not accurate since students may cheat.	3 (4.8%)
4. Negative effects of peer assessment as perceived by students	
- Peer assessment causes trouble among students.	5 (8.1%)
5. Difficulty in implementing peer assessment	
- It is difficult to discern between good and poor performances and to assign specific grades.	5 (8.1%)

*The number of students refers to those who provided opinions regarding the peer assessment method at least once, either in the first semester or in the second one. A student may provide multiple opinions so that the total number of responses is greater than 62.

Findings

Positive Nature of Peer Assessment as Perceived by Students

According to their reflective writings, the students involved in the classroom action research were convinced of the worth of peer assessment. Fourteen (22.6%) students viewed peer assessment as positive in the sense that their own perspectives were considered. Peer assessment was also regarded as comprehensive since it was the method of evaluation in which ideas of many people were included. Ten (16.1%) students referred to this comprehensive nature as a positive aspect of the peer assessment method. In their writings, students made remarks such as:

> Because students completed the evaluation rubric, the scores made from the student's perspectives, not the teacher's, were also counted in the assessment. I think this is how the science classroom has been improved (MDR in class 2B).
> [Peer assessment] reflects more people's ideas, ... and evaluates the investigations from a wider variety of viewpoints (JHK in class 2A).

There were three students (4.8%) who referred to the evaluation based on students' actual performances as an example of the positive aspects of the peer assessment method. Particularly, KT in class 2A argued for student involvement in the assessment process by saying that students were better at assessing their peers than the teacher because they knew "who did and who did not [contribute to group activities]."

Positive Effects of Peer Assessment as Perceived by Students

The students who experienced peer assessment in the context of Mr. Park's action research perceived that the new assessment method brought about positive changes in their science learning. As many as 53.2% of the students indicated that the peer assessment method motivated them to engage more actively in learning. As shown in the following quotations, several students reported that since they had the responsibility to assess their peers, they paid more careful attention to what was being presented by their classmates.

> Since students themselves assess their learning, nobody is isolated or excluded from the earth science class (SY in class 2A).
> I remember that, because I had to evaluate, I listened more carefully to the presentations by other groups. Probably it is the best thing about peer assessment (WJ in class 2B).

The peer assessment method also encouraged students' to perform better on investigations and presentations (based on 19.4% of the students responses) and to interact and collaborate more effectively within their groups (16.1%). Examples of student explanations about such positive effects of peer assessment include:

> We could make a more 'up-graded' presentation, anticipating how others would assess our group (THK in class 2A).
> It was difficult for me to evaluate my friends' presentation. However, it was not that difficult to assess together through group discussions of how well they did. This method also improved my ability to engage in discussion (MH in class 2A).

In addition, peer assessment provided an opportunity for students to reflect on their own practices and produce better plans for learning science (4.8%). For instance, SE in class 2B stated in her writings, "What was good about the use of the co-evaluation rubric was that I could improve myself while pondering my classmates activities and thinking about what they should improve."

Negative Nature of Peer Assessment Due to Inappropriate Student Attitudes

Student perceived negative aspects of peer assessment were mostly linked to the inappropriate

attitudes of the students toward the new method. According to the information from the reflective writings, students often judged their peers' performances based on their personal emotions and relationship to others. For example, they tended to "give a lower score to a group to which a particular student or females belong" (HC in class 2A). Also, it was likely that "students would get the same score as they gave others. That is, they would be rewarded in their evaluations if they gave others a high score" (WJ in class 2B). Twenty-nine (46.8%) students responded that due to such problematic attitudes of students, they did not believe the peer assessment strategy was fair or objective.

Similarly, twenty students (32.3%) perceived peer assessment as ineffective since students did not implement the peer assessment method carefully and seriously. The student writings included the following remarks:

> There were many students who considered it [peer assessment] a joke. I lost my words when they said that they gave the score just for fun (HJ in class 2A).
>
> Students may give scores at random without listening to the presentation. They do it irresponsibly because they do not know whether the group performed well or not (JS in class 2B).

Based upon 22.6% of the students' responses, such inappropriate reactions to peer assessment may be because they do not understand the criteria and follow the guidelines very well. SW in class 2B indicated, for example, "Students tend to give a good score when the presenter is talkative or s/he just picks up on what they did not know, rather than listening to what s/he presents attentively." Even further, it was reported by students (4.8%) that it was not impossible to cheat for a high score. For instance, CH in class 2B commented critically on students negotiating grades: "It is just like a lobby between politicians."

Negative Effects of Peer Assessment as Perceived by Students

A negative perception of the students concerning peer assessment was also related to the unpleasant experiences that they encountered while engaging in evaluating one another. In their reflective writings, five students (8.1%) reported similar problems, including "If they give me a poor score even when I work very hard, it upsets both them and me" (HMP in class 2A); "I am afraid that friendships may be hurt because of [unexpected/unreasonable] scores" (DH in class 2B). Such trouble among classmates was believed to be a possible negative effect occurring with the new implementation of alternative methods such as peer assessment.

Difficulty in Implementing Peer Assessment

It was found that for some students (8.1%) it was difficult to discern between good and poor performances and to give grades. This was not simply because the students did not understand the criteria. It was also because "most students make presentations in similar ways" (SJ in class 2B). In addition, as JK in class 2B wrote in his writing, "It often appears to be disappointing to quantify what students have eagerly worked on."

Discussion

The overarching goal of Mr. Park's action research was to develop his earth science classrooms into more constructivist learning environments. In the constructivist classroom, students should take ownership of designing and maintaining their learning environments (Aldridge et al., 2000; Reigeluth, 1999; Taylor et al., 1997; Willis, 2000). This means that students should collaborate with the teacher in sharing control of all aspects of developing a learning environment, such as the articulation of learning goals, the planning and

management of learning activities, and the determination and application of assessment criteria. Peer assessment in Mr. Park's action research was basically intended to increase such student ownership by allowing the students to assume the primary role in evaluating performances of each other. As a consequence, for all the classes involved in Mr. Parks action research, the level of student perceptions of shared control increased over time, indicating that Mr. Park's science classrooms were becoming more constructivist (see Oh et al., 2003). In this study, it was obvious that the students appraised positively their involvement in the peer assessment process when they indicated the participatory and comprehensive nature of the new assessment method. Furthermore, the reflective writings of the students showed that the ownership for assessment appeared to lead to increased responsibility for learning and that this responsibility in turn motivated them to engage actively in their lessons. This result provides support for the claim that as students take more autonomy for their learning and assessment, they become better able to use the assessment process as a tool for learning, not as an end of learning (Zessoules & Gardner, 1991).

Following the principle that assessment ought to be planned and implemented in ways that facilitate student learning (Berry, 2003; Brooks & Brooks, 1999; Champagne et al., 2000; Duffy & Cunningham, 1996; NRC, 1996), the scoring rubric for peer assessment in Mr. Park's classrooms was developed as a set of standard performances for student inquiry. As evident in the reflective writings, the use of the performance standards as evaluation criteria resulted in students using the assessment tool to improve their learning practices. That is, the students better inquiry performances and their active interactions and collaboration were prompted by the peer assessment process in which the co-evaluation rubric served as a set of classroom norms for coordinating inquiry practices. This result is congruent with those of previous studies which revealed that students who engaged in alternative assessment tasks were likely to be more motivated to learn (Hargreaves, 1997; Herman & Klein, 1999; Lin et al., 2002). More importantly, such positive impacts of peer assessment are found consistently across grade levels, in both secondary and postsecondary schools. It is therefore suggested that assessment instruments should be designed as standards of student performances which can help students enhance their learning.

Despite its contribution to developing constructivist learning environments and to motivating students to enhance their learning, the peer assessment method used in Mr. Park's classrooms revealed some practical problems which resulted in negative student perceptions. As described previously, students at times made judgments based on their personal emotions and relationships to others. It was also reported that some of the students did not engage in the assessment process carefully and that there were even a few students who cheated on assessing their peers. As a result, the peer assessment method sometimes caused trouble among students. The reason for such problematic attitudes included that the students did not understand the evaluation criteria and/or that they did not follow the guidelines very well. In fact, the problems found in Mr. Park's science classrooms are not unfamiliar to those who have applied innovative methods of assessment in their classrooms (c.f., Herman & Klein, 1997; Sivan, 2000). However, it should be remembered that, although the implementation of new methods in classrooms often occurs with such practical problems, such methods are still educationally worthwhile because teachers and students can find better ways of using the methods from their experiences (AEL & VEA, 1992). Therefore, as Sivan (2000) suggests properly, this study recommends that teachers use peer assessment consistently and that they guide students gradually so that the students develop better assessment practices in the course of their learning. It would be particularly important to involve students in determining, applying, and modifying

the assessment criteria because the involvement can encourage students to regulate their own learning and improve their practices on an ongoing basis. It is also recommended that other strategies be employed, such as self assessment, adjusting the ratio of student assessment to the teachers, and group member rotation, in order to mitigate possible negative effects from using peer assessment exclusively.

Limitations of the Present Study

As a report about student perceptions of peer assessment used in an action research context, this study contains some limitations which should be considered in future use of the alternative method. First of all, although peer assessment resulted in several positive aspects for promoting learning, the students at times displayed undesirable behaviors when they were engaged in the new assessment method. These negative results appear to be caused by the students lack of experiences with such alternative methods in prior grades and by the fact that they were not given enough training before the actual use of the co-evaluation rubric. Therefore, preliminary training opportunities could be offered to increase the positive effects of peer assessment when similar efforts are made in the future.

In addition, as mentioned in the previous section, some mitigation measures can be used to reduce possible negative effects of peer assessment. However, the present study is weak in the sense that it lacks evidence concerning the effectiveness of such complementary strategies. Therefore, a research question for future study should deal with how these strategies actually affect student learning and how teachers and students develop their own ways of using the strategies in their own classrooms.

Lastly, in Mr. Parks action research the peer assessment method was employed to strengthen constructivist features resulting from the use of GI. It is possible that students perceptions also reflected their reactions to the GI method even though only the answers directly linked to the question about peer assessment were analyzed in this study. Hence, the findings of this study could be understood best when readers interpret them considering both the GI and peer assessment methods. Also, it should be noted that peer assessment can be more effective in a context where science learning occurs in inquiry-based situations such as GI.

Conclusions

Todays reforms in the broad field of education have moved to student-centered approaches to classroom learning (NRC, 1996; Lambert & McCombs, 1998). When learning environments become learner-centered, then the form and content of assessment also need to undergo change (Valanides & Angeli, 2002). Alternative methods such as portfolio assessment, performance assessment, and student self- and peer assessment are appropriate for classrooms in which students engage actively in their own learning. These methods can also contribute to developing constructivist learning environments because they increase student ownership and responsibility while encouraging the students to improve their learning practices continuously.

For teachers to be prepared for more effective assessment, a professional development program can be designed in which teachers can receive ongoing support from experts, be supplied with good examples of assessment from their colleagues, and be encouraged to apply those in their own classrooms (Shepard, 1995). When teacher inservice programs are developed in this way, it can be expected that improvement in science education will be realized at the classroom level through changes in assessment practices.

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