Classroom Assessments in Mathematics: High School Students' Perceptions

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Abstract

This study examined high school students' perceptions of mathematics classroom assessments. 248 American students gave valid responses to a questionnaire. Data analysis involved counting frequencies, calculating percentages, and running Chi-square tests. Results reveal that students felt a strong congruence between mathematics assessment, planned learning and adequate transparency regarding the purpose and forms of the assessment, inadequate authenticity in assessment tasks, and had little or no say in the assessment planning process. Results show the most variance in the questions regarding accommodation of student diversity. Gender difference was observed in assessment authenticity and transparency. Results are discussed in regard to previous literature and future research.

Key words: mathematics, classroom assessment, perception, high school student

1. Introduction

Classroom assessments are an essential component of the teaching and learning process (Goodrum, Hackling, & Rennie, 2001). Such assessments are not only a means to assign grades and determine whether students achieve objectives but have also become a learning tool (Watering, Gijbels, Dochy, & Rijt, 2008). Traditionally, assessment forms and tasks employed in schools have been overwhelmingly decided by teachers and administrators (Fisher, Waldrip, & Dorman, 2005). However, for effective learning to occur, students need to understand assessment processes and the implications for themselves as learners (Schaffner, Burry-Stock, Cho, Boney, & Hamilton, 2000). To this end, students must be involved in decisions about classroom assessment. Despite this knowledge, little contemporary research has addressed student involvement in the assessment planning process (Dorman & Knightley, 2006). The present paper reports on one study that examined high school students' perceptions of classroom assessment in mathematics.

1.1 Classroom Assessments in Mathematics

According to a recent report by the Organization of Economic Co-operation and Development (OECD, 2005), classroom assessments—summative and formative—are integral to the education process. Summative assessments are a major detector of what students have learned and how schools account for student performance. Through formative assessments, teachers monitor student progress, provide students feedback, and adjust instructional approaches toward improved teaching and learning. Overall, classroom assessments are effective strategies for improvement of student learning.

Classroom assessments in mathematics have encountered a wide range of barriers to student achievement. Some examples of these barriers include: (1) perceived tensions between teacher-made formative assessments and highly visible summative assessment for school accountability (OECD, 2005); (2) a focus on recall of isolated items of knowledge (Black & William, 1998; Crooks, 1988); (3) inadequacy in aligning assessment tasks with students' real-life situations (Gulikers, Bastiaens, Kirschner, & Kester, 2008); (4) inadequacy in student consultation regarding what should be included in assessment tasks (Schaffner et al., 2000); (5) a secretive process of setting criteria for judging student performance (Schwarz, 1992); (6) inequity or biases against students of diverse backgrounds (Lane, 1993; Pullin, 1993); and (7) a lack of awareness that gender has an effect on student performance on mathematics assessments. Concerning this final barrier, certain assessment formats favor boys more than girls (Kovas, Haworth, Petrill, & Plomin, 2007); boys do better under time pressure than girls (de Lange, 1999); and girls fare better when more language is involved (van den Heuvel-Panhuizen & Vermeer, 1999). To improve student achievement, mathematics assessment should be congruent with planned instruction (Reynolds, Doran, Allers, & Agruso, 1995), relate to the students' real world experiences (Gulikers et al., 2008), and give every student the optimal opportunity to demonstrate mathematical power (de Lange, 1999).

By including students in the teaching-testing-grading cycle, the validity of the assessment processes can be enhanced and invalid assessment instruments that result in very high failure rates can be avoided (Steinberg, 2000). Students will also learn throughout the assessment when expectations and scoring procedures are openly discussed and jointly negotiated (de Lange, 1999).

1.2 Students' Perceptions of Classroom Assessments

Students hold clear views on most aspects of school life such as how they are assessed (Dorman & Knightley, 2006). Students also have great concerns about the importance and fairness of assessment tasks, their congruence with classroom learning and relevance to the real world. According to Cavanagh, Waldrip, Romanoski, and Dorman (2005), student views of classroom assessment comprises five characteristic elements: congruence with planned learning, authenticity, student consultation, transparency, and accommodation of student diversity. Ideally, students should affirm the following: (1) assessment tasks align with the goals, objectives, and activities of the learning program; (2) assessment tasks feature real-life situations that are relevant to the students; (3) students are consulted and informed about the forms of assessment tasks being employed; (4) purpose and forms of assessment tasks being used are clearly conveyed; and (5) all students have an equal chance of completing assessment tasks.

Table 1

Purpose and Description of the Items in the Students' Perceptions of Assessment Questionnaire (adapted from Dorman & Knightley, 2006)

Items	Element	Description	Exemplary Item
01-05	Congruence with Planned Learning	The extent to which assessment tasks align with the goals, objectives and activities of the learning program.	My math assignments / tests are about what I have done in math class.
06-10	Authenticity	The extent to which assessment tasks feature real life situations or those are relevant to the learner.	I find math assessment tasks are relevant to what I do outside of school.
11-15	Student Consultation	The extent to which students are consulted and informed about the forms of assessment tasks being employed.	I have a say in how I will be assessed in mathematics class
16-20	Transparency	The extent to which the purposes and forms of assessment tasks are well-defined and clear to the learner.	I am clear about what my teacher wants in my math assessment tasks.
21-24	Accommodation of Student Diversity	The extent to which all students have an equal chance at completing assessment tasks.	I have as much chance as any other student at completing math assessment tasks.

Guided by this five-element conceptual framework, Cavanagh et al. (2005) developed the Students' Perceptions of Assessment Questionnaire (SPAQ). The SPAQ includes 24 items, each in the form of a statement (e.g., my assignments/tests are about what I have done in class) and uses a 4-point Likert scale (0 = *almost never*; 1 = *sometimes*; 2 = *often*; and 3 = *almost always*). During data analysis, these items are collapsed into five subscales. Table 1 presents the five subscales and their respective description. Scale 1 (Items 1-5) measures the element of congruence with planned learning; Scale 2 (Items 6-10) measures authenticity; Scale 3 (Items 11-15) measures student consultation; Scale 4 (Items 15-20) measures transparency; and Scale 5 (Items 21-24) measures accommodation of student diversity. Originally, Cavanagh et al. (2005) designed the SPAQ to measure student perceptions of classroom assessments in science. For the purpose of the current study, this researcher has adapted the SPAQ by replacing the word science with mathematics where appropriate.

1.3. Research Questions

Based on previous literature, the researcher hypothesized that mathematics classroom assessments lack congruence with planned learning, authenticity, consultation with students, transparency, and accommodation of student diversity. To test this hypothesis, this research sought to answer the following research questions:

1) Do students perceive any congruence between mathematics assessment and classroom learning?
2) Do students perceive assessment tasks as authentic and relevant to real-life situations?
3) Do students report that they are consulted about the purpose and forms of assessments that are used in their classrooms?
4) Do students feel that the assessment requirements and expectations are clearly conveyed?
5) Do students perceive that accommodations for special needs are provided during the assessment process?

In addition, because previous literature has reported gender difference in mathematics assessments, this study also addressed whether boys and girls differed in the five aspects of perceptions about mathematics assessment.

2. Methods

2.1 Procedures

The researcher contacted 25 high school mathematics teachers around northeast Arkansas by phone call, email, or mail to assist in identifying student participants. Of those contacted, 15 teachers agreed to assist with this study. Informed consent was obtained from the students and their parents or guardians. On behalf of this researcher, teachers administered the survey in their respective classes. 396 students responded to the survey and 248 (63%) of the completed surveys were valid.

2.2 Respondents

The valid respondents (N = 248) included 104 boys and 144 girls and the gender difference was significant at .05 alpha level (χ^2 (1, N = 248) = 6.45, p = .01). Participants were aged 16 to 18 years (M = 16.82, SD = 0.69). Finally, 201 participants were white, 34 Black, 5 Latinos, 3 Native Americans, and 5 bi-racial.

2.3 Reliability

As previously discussed, the questionnaire used in the current study was adapted from Cavanagh et al.'s (2005) SPAQ in science. Although the SPAQ in science was validated, this researcher believed that it was necessary to re-assess the reliability of the SPAQ in mathematics as used in this study. Therefore, Cronbach's alpha was calculated and the reliability coefficient for each item was high ($\alpha \geq .80$), which suggests that the SPAQ in mathematics was reliable.

2.4 Data Analysis

The data were analyzed in SPSS by counting the frequencies and calculating the percentages of the responses (i.e., Almost Never, Sometimes, Often, and Almost Always) of each item. Results were collated and reported by means of descriptive statistics for each of the five elements. In addition, Chi square tests were conducted to determine whether boys and girls differed significantly in their perceptions of mathematics classroom assessments.

3. Results

3.1 Congruence with Planned Learning

The first 5 items on the questionnaire addressed congruence with planned learning. These statements evaluated whether students feel there is a direct correlation between math assessments and classroom instruction. Overall, 85% of respondents felt that there was "Almost Always" or "Often" a congruency between assignments or tests and learning activities. Specifically, 96% of boys and 77% of girls answered "Almost Always" or "Often" in this category. The gender difference was non-significant (χ^2 (1, N = 248) = 0.57, p > .05).

3.2 Authenticity

Items 6-10 on the questionnaire addressed whether students perceived that the math they learned in class had relevance to real-life tasks. Overall, 78% of respondents felt that the math assessments were "Almost Never" or only "Sometimes" applicable to real-life situations.

Here, the boys and girls were clearly divided on their opinions regarding authenticity as 60% of boys and 91% of girls felt that the assessment tasks were "Almost Never" or "Sometimes" applicable. This gender difference was significant (χ^2 (1, N = 248) = 24.67, p < .001).

3.3 Student Consultation

Items 11-15 addressed whether students were consulted and included in the assessment decision process. These items ranged from the teacher communication with students concerning types of assessments and scoring to greater student participation concerning rule making, selecting types of assessments, and having a say in how assessments were conducted. In this category, the students' responses showed considerable variance, and the results were not strongly conclusive. Specifically, 73% of respondents indicated that they were "Often" or "Almost Always" clear about the type of assessments being used (Item 11) and how they were marked (Item 12). However, on the 3 items that measured students having a voice in the process (Items 13, 14, & 15), 73% of respondents indicated that they were "Almost Never" or "Sometimes" consulted in the process. The scores of boys and girls generally followed the pattern of the combined group and there was no clear gender differentiation in this category.

3.4 Transparency

Items 16-20 evaluated the students' perception of transparency in the math assessment process. 82% of respondents on Items 16-19 indicated that they "Almost Always" or "Often" understood what was expected and needed to successfully accomplish math tasks. This result was similar for the item that measured whether the teachers were clear in telling students what was being assessed and when the assessments were given. On Item 20, boys and girls were divided in their responses; 68% of girls and 20% of boys reported that they "Almost Always" or "Often" knew how a particular assessment task would be graded. This gender difference was significant (χ^2 (1, N = 248) = 49.82, p < .001).

3.5 Accommodation of Student Diversity

Items 21-24 addressed whether accommodations were made for student diversity in the math assessment process. The students showed the most variance in this category. All respondents (100%) indicated that they "Often" or "Almost Always" had as much chance as any other students to complete assessment tasks (Item 21). 73% of respondents felt that they "Often" or "Almost Always" were allowed to complete tasks at their own speed (Item 22). On Items 23, only 27% of respondents felt that they "Often" or "Almost Always" were given tasks that addressed individual needs with regards to ability. Student responses were evenly distributed across "Sometimes," "Often," or "Almost Always" on Item 24, which asked whether students could complete assignments in different ways. Of note, boys' responses clustered to the high end of this scale.

4. Discussion

4.1 Findings

The results of the study reveal that students, regardless of gender, strongly feel that there is a congruency between mathematics classroom assessments and planned learning. Moreover, the current study shows that students feel that there is transparency between the teachers' intent and students' understanding related to assessments. Previous research has argued that congruence between instruction and assessment enhances students' academic attitudes and efficacies and, as a result, correlates significantly with student academic achievement (Koul & Fisher, 2006; Reynolds et al., 1995). When students are aware that what they are learning in class will appear on assessment tasks, they are usually more willing to invest time and energy in the learning activities (Brookhart & Bronowicz, 2003; McMillan, 2000). The current study also provides evidence to confirm the perceived importance of informing students whether and how assessment tasks align with the goals, objectives, and activities of the learning program.

Authenticity is another category where a strong spike in the scale was noted. Most students indicated that they did not feel that there was a strong correlation between math assessments and everyday tasks. This finding lends support to Gulikers et al. (2008) who documented a gap between teacher and student perceptions of authenticity. Assessment tasks that teachers felt were authentic were not considered authentic by students. Gulikers et al. further suggested that authenticity is a matter of individual perception and is somewhat dependent on personal experience. For assessment tasks to relate to real-life situations, it is imperative that teachers and other personnel who are involved in the assessment decision process understand what real-life situations students are really concerned about.

The category of student consultation did not show clear results in the overall picture; however, student responses clearly indicate that they have little or no say in the assessment planning process. Struyven, Dochy, and Janssens (2005) reported a strong relationship between student perceptions of assessments and how they approach learning. Struyven et al. also highlighted the improvement in student performances when students felt included in the decision of assessment mode.

In addition, the questions related diversity showed the most variance and did not paint a clear picture as to whether accommodations are made for student diversity. Often, student diversity needs are not accommodated for because students, parents, and, in some cases, teachers are not clear about their rights and options. For effective learning to occur, it is imperative that accommodations are made for students of diverse backgrounds to demonstrate their mathematic power.

The current findings were surprising, not in their uniqueness, but more in their similarity to the published opinions of most students, who question the authenticity of class work and real-life application (Gulikers et al., 2008). Moreover, while teachers may feel that they are doing an adequate job of communicating with students those issues that regard scheduling assessments and congruency between testing and class work (Koul & Fisher, 2006; Struyven et al., 2005), the students in the present study did not feel that they were consulted or were included in decisions of how they are assessed. With concentration on academic achievement so focused on assessment, it is imperative that teachers better understand how students perceive the classroom assessment processes toward improved student consultation and inclusion in classroom assessments.

4.2 Conclusion

This study has for the first time applied the SPAQ in mathematics by surveying student views on math assessments. The findings offer many insights into the ways American high school students look at mathematics classroom assessments. The findings suggest that, while mathematics assessments demonstrate congruence with planned learning and transparency, there still is a long way to go in areas such as accommodating students' special needs, involving students in the assessment decision process, and increasing authenticity of assessment tasks. In revealing the multi-dimensions of student perceptions, this study can help readers appreciate, not only the subtle character of classroom assessments in mathematics, but beyond. However, due to the cross-sectional data and geographically homogeneous student sample, the findings of the current study should be interpreted with caution. Therefore, it is suggested that future researchers obtain a larger sample of students from various school levels and regions to develop a more complete picture of student perceptions of mathematics assessments.

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