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*Full Length Research Paper*

# Behaviour assessment in ontario mathematics classrooms

**Tess Miller[1], Dr. D. Klinger[2], Dr. L. Shulha[3]**

01A 9105, 112 Street Edmonton, Alberta T6G 2C5 Phone: 780-434-0117

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**Curriculum reform in Ontario secondary schools proposed that the assessment of student achievement be separated into academic achievement and non- academic achievement or the behaviours that can influence academic achievement. The purpose of this study was to explore teachers' assessment practices of non-academic achievement in Ontario's grade 9 Academic and Applied mathematics programs. A questionnaire was distributed to grade 9 mathematics teachers attending a provincial mathematics conference. Analysis revealed that teachers were not engaging in this area of assessment as much as they felt they should and that the assessment of homework, in particular, was still being incorporated into a student's academic score.**

**Key words:** Assessment, mathematics, learning skills, learning behaviors/behaviours.

## INTRODUCTION

Student achievement is influenced by many factors. According to Clark (2002) these factors can be classified as either in-school or out-of-school factors. Miller (2003) is more descriptive in stating that student achievement is influenced by student, teacher, and school level factors. Student-level factors are also known as learning behaviours, non-achievement factors or learning skills. Marzano (2000b), for example, identified effort (participation and work completion), behaviour (following rules, teamwork), and attendance (tardiness, absentteeism) as non-achievement factors that have the potential to influence a student's academic achievement.

The purpose of this study was to examine teachers' reported assessment practices of these factors. Specific focus was on the Ontario education system since they have chosen to report on these factors or what they term learning skills (the term learning skills will be used from this point forward to refer to learning behaviours or non-achievement factors) separately from students' academic achievement. Research exploring the extent in which some learning skills that were traditionally incorporated in a student's final score (i.e. homework and participation) as well as other learning skills have been separated from academic achievement will provide inaugural evidence of how well this area of assessment has been embraced by Ontario mathematics teachers.

### Literature Review

Upon examining Ontario education documents, the term learning skills first appeared in the Ontario Ministry of Education and Training, For the Love of Learning, Royal Commission on Learning (MET/FLL/RCL) (1994) report; referencing only *essential* and *group* learning skills. The Ontario Ministry of Education, Program Planning and Assessment (MET/PPA) (2000) document describes the factors influencing academic achievement as learning skills. The five learning skills in which students in Ontario secondary schools are assessed and reported on are: Works Independently, Teamwork, Organization, Work

*Corresponding authors E-mail: millert@educ.queensu.ca.

Habits/Homework, and Initiative (MET/PPA, 2000). Student's learning skills achievement is communicated to parents on a standardized report card using an ordinal scale ranging from *excellent* to *needs improvement*. The MET/PPA (2000) document clearly states that the assessment of a student's learning skills are not to be included as part of a student's academic achievement. According to the MET/PPA (2000) document, the purpose of separating these two areas of student learning, which can be very connected, is to provide different information about student learning. The absence of a reference list in support of this assessment practice in the MET/PPA (2000) document or on the Ontario Ministry of Education web-site makes it difficult to understand the rationale behind this practice and why these five learning skills in particular were chosen.

Some researchers support the separation of students' learning skills achievement from their academic achievement although examples of where this theory is put into practice or empirical evidence documenting the effectiveness of this practice are not provided. Pope (1989), for example, felt that incorporating learning behaviours such as participation disadvantaged shy or introverted students. He also noted that scores related to participation were hard to justify when challenged. Bean and Peterson (1998) noted that when the assessment of student participation was included as part of their overall grade, teachers had no concrete means of measuring students' participation hence the participation score was determined by the impression made by the students. Jacobs and Chase (1992) reported that including measurements of student behaviours with academic achievement measures "contaminates the grade as a measure of achievement of the course objects" (p. 195). Other researchers (i.e. Brookhart, 1999; Cizek, Fitzgerald, & Rachor, 1996) found that the assessment of the homework learning skill was used to determine a student's final score which was contrary to their views of assessment since the assessment of homework was thought to be a formative measure.

A search in other jurisdictions for assessment practices similar to those called for in Ontario revealed a middle school in Maryland, United States was also separating academic and learning skills achievement (Montgomery County Public Schools, 2005a). Similarly, this school used the term *learning skills* to describe two factors influencing student achievement. The two learning skills used were *participation*, which is used to report student involvement/engagement (degree and frequency), and *assignment completion*, which includes class work and homework. The rationale for this practice was included on their web-site and sited the work of Marzano (2000a) as the principle source guiding this assessment practice (Montgomery County Public Schools, 2005b).

According to Marzano (2000b), factors that influence student learning can be assessed separately and with accuracy when using a rubric. Marzano's rationale for this practice centres around the value placed on what is being assessed. If learning skills are being assessed then, according to Marzano, students will adjust their study habits accordingly. Marzano further supported this practice with acknowledging calls from employers and parents who support the assessment of learning skills; some of which are transferable to employability skills such as teamwork or attendance.

In a meta-analysis of research on instruction Marzano, Pickering, and Pollock (2001) (1998) identified nine instructional strategies; four of which are very similar to the learning skills Ontario students are being assessed on. The four of the instructional strategies corresponding with the four learning skills in Ontario are: Summarizing and note taking (Organization); Homework and practice (Work habits / Homework); Cooperative learning (Teamwork); and Setting goals and providing feedback (Initiative). The parallel between Marzano's work and the learning skills identified in the Ontario curriculum suggests that the rationale for Ontario's learning skills assessment may stem from the work of Marzano.

## Methodology

The purpose of this study was to examine teachers' reported assessment practices of learning skills that have the potential to influence academic achievement in the two mathematics streams (i.e. Academic and Applied). A questionnaire was used to gather evidence of teachers' reported assessment practices. The following section describes how this instrument was designed, the participants in the study, and the data analysis.

## Questionnaire Design

Questionnaire items were developed in relation to the question posed in this study. The questionnaire format employed both qualitative and quantitative items. Quantitative items were used to extract basic assessment knowledge, practices, and beliefs. These items were measured using the five-point likert scale: strongly disagree, disagree, neither agree nor disagree, agree, or strongly agree. Items referencing the frequency of practice used the four-point likert scale: never, rarely, sometimes, or frequently. In addition, nominal and ordinal scales were included to explore assessment practices and beliefs.

Salant and Dillman (1994) noted that people's attitudes and beliefs are much more fluid than their knowledge about specific facts; consequently, the measurement error can be large. To minimize the measurement error, multiple questions related to the same belief were created for each area of inquiry and then collapsed

during the analysis stage to provide one indicator reflecting a specific belief for each construct being measured.

**Participants**

Participants in this study were from the 2004 annual provincial mathematics conference held in Waterloo, Ontario. A total of 110 grade 9 mathematics teachers completed the questionnaire. Almost half (46%) of these teachers taught in both the Academic and Applied streams. Teachers were asked to complete the questionnaire in the role of Academic or Applied teacher, not both. As a result, 65 teachers completed the questionnaire as Academic teachers and 45 as Applied teachers. Based on the number of teachers who completed the teacher questionnaire component of the 2002-2003 (previous school year) provincial Grade 9 Assessment of Mathematics (G9AM), this sample represents approximately 2.6% of Academic and 2.9% of Applied teachers who taught grade 9 mathematics in the province of Ontario during the 2003 – 2004 school year.

**Geographical characteristics**

Mathematics teachers from 35 of the 62 public and Catholic district school boards in Ontario participated in this survey. The geographical area in this sample was diverse, with School Boards extending from the west (Windsor-Essex Catholic School Board) to the most easterly school boards (Ottawa Carleton Public and Catholic District School Boards). The northern part of Ontario was represented by teachers from Huron-Superior, Sudbury Catholic, and Ontario North East District School Boards. The representation from School Boards surrounding the conference site (Waterloo, Ontario) had a slightly higher number of respondents in comparison to School Boards in the outlying areas. Thus the population in this study is not geographically representative in terms of proportions due to the concentration of participants from areas surrounding the conference site

**Data analysis**

Prior to entering data into SPSS, a code-book was created to log abbreviations or codes and instructions used to describe each variable. Once the data was collected and entered into SPSS it was checked for accuracy and completion. For example, questions that required a response in the range of one to five were analyzed using the maximum and minimum functions to ensure data was in the appropriate range. Outliers were identified and corrected. The data set was examined for incomplete responses and only the questionnaires that were at least 60% complete remained in the data set. Lastly, negatively worded items were reversed and totals for items in each scale were calculated (total scale scores).

Open-ended or qualitative items were numerically coded in order to identify recurring themes. Responses were scanned and common themes (a response reported by 5 or more respondents) were identified. These themes were assigned a number in a new field (same item number followed by the term *code*) in SPSS. An additional number was created for responses that did not fall into the themes identified.

The following section, organized into descriptive and inferential statistical procedures, describes the method of data analysis.

**Descriptive statistics**

According to Fink (2002), "ordinal scales typically are seen in questions that call for ratings of quality (excellent, very good, good, fair, poor, very poor), agreement (e.g. strongly agree, agree, disagree, strongly disagree)" or top 10 preferences (p. 29). It is argued that the ordinal scale is robust enough to confidently state, for example, that an excellent response is higher or greater than a very good response. Thus descriptive statistics reserved for interval data, such as means and standard deviations, can be performed on an ordinal scale when the distance between each of the points can be considered equally spaced part. This scale is then referred to as a quasi-interval scale. Descriptive statistics include percentages, variation in responses, and measures of central tendency were calculated for each quasi-interval item.

Percentages were calculated for nominal and categorical items. To determine if there was a relationship between these variables and stream (Academic or Applied), the chi-square test for independence was performed.

**Inferential statistics**

**Reliability:** "The reliability of a scale indicates how free it is from random error" (Pallant, 2001). To test reliability of the scale, similar questions but alternate wordings were imbedded in the questionnaire. In addition, to determine whether or not the items in a scale are all measuring the same underlying construct, commonly known as the scale's internal consistency, Cronbach's alpha was calculated for each scale. The higher the alpha coefficient, the more reliable the items. There is little agreement where the cut-off point lies; however, alpha coefficients above 0.7 are considered acceptable (Pallant, 2001). This does not imply that alpha coeffi-

cients below 0.7 are not acceptable but rather that they may be reflective of the number of items in the scale or the lack of consistency within a scale. For items with no variance, Cronbach's alpha was not calculated.

Analysis of variance (ANOVA). A one-way ANOVA was used to identify the degree of variance in the way teachers in the two streams (Academic and Applied) reported they assessed mathematics. The dependent variable was the total score on each scale representing the area of inquiry and the independent variable was stream. The significance level was set at 0.05 for each test.

There are a few assumptions underlying the use of ANOVA. The assumption of an interval scale and independence of observations are handled by design features in the questionnaire. The normality assumption is not a cause for concern since the sample size for both groups exceeds the minimum (30+) (Pallant, 2001). Homogeneity of variance was tested using Levene's test of equality of error variance. If this was significant, a cautionary note was reported along with the results. This is because the lack of homogeneity of variance can affect the actual versus the reported significance level.

Results

**Descriptive summary**

Teachers in both streams are adapting some aspects of the philosophy proposed by the Ministry of Education with respect to the assessment of students' learning skills achievement. The majority of teachers in both streams reported they do not award marks as a means to motivate their students (Academic: M = 1.28, SD = 0.70, Applied: M = 1.43, SD = 0.79) or to encourage partici-pation in class (Academic: M = 1.44, SD = 0.79, Applied: M = 1.66, SD = 0.96). However the majority of teachers in both streams recognized (agreed or strongly agreed) that checking and marking homework motivated students to complete their homework.

The practice of separating the homework learning skill from students' academic achievement is further supported in item q37 in which teachers in both streams reported that checking homework was recorded as learning skill (Academic: $M$ = 4.20, $SD$ = 0.80, Applied: $M$ = 4.05, $SD$ = 0.86). However, contrary evidence that teachers are not separating learning skills achievement from academic achievement was present. The mean scores for item q36 (Academic: $M$ = 2.38, $SD$ = 1.25, Applied: $M$ = 2.50, $SD$ = 1.07) "evaluating the accuracy of students' homework is recorded as part of their academic achievement", revealed that a proportion of teachers are incorporating scores from assessing the accuracy of students' homework in with their academic achievement. Item q45 directly probed whether teachers recorded homework scores as part of a student's term mark and 21.5 % of Academic teachers and 28.9% of Applied teachers indicated they engaged in this practice.

Lastly, some teachers reported they should check learning skills achievement more frequently than they do (Academic: $M$ = 2.58, $SD$ = 0.87, Applied: $M$ = 2.26, $SD$ = 0.77) and that some learning skills were difficult to assess (Academic: $M$ = 3.83, $SD$ = 0.66, Applied: $M$ = 3.91, $SD$ = 0.72). Teachers reported that parents did not frequently inquired about students' learning skills achievement and students never or rarely inquired about their learning skills achievement.

**Reliability summary**

Initially the reliability analysis revealed a very low Cronbach alpha coefficient for items (q34 to q42 and q46 to q49). When items q36, q37, q40, q41, q42 were removed from the scale due to low corrected item – total correlation values (possibly due to measuring different constructs), Cronbach's alpha coefficient improved to 0.61. This value is not strong, but given the number of items in this scale, it was considered acceptable.

There was no statistically significant difference at the $p < 0.05$ level in teachers report learning skills assessment practices [$F$ (1, 102) = 0.2, p = 0.68] between the two streams.

**DISCUSSION**

This section provides a summary and interpretation of the findings from this study. The discussion begins with a discussion on the outcome of this study followed by the limitations of the study and, lastly, the implications for future research.

**Learning skills assessment**

The introduction of learning skills has not been widely embraced. Teachers reported they do not check learning skills achievement as frequently as they felt they should and they reported some learning skills were difficult to assess. Contrary to Mazano (2000b), Madaus and Kellaghan (1992) also noted the difficulty in assessing this area of student achievement and indicated the difficulty was related to the meaning and value placed upon these skills. Teachers reported both students and parents did not frequently inquire about learning skills achievement. This suggests learning skills achievement may be valued differently than academic achievement even though these skills are demanded in the workforce.

The homework learning skill was an important focus of this study since previous studies indicated the assessment of homework played a significant role in determining a student's grade (Cizek, 1998). Teachers in

this study reported they are separating the assessment of the homework learning skill from students' academic achievement. However, there appears to be some overlap between homework being assessed for *completion* and recorded as a learning skill with its being assessed for *accuracy* and counted towards a student's academic achievement. Half of the teachers strongly disagreed or disagreed that, when homework was assessed for accuracy, it was recorded as part of a student's academic achievement. One teacher commented that they "get around this [homework] guideline" by having homework quizzes the next day in class where questions on the quiz are taken from homework from the previous day. Based on the results in this study, the assessment of homework appears to be managed in two distinct ways in spite of guidelines that deem homework a learning skill. These two methods of reporting student achievement in the area of homework may be satisfying the call to report homework as a learning skill and at the same time provide a means to motivate students to complete their homework (increase the value of homework) by recording a mark for the accuracy of their work. This practice allows teachers to make informed statements about how frequently students complete homework exercises as well as how accurately they complete their homework.

A greater percentage (18.5% more) of Applied teachers reported (agreed or strongly agreed) that if they did not mark students' homework, students would not do it. A possible explanation is that teachers have found that students in the Applied stream may require some form of external motivation to complete their homework. Other than the difference noted above, the response distributions between the two streams were similar.

In sum, the assessment of learning skills is to some degree being separated from students' academic achievement. However, the frequency in which teachers assess learning skills, particularly the learning skills they feel are difficult to assess (i.e. initiative) suggests these new areas of assessment may not be as reliable as other measures due to the insufficient amount of data upon which teachers have gathered. In addition, the assessment of the homework learning skill would benefit from further studies exploring effective methods of assessing homework, including assessing homework for the purpose of motivating students.

## Limitations

The results in this study represent grade 9 mathematics teachers' reported assessment practices in the province of Ontario. Respondents were from a wide geographical area and had varying years teaching experience and teaching experience in grade 9 mathematics. The large number of certified teachers and teachers whose preference it is to teach mathematics (mostly Academic mathematics) suggests the possibility of a sub-population of uncertified teachers or teachers who teach mathematics as a second option that may not be represented in this study. Thus caution should be exercised in extending these results to the entire population. Another limitation related to demographics was a high distribution of female teachers in both streams; however, an analysis of variance revealed no significant differences in teachers' reported assessment practices with respect to gender.

Lastly, the role (Academic or Applied) in which teachers responded may have been blurred if the teacher taught in both streams. Precautions were taken to clearly identify the respondents' stream including different colour of paper and bold and enlarged labels identifying the questionnaire as Academic or Applied.

## Implications

The exploration into teachers' learning skills assessment in Ontario's grade 9 mathematics program has provided a preliminary examination of this new area of assessment. The next step involves research exploring *why* teachers are not assessing learning skills achievement as frequently as they felt they should and how or what instruments they use to assess student achievement in this area in order to determine whether these measures of student achievement are reliable and valid measures.

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