Creating Context for Engagement in Mathematics Classroom Task

*Reda Darge

Abstract*:* This study explores the associations between mathematics teachers' presentation of classroom tasks and students' subsequent engagement in those tasks. Data were obtained from 200 randomly selected grade ten students in Ghion Secondary School (Bahir Dar town). Index of students' self-report of task engagement in mathematics was measured by employing student engagement scale. Chi -square test suggested that the degree to which the teacher presents the task as likely to be interesting, challenging, or worthwhile as a whole made no difference, one way or the other, to affect student engagement in classroom tasks. The educational implications that help to promote effective classroom learning are forwarded.

INTRODUCTION

The Problem

The original works in the area of teacher expectations (Rosenthal and Jacobson, 1968; Brophy and Good, 1974; Cooper, 1979) put forth the theory that teacher expectations of achievement for a given student lead to a self-fulfilling prophecy. That is, if a teacher consistently communicates either high or low expectations about a student's achievement, the student tends to achieve in the way the teacher expects. The result was similar to those found in several other expectation studies (Good and Brophy, 1978). Although these works have concentrated on teacher's expectations for student achievement, Good and Brophy (1978, 1980) have pointed out that theoretically, self- fulfilling prophecy effects may also occur with

* Associate Professor, Faculty of Education, Bahir Dar University.

respect to any student outcome other than achievement, about which teachers communicate consistent beliefs, attitudes, or expectations. Good and Brophy (1980) emphasize that teachers who believe that schoolwork is inherently enjoyable may foster similar beliefs in their students if they consistently project the expectation that the students will enjoy their classroom tasks. Similarly, teachers who see schoolwork as challenging are likely to shape the same attitude in their students.

Doyle (1986) invariably highlights that what teachers do influences what students do, which in turn influences what teachers do, and so on throughout the instructional process. Skinner and Belmont (1993) and Bandura (1986) suggest that teachers' expressions of beliefs about classroom tasks tend to develop similar beliefs or attitudes in their students if students accept their teachers as creditable source of information and identify with them sufficiently to begin to model their attitudes and behavior. Thus, the notion that teachers expressions of belief or attitude about academic activities should tend to develop similar beliefs or attitudes in their students can be inferred from social - learning theory (Bandura, 1986).

It also follows that students' beliefs and attitudes about academic tasks are likely to affect their motivation concerning the tasks and the nature of their engagement (level of effort, sustained concentration, persistence, enjoyment, and goal setting) if they take up the tasks (Brophy et al., 1982). Brophy and his associates further emphasized that other things being equal (task difficulty level, time pressure factors), a higher quality of student task engagement can be expected when students are working on tasks that they enjoy or believe to be interesting or worthwhile than when they are working on tasks that they dislike or believe to be boring or pointless.

Researches on classrooms that foster ego involvement and that promote task involvement indicated that students in task-oriented

classrooms believe that success in school depends on interest, effort and the attempt they make to learn (Nicholls and Thorkildsen, 1987). In contrast, students in ego-involved classrooms believe that success depends on being smarter than other classmates and trying to beat out other students. Moreover, students in task - oriented classrooms express more satisfaction with school and learning in school than students in ego-oriented classrooms. They are also more likely to ask for help that enables them to develop competencies (Butler and Neuman, 1995). This contrasts involvement: working hard only on graded assignments, being upset by low grades, comparing grades with classmates, choosing easier tasks, and copying other students' work (Stipek, 1993).

Lampert (1990) suggests that in the actual work setting of the classroom, doing mathematics means following the rules laid down by the teacher. Knowing mathematics means remembering and applying the correct rules when the teacher asks a question, and mathematical truth is determined when the answer is ratified by the teacher. Accordingly, Carr (1996) and Prawat and Anderson (1994) assumed that the culture of mathematics classes might place a premium on teacher control and performing well, thus encouraging students to focus on the consequence of success or failure on the task rather than the task itself or the process of working on the task. This emphasis would be less likely to foster a climate for intrinsic motivation and task process.

According to reinforcement theorists, the approach to classroom motivation focused on extrinsic motivation and performance outcome. Thus, what teachers implied about what the students could expect would be the consequence of success or failure on the task (Skinner and Belmont, 1993). Deci et al., (1981) argued that intrinsic motivation is encouraged when teachers emphasize providing information to students rather than controlling them. Teachers who believe that classroom problem should be solved by encouraging students'

autonomy and responsibility tend to have students who are more intrinsically motivated and who solve problems more effectively. Brophy (1986) suggests that many teachers do not understand all that they can do and need to do to maximize motivation in their classroom. Teachers, however, can learn tactics for increasing students' motivation: teachers should model interest in learning, communicate to students reasons for being enthusiastic about school; create low - anxiety classrooms; induce curiosity and suspense, and make abstract material more personal, concrete, and familiar.

In the Ethiopian context, the New Education and Training Policy (NETP, 1994) entails a commitment to active, learner - focused education. The NETP recognizes that knowledge is a creative and participatory process and not something that can be reduced to a matter of transmission. The current call for learner-centered education promotes learners to participate in the creation of shared knowledge in the fields of education.

Negative effect is common in mathematics classrooms, where students often report confusion and concern with completion and accuracy (Parawt and Anderson, 1994). These negative qualities of math instruction are presumed to influence students' quality of engagement in mathematics, and, later on, their choice of mathematics courses and mathematics-related careers. Many academically capable students prematurely restrict their educational and career options by discontinuing their mathematical training early in high school. Several recent surveys (National Assessment of Educational Progress, 1988; National Center for Educational Statistics, 1984) indicated that only half of all high school graduates enroll in mathematics courses beyond the tenth-grade. As a result, reforms (e.g., National Council of Teachers of Mathematics, 1989) have emphasized the importance of promoting students positive beliefs or attitudes in conjunction with developing understanding mathematics.

Although the understanding of the relationships between teachers presentations of classroom tasks and students engagement in those tasks has been well documented in the literature, local research in this issue is scanty. The few studies that exist have focused on the following issues: the contribution of homework to students' achievement in mathematics (Adane and Dawit, 2000); the effects of grade, self-efficacy, learned-helplessness, and cognitive engagement on liking mathematics (Yalew, 2005), and mathematics teachers' present competencies (Tsehai, 2005). There has been little attention to the dynamic aspects of the motivationally relevant student beliefs, expectations, and attitudes or to the role of the teacher in shaping them.

Hence, the present study was designed to examine classroom motivation with respect to not only incentive variables but also task variables (characteristics of tasks that affect the degree to which they are perceived as interesting, challenging, or worthwhile) and teacher presentation variables (teacher comments while presenting tasks to students that communicate expectations about the degree to which the tasks are likely to be interesting, challenging, or worthwhile). There is more than one way, however, to classify teacher task presentation statements as positive, neutral or negative with respect to their probable effects on student motivation. In line with, Brophy et al. (1982) assumed that the researcher developed two classification systems, one based on what teachers implied about what students could expect from the task itself or from the process of working on the task, and the other based on what teachers implied would be the consequence of success or failure in the task. The first classification focused on intrinsic motivation and task process, whereas the second focused on extrinsic motivation and performance outcome.

Attribution theorists would favor the first classification system to measure relationships between teachers' presentations of classroom

tasks and students' engagement in those tasks, whereas reinforcement theorists would favor the second classification system.

The first system, focusing on what teachers implied about the task itself, classified the categories as positive, negative, or neutral based on the assumption that teachers' expressions of beliefs in their students, and that students would become engaged more eagerly and consistently in tasks they expected to find interesting (Brophy et al., 1983). The assumption here was that teacher presentation statements would create parallel expectations or attitudes in the students, and that students would become engaged more eagerly and consistently in tasks they expected to find enjoyable or meaningful than tasks they expected to be boring or frustrating.

The second classification, focusing on students' expectations about the consequences of success or failure on the tasks, produces a different classification system (see appendix A). Here, teacher-presentation statements were classified based on teachers mention of reward or punishment. Some categories are classified as positive because they promise reward for engaging in a task. Others are qualified as negative because they threaten punishment for failure, and the remaining tasks are classified as neutral because they imply neither reward nor punishment. The prediction was that anticipation of reward for the engagement would motivate concentration and effort on the task but the chances of achieving success by putting such reasonable concentration and effort might be impaired by anticipated punishment triggered by teachers' negative task introduction statements (even though, theoretically, threatening punishment should raise motivation in the sense of raising arousal level). In this regard students' performance depends not only on the level of motivation, but also on its quality. This emphasis provides evidence for the impact of extrinsic motivation on students' ability to concentrate on a task or desire to do the task well, especially, if it engenders anxiety (Skinner and Belamont, 1993). To examine these

issues further in the current study the research questions entertained in this study are:

1. What is the type of student engagement in tenth grade math task presentation when the task presentation statements are classified based on the consequences of success or failure on the task (reward, neutral, or punishment) and the task itself or from the process of working on the task (positive, neutral, or negative)?

2. Are statements that mathematics teachers made about classroom tasks when presenting those tasks to their students associated with the degree of student engagement subsequently observed on the same tasks?
   (A) Which sets of teachers' task-presentation statements (positive, neutral, or negative) are associated with high, medium, and low rate of student engagement?
   (B) Which sets of task presentation statements (reward, neutral, or punishment) are associated with high, medium, or low rate of student engagement?
3. Is the rate of student engagement associated with, or different in the two classes of task presentation mentioned in number two above?

Significance of the Study

Understanding how teachers create positive climates for learning and motivation in mathematics has considerable pedagogical significance as well as implications for students' engagement in mathematics classroom tasks. Specifically, the understanding of which conditions garner student motivation would help math teachers understand which specific practices of mathematics instruction promote or discourage students' task engagement rates.

Limitation of the Study

The difficulty in conducting such research is that respondents could respond to the items in the self-report measure of students' task engagement rates not on the basis of what they really feel but on the basis of what they think are socially acceptable or desirable answers. Even so, the data collected in the present study were valid and reliable to a large extent.

METHOD

Subjects

Data for this study were drawn from one randomly selected secondary school, namely, Ghion Secondary School (in Bahir Dar town). In all, 200 tenth-grade students, selected randomly, participated in this research. Four classrooms were randomly chosen out of the five sections by the researcher to represent a wide range of student ability. The study was conducted in Bahir Dar town because the researcher's place of work is there and, hence, follows up plans and participation in future interventions would be easily attained.

Secondary school students were the focus of this research. An important consideration is that such sophisticated social perception (see Appendix A) concerning teacher behavior and its interpretation would not be expected in elementary school, but Meyer et al. (1979) emphasized that student interpretation of teacher praise and blame statements could be expected in secondary school.

Fisher et al. (1978) have demonstrated that because effective teacher behavior is often specific to grade and subject taught, then grade ten and tenth- grade mathematics were randomly selected. Thus, the inclusion of secondary school students (grade ten) and tenth - grade mathematics in the present study is considered appropriate for the

purpose of the study. The subjects who participated in this study were selected with the help of two pedagogical science instructors (in Bahir Dar University) who had been teaching mathematics in high school for many years prior to their beginning of teaching at the university.

Measure of Student Engagement

Student engagement scale was used to gather data from students. This scale assessed the degree of student engagement on tasks presented by mathematics teachers. This scale was adapted from Brophy et al. (1983) and Brophy (1988) with slight modification on direction and scoring method. From the pool of 23 items hypothesized to be part of self - report measure of students' task engagement scale, 18 items assumed to be relevant and meaningful to math instruction.

Procedures

The pilot study involved interviewing ten students about how they would think or feel upon hearing particular task introductory statements as shown in Appendix A. Students reported no evidence of tendency to question the motives behind teachers' attempts to portray tasks in a positive or negative light. They further reported that they were potentially open to teachers' attempts in shaping them to meet the demands of teaching. Examples of the sample items are:

1. To what extent do you engage yourself in the subsequent task while the math teacher moves directly into a task without attention getting devices?
2. To what extent do you engage yourself in the subsequent task while the math teacher urges students to work hard in a non-evaluative atmosphere?

In the students' task engagement scale, the responses to the statements are " High engagement", "Medium engagement ", and "Low or not at all". The scale was translated from English to Amharic language with the help of two English language instructors in Bahir Dar University. The Amharic version of the scale was administered to the study sample and the Kuder - Richardson estimate of reliability of the scale was found to be 0.85.All items discriminated between the highest and the lowest scores (the upper and the lower 27 percent). T-test results for each item in the measure of task engagement scale are ranging from 4.010 to 6.73.

In general, the students' task engagement scale was selected for the main study for three reasons. First, reliability index of the scale was qualified as "good" according to the standard of 0.75 set by Shaw and Wright (1967). Second, the items in the scale were unambiguous to the subjects who participated in the study. The items were also assumed to be relevant and meaningful to math instruction. Third, the significant discrimination indices for each item showed validity of the scale.

Because there is more than one way to classify teacher task presentation statements as positive, neutral, or negative with respect to their probable effects on student achievement motivation, the student engagement data collected from the respondents were divided into two classification systems. The first classification was based on what teachers implied about what the students would expect from the task itself or from the process of working on the task (see Appendix A).The second classification was based on what teachers implied about the consequences of success or failure on the task (see Appendix A). Brophy et al. (1983) emphasizes that the first classification system focuses on intrinsic motivation and task process, whereas the second one focuses on extrinsic motivation and performance outcome.

Method of Data Analysis

The analysis for this study involved percentage and Chi-square test. Initially, percentage analysis was used to explore whether student task engagement existed when the teacher attempted to portray tasks in a negative or positive light, or when the teacher gave a neutral presentation about the task.

Chi- square test with alpha preset at 0.05 was used to examine associations between gross measures of teacher- presentation statements based on what they imply about the task itself (positive, negative, neutral) and a gross measure of students' subsequent task engagement rates. Chi- square test was further involved to examine associations between classification of teacher- presentation statements based on mention of reward or punishment as consequences and students' subsequent task engagement rates.

RESULTS

Results are reported in two sections. First, frequency of rate of students' engagement is reported. This is followed by results of Chi-square analysis.

Table 1 indicates the frequencies in which each student engaged in the 18 content categories of tasks.

Table 1.Rate of Student Engagement.

Classification based on task	Classification Based on Consequences	Task presentation categories		Rate of students Engagement		
				High	Medium	Low
Neut.	Neut.	1	None	40	78	82
Neut.	Neut.	2	Cues effort	116	62	22
Neut.	Neut.	3	Continuity	140	36	24
Neut.	Pos.	4	Recognition	124	38	38
Neut.	Pos.	5	Extrinsic reward	106	54	40
Neut.	Neg.	6	Threat/ punishment	91	82	27
Neut.	Neg	7	Accountability	125	54	21
Neut.	Neut	8	Time reminder	81	76	43
Neut.	Neut.	9	Embarrassment	120	34	46
Neg.	Neut.	10	Apology	125	45	30
Neg.	Neut.	11	Cues negative expectation	107	51	42
Neut.	Neut.	12	Challenge/ goal setting	111	49	40
Pos	Neut.	13	Teacher personalizes	119	63	18
Pos	Neut.	14	Teacher enthusiasm	124	48	28
Pos	Pos	15	Self - actualization value	110	48	42
Neut.	Pos	16	Survival value	121	57	22
Pos	Pos	17	Cues positive expectation	121	56	23
Pos	Neut.	18	Personal relevance	120	47	33

* *The task categories are parallel to those cited in Appendix A.*
pos. = positive, neg. = negative, neut. = neutral.

Consideration of the data in Table 1 in the light of teacher task-presentation statements as positive, neutral, or negative makes it clear that students did not systematically take advantage of

opportunities to engage more in tasks stated in a positive light than tasks stated in a negative way or when the teacher gave a neutral presentation about the task. Students seemed to engage across all of the tasks that may be observed in a classroom regardless of the degree to which the teacher presents the task as likely to be interesting, challenging, or worthwhile.

The data for category 1 (no attempt to motivate the students) showed 82 of the 200 respondents rated low engagement to a greater extent than the high engagement (40 respondents) and medium engagement rates (78 respondents). For the other 17 categories representing positive, neutral, or negative statements about tasks, all categories indicated that respondents used to rate high and medium engagement to a grater extent when teachers made some statement about the task than when they did not.

To assess associations between teacher-presentation codes and student-engagement rates, contingencies between classifications of teacher-presentation statements as positive, neutral, or negative and rate of student- engagement measures the Chi-square value was computed, using the 3x3 contingency table. The Chi-square value shown in Table 2 revealed no significant difference in student task engagement rates, $\chi^2_{(4,200)} = 0.03$.

Table 2. Associations between Teachers' Introductory Statements about the Tasks and Students' Subsequent Task Engagement Rates.

Rate of student engagement Measures	Positive	Neutral	Negative	Total
High	594	1175	232	2001
Medium	262	620	96	978
Low	144	405	72	621
Total	1000	2200	400	3600

Similarly, contingencies between classifications of teacher-presentation statements based on mention of reward or punishment as consequences and rate of student-engagement measures are given in Table 3. The Chi-square value was computed, using the 3x3 contingency table. The Chi- square value shown in Table 3, $\chi^2_{(4,200)} = 9.80$, revealed no significant difference in student task engagement rates.

Table 3. Associations between Teachers' Mention of Reward or Punishment as Consequences When Introducing Tasks and Students' Rate of Engagement.

	Introductory statement about task			
Rate of Student engagement	Reward	No mention	Punishment	Total
High	582	1083	336	2001
Medium	253	555	170	978
Low	165	362	94	621
Total	1000	2000	600	3600

DISCUSSION

The present study examines teachers' presentations of classroom tasks. The discussion regarding this central issue is presented along the following lines.

The Frequency of students' engagement revealed that students seemed to engage across all of the tasks that may be observed in a classroom regardless of the degree to which the teacher presents the task as likely to be interesting, challenging, or worthwhile. Results of the Chi-square analysis involving contingencies between classifications of teacher-presentation statements as positive, neutral,

or negative and incidence of students' subsequent task engagement (high, medium, or low) was in the expected direction but did not reach the statistical significance. The data provided no clear support to the assumption that teacher-presentation statements would create parallel expectations or attitudes in the students, and that students would become engaged more eagerly and consistently in tasks they expected to find enjoyable or meaningful than in tasks they expected to find boring or frustrating. The classifications within the teacher-presentation statements are overshadowed by the major finding that student task engagement in those tasks are similar when teachers made either positive, negative, or no presentation statements at all based on what they imply about the task itself.

Moreover, a Chi-square analysis involving contingencies between classifications of teacher-presentation statements based on mention of reward or punishment as consequences and incidence of students' subsequent task engagement (high, medium, or low) was not in the expected direction. The data suggested that students' task engagement rates were similar when teachers made reward, punishment, or no presentation statements at all.

However, the findings of the current study varied from Brophy et al. (1983). They showed that student engagement was generally higher when teachers moved directly into tasks than when they began with some presentation statements. Teacher-presentation statements classified as likely to have negative effects on student engagement were associated with lower student engagement.

Apparent lack of uniformity in the observed relationships between teachers' task-presentation statements and students' engagement rates on those tasks might arise due to variations in the study procedure they used. For example, Brophy et al. (1983), unlike the case in the present study, conducted their study using direct

observation in a naturalistic setting when the teacher actually introduced and implemented classroom activities.

CONCLUSIONS AND IMPLICATIONS

The findings of the present study have revealed that teacher presentation statements as a whole made no difference one way or the other in rates of student task engagement. At least, the results of the present study conclude that the use of positive introductory statements about upcoming learning tasks as practiced by teachers in today's classrooms contributes little or nothing to student task engagement.

Thus, the teaching implications of the present study is that students may not always be motivated to learn more or to use what they know already as a function of teachers presentations of classroom tasks. Some students may do just enough to get by instead of using every opportunity to learn all they can. Others may stop making any attempt to succeed academically altogether. Therefore, in order to create active learners, teachers should understand academic motivation better and consider new ways of structuring classroom tasks to enhance academic motivation.

Teachers must be aware that academic motivation can be influenced by factors other than teachers' presentations of classroom tasks. Such factors may include students' beliefs and perceptions as well by classroom practices. For example, students' expectations of success and failure, and how students explain their performances to themselves influence future performance. Hence, the teaching implication of the present study is that classroom rules focusing on a complex mix of students' beliefs and perceptions, teachers' behaviors, and classroom practices are worthwhile for increasing students' motivation to learn.

Indeed, many teachers may not understand all that they can do and need to do to maximize motivation in their classrooms. Teachers, however, can learn tactics for increasing students' motivation. As a result, pre-service and in-service teacher training programmes should work to raise teachers' awareness of tactics for increasing students' motivation. From this point of view, training teachers using such strategies as modeling interest and enjoyment of learning, and communicating expectations are powerful. They could perhaps be the most powerful strategies that enable teachers to implement the motivational principles systematically in the classroom.

Finally, it is worth noting that the study of teachers' task presentation and students' engagement in the tasks has focused only on students' self - report data to engage in a task as opposed to conceptualizing students' motivation to actually engage in the learning tasks as practiced by teachers in classrooms. Therefore, it is of paramount importance to conduct a detailed study of this type using direct observation in natural setting-when teachers actually introduce and implement classroom activities.

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Appendix A: Teachers ' Task - Presentation Statements.

No	Task- presentation categories	Classification based on task	Classification based on consequences
1	None (teacher moves directly into a task without attention - getting devices).	Neutral	Neutral
2	Cues effort (teacher urges students to work hard in a non- evaluative atmosphere).	Neutral	Neutral
3	Continuity (teacher checks for task- relevance prior to learning or at the beginning of lesson and reteaches when necessary).	Neutral	Neutral
4	Recognition (teacher promises that students who do well on the task will be recognized with meaningful symbolic rewards).	Neutral	Positive
5	Extrinsic reward (teacher uses of meaningful reward for good performance).	Neutral	Positive
6	Threat punishment (teacher threatens negative consequences for poor response).	Neutral	Negative
7	Accountability (teacher reminds student that the work will be carefully monitored and checked).	Neutral	Negative
8	Time reminder (teacher reminds students that they have limited time to get the assignment done).	Neutral	Neutral
9	Embarrassment (teacher shows the importance of the task to the students, but does it in a negative way, suggesting that they are likely to be embarrassed at some time in the future if they do not acquire the desired skills).	Neutral	Neutral
10	Apology (teacher apologizes to students for foisting a task slightly above students current level of functioning).	Neutral	Neutral
11	Cues negative expectation (teacher informs directly that the students are not expected to like the task or to do well on the task).	Neutral	Neutral
12	Challenge goal setting (teacher sets some guided practices or goal to ask the student to attain the desired behavior or skill after instruction has been given).	Neutral	Neutral
13	Teacher personalizes (teacher expresses personal beliefs directly, or informs students about personal experiences that illustrate the importance of the task).	Positive	Neutral
14	Teacher enthusiasm (teacher expresses his/her own liking for this type of task).	Positive	Neutral
15	Self- actualization value (teacher suggests that students can develop knowledge or skill that will bring pleasure).	Positive	Neutral
16	Survival value (teacher informs that students will need to learn these tasks to get along in life).	Neutral	Positive
17	Cues positive expectation (teacher states that the students are expected to enjoy the task).	Positive	Neutral
18	Personal relevance (teacher uses individualized strategies to promote the learning needs of special types of learners when appropriate).	Positive	Neutral