Effects of Instructional Activities andClassroom Assessment Environment on Mathematics Achievement in Jordan

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أثر الأنشطة التدريسية وبيئة التقويم الصفي في تحصيل طلبة الأردن للرياضيات

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الملخص

هدفت هذه الدراسة إلى تحديد الأهمية النسبية لبعض المتغيرات المتعلقة بالأنشطة التدريسية وبيئة التقويم الصفية بالنسبة لتحصيل الطلبة في الرياضيات. وقد تم الحصول على بيانات هذه الدراسة من الدراسة الدولية الثالثة للرياضيات والعلوم (TIMSS-R) التي شارك فيها (١٤٧) معلمة ومعلماً للرياضيات و (٣٨١٣) من طلبة الصف الثامن الأساسي في الأردن، تبلغ أعمارهم (١٣) سنة. أجاب المعلمون عن فقرات استبانة المعلم، كما أجاب الطلبة عن فقرات استبانة الطالب، بالإضافة إلى إجابتهم عن أسئلة الامتحان الدولي للرياضيات.

وقد كشف استخدام تحليل الانحدار ذي المجموعات، أن هنالك ثمانية متغيرات ساهمت في الزيادة ذات الدلالة الإحصائية في التباين في تحصيل الرياضيات، ستة من الأنشطة الصفية واثنان ينتميان إلى بيئة التقويم الصفية. وبينت النتائج أيضاً أن ثلاثة من المتغيرات ذوات الدلالات الإحصائية كانت طامسة (ذات أثر سلبي)، اثنين منها ينتميان إلى الأنشطة الصفية. وقد ساهمت جميع المتغيرات في ٣٫٢٩٪ من التباين في تحصيل الرياضيات. وفي ضوء النتائج، تم تقديم بعض المقترحات المتعلقة بالسياسات التربوية الأردنية والبحث التربوي.

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Abstract

The purpose of this study was to assess the relative importance of instructional activities and classroom assessment environment variables to mathematics achievement. Data on 147 mathematics teachers and 3,813 thirteen-year old eighth Jordanian graders were collected. The teachers and their students participated in the Third International Mathematics and Science Study (TIMSS-R) and completed students' and teachers' questionnaires. The students participated in the mathematics test.

Using Blockwise Regression Analysis, it was found that eight variables accounted for statistically significant proportion of the variance of math's achievement. Six of them related to instructional activities, two were suppressors. Whereas, two variables related to classroom assessment environment, one of them was a suppressor. Moreover, instructional activities and classroom assessment environment variables accounted for 29.3% of mathematics achievement variance.

Implications of the study for Jordanian educational policies and for educational research are discussed

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Introduction

Large-scale comparative international surveys continue to show poor performance of Jordanian eighth graders in mathematics (Martin, Mullis, Gregory, Hoyle, & Shell, 2000). Given such consistently poor productivity in math, much research has sought to identify students' in-school and out-of-school experiences that influence achievement and related outcomes, especially those that are alterable or partly alterable by educators and could be manipulated by policy makers.

Research in Western countries has shifted attention away from school-level factors to the learning environment of the classroom (Willms & Somers, 2001). In fact, all factors that contribute to educational outcomes exist in a way or another in classrooms that differ in terms of learning environments. They have unique effects on pupils learning, independently of factors operating at school and individual levels (Kyriakides, Campbell, & Gagatsis, 2000). According to Webster & Fisher (2000), classrooms have two or three times the influence on student achievement than the school level does.

Classroom teaching is nearly a universal activity designed to help students to learn. It is the process that brings the curriculum into contact with students and through which educational goals are to be achieved. The quality of classroom teaching is a key to improving students' learning (Kilpatrick, Swafford, & Findell, 2001). Although, setting standards for content and performance is an important first step, but merely so doing and holding teachers accountable will not improve students' learning

(Stigler & Hiebert, 1997). Accordingly, a particular attention should be paid to the actual process of teaching. However, Third International Mathematics and Science Study (TIMSS) provides the critical link between students achievement data and teacher practices at classroom level (House, 2001). This link is unfortunately lacking in most national education surveys (Quinn, Foshay, & Morris, 2003).

Teaching and assessment are rarely studied at a Jordanian level, but education policy is often discussed nationally. It is important to know what aspects of teaching and assessment contribute significantly to mathematics achievement so that national discussions of classroom practices focus on the typical experiences of students (Hiebert et *al.*, 2003). Accordingly, research is needed to answer questions raised about effectiveness of classroom practices related to instructional activities and classroom assessment environment in terms of achievement results of Jordanian students in mathematics.

Instructional activities

Findings of research suggested that several classroom instructional activities were associated with achievement (Arnold, 1995). Gipps (1994) noted that the ways in which instructional activities are presented in the classroom context affects student achievement. Moreover, Kller, Baumert, Clausen, and Hosenfeld, (1999) found that quality and quantity of instruction influence achievement at the class level. Instructional activities in class include variables that describe aspects of classroom instruction, such as quality of teaching, teaching style, and opportunity to learn.

Quality of teaching

The teaching context is established through preconceptions held by the teacher about the process of learning and how that might be facilitated (Kember, 1998; Prosser & Trigwell, 1997). Perceptions of the learning process as variously transmissive or constructive inform different teaching practices which, in turn, lead to modifications of the students' perception of the learning environment (Trigwell, Prosser, & Taylor. 1994)
House (1999) found that quality of teaching was a significant predictor of

student achievement even after controlling for effects of students characteristics.Whilst, Kyriakides, Campbell, and Gagatsis (2000) and Reynolds and Walberg (1992) found that quality of teaching did not have a statistically significant effect on maths achievement at classroom level.

Teaching style

An important part of any instructional setting is the teaching style. Research results suggested that teaching style exerted effects on student achievement that were independent of students' characteristics (House, 2002 a). The premise "one teaching style fits all" which is attributed to a teacher-centered teaching style, is not working for a growing number of diverse student population. Problems occur when teaching styles conflict with students' learning styles, often resulting in limited learning or no learning. Altan and Trombly (2001) offer learner-centeredness as a model for responding to classroom challenges because of its viability for meeting diverse needs.

McCombs (2000) defined learner-centered, from a research-based perspective, as a foundation for clarifying what is needed to create positive learning contexts to increase the likelihood that more students will experience success. The teacher-centered teaching style, on the hand, is associated chiefly with the transmission of knowledge and focus more on content than on student processing (Brown, 2003).

Both teaching styles (teacher- and learner-centered) recognize the student as a key factor in improving student achievement. The teacher-centered style places control for learning in the hands of the teacher who decided what students would learn and how. The teacher uses her/his expertise in content knowledge to help learners make connections. Orchestration in this approach is limited because student interaction is basically responding to teacher-directed questions. Rarely do students construct their own learning. The learner-centered style, however, places more of the responsibility for knowing individual learner capabilities and creating an environment where learners can make learning connections. Similarly, the responsibility for achieving is shifted to the student. Teachers provide a variety of instructional methods and techniques for helping learners construct their learning and develop a system for applying knowledge and theory (Brown, 2003).

Research findings are contradictory. D' Agostino (2000) found that introducing learner-centered instructional elements into classroom activities was the most effective approach, for facilitating the development of students' basic skills. (House ,2002b) found that each of working on group projects and working on an independent research projects explained significant proportion of the variance in student achievement, even after controlling for student characteristics. However, Bos (2002) found that Belgium Flanders students, who perceive the instructional behaviour of their teacher as more a learner-centered, perform less well in math than students who perceive the opposite. Whilst, Borich (1996) and Muijs and Reynolds (2000) found that students learn more in classes where they spend most of their time being taught or supervised by teachers, rather than working on their own.

Opportunity to learn

One of the main factors related to mathematics achievement scores is opportunity to learn (OTL) (Muijs & Reynolds, 2000). OTL refers to the amount of time students are given to learn the curriculum (D' Agostino, 2000). The extent of the students' opportunity to learn mathematics content bears directly and decisively on student mathematics achievement (Grouws & Cebulla, 2000). OTL was studied in the First International Mathematics Study (Husen, 1967), strong positive correlations were found between OTL and maths achievement, with high OTL scores associated with high achievement. The link was also found in the Second International Mathematics Study and the Third International Mathematics and Science study (Schmidt, McKnight, & Raizen, 1997). Numerous classroom-level studies have found support for the positive effects of OTL on maths achievements (D' Agostino, 2000;Kyriakides, Campbell, & Gagatsis, 2000). However, Bos and Kuiper (1999) found that it did not show a significant path coefficient on maths achievement.

Homework is seen as a contribution towards students' learning extending the curriculum beyond the classroom (Martin et al., 2000). It can be conceived as one facet of OTL in the sense that home assignments offer students the opportunity to continue schoolwork after regular school hours. Mortimore, Sammons, Stoll, Lewis, and Ecob (1988) argued that through homework assignments teachers could be assured that students extend their learning time beyond school hours. Homework could be considered as a proxy measure for the degree to which teachers academically challenged or "pressed" their students (D' Agostino, 2000; Kyriakides, Campbell, & Gagatsis, 2000).

While doing homework in mathematics may be important, the amount, type, and efficiency of homework may also be important. Research has indicated that the amount of homework given by teacher was found to have contradictory effects on mathematics achievement. For instance, Trautwein, Koller, Schmitz, and Baumert (2002) showed that the frequency of homework assignments had a positive effect on math achievement gains, Creemers, (1994) found that teachers who assigned more homework taught students who made greater academic gains. Moreover, Mau and Lynn, (2000) revealed significant positive correlations between test scores and amount of homework, suggesting that the amount of homework contributes to test scores.

Bradford (1995), D'Agostino (2000), and Meyinsse and Tashakkori (1995) found that students who spend more time on homework tend to show higher levels of academic achievement. Brookhart (1995) found that the amount of time spent outside of class on math was one of the variables that had the greatest positive effect on achievement.

Cooper (1989) observed a positive linear relationship between hours per week spent on homework (0 to 10 hr) and achievement. Through examining 27 studies, Cooper reported that the average correlation between time spent on homework and achievement was 0.21. Whilst, Bos (2002), Martin et al. (2000), and Mullis (1991) found that higher achievement was associated with less time spent on maths homework. In line with this result, Howie (2002) found that students who received more homework (3x, 4x per week) did not perform significantly better than those with less (never, lx, 2x per week). However, Wong (1992) found no correlation between pupils' time on homework and their maths achievement.

Scheerens and Creemers (1996) found that time spent on homework

being positively related to pupils' outcomes in four studies out of 29 and negatively related to none.

The assignment of appropriate homework can stimulate independent engagement in learning tasks (Singh, Granville, & Dika, 2002). According to Arnold (1995), textbook-based homework was associated with higher achievement. Whilst, working on textbook problems and on mathematics projects were associated with lower test scores(House, 2001) .Regular review of student homework can provide insight into student progress and source of problems. A clear message needs to be conveyed to students that the responsibility to do the homework is the same as the responsibility to work in class (Columba, 2001). The effective use of homework has been found to facilitate student achievement (House, 2002 a).

OTL aims at maximizing time-on-task, which was defined as the number of hours of instruction in a subject (Howie, 2002; Creemers & Reezigt, 1996). Time-on-task influences achievement (Singh, Granville & Dika, 2002) and was found to have the largest effect on achievement (Strahan, 2003). It explained significant proportion of the variance in maths performance (House, 2002 b). However, Kyriakides, Campbell, and Gagatsis (2000) found that this variable show very small but significant effect on maths achievement, while Muijs and Reynolds (2000) found that amount of time spent teaching the whole class was related indirectly to pupils' progress, whereas, Reynolds and Walberg (1992) found that it had a positive direct effect on maths achievement; although Fisher (1990) claimed that time on task is the most influential factor linking class activities to success in achievement tests.

The Classroom Assessment Environment

The classroom assessment environment (CAB) has been defined as the context created for learners by several aspects of teachers' use of formative and summative evaluations of their work (Stiggins & Conklin, 1992). CAB is not formed only by tests; it also encompasses all opportunities arranged by teachers for observing and evaluating students (Brookhart, 1995) and all activities that teachers and students undertake to get information that can be used diagnostically to alter teaching and learning (Black & Wiliam, 1998). Research revealed that (CAB) affects achievement in mathematics (Brookhart, 1995).

Assessment should, as far as possible, be integral to the normal teaching and learning programme. For instance, testing should be considered as an opportunity to learn not, only, a way to assess students. Assessment should be realistic, meaning that it must be based on several kinds of information collected over time (Glazer, 1993). Teachers create assessment environment by the choices they make about assessment formats (Brookhart, 1997). Assessment encompasses teacher observation, demonstration formats, group and team activities, classroom discussion, and analysis of student work including homework and tests (Black & Wiliam (1998). Assessment becomes active when the information is used to adapt teaching and learning that meets students' needs. This means that when teachers know how students are progressing and where they are having trouble, they can use this information to make necessary instructional adjustments, such as re-teaching, trying alternative instructional approaches, or offering more opportunities for practice. These activities can lead to improved student success (Boston, 2002).

One key to effective use of classroom assessment is the quality and usefulness of feedback to students (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991). Assessment of one kind or another is always occurring in today's classrooms. Natriello and Dornbusch (1984) pointed out that in order to foster student effort, assessments must be relatively frequent and challenging. Many teachers no longer find it necessary to give only written tests to collect information and form judgment about students' performance (Columba, 2001). A variety of techniques are available to assist teachers in their assessments of student performance. Teachers and educators must never determine students' abilities and achievements in school using only one piece of data (the test score). Teachers collect information about students' behaviours and achievement as they carry out tasks. They review the sample, again and again, in order to come to conclusions about what students need to learn. Testing, sampling, assessing must be driven by the desire to create effective instruction in classroom. Those assessment techniques are certainly more useful than teacher made or external tests in providing information on difficult-to-evaluate areas such as problem solving.However, good daily assessment is good instruction, because it is carefully aligned with what is taught and how it is taught (Columba, 2001). Teachers' feedback to students and parents may prove valuable for purposes of personal growth.

Teachers who develop useful assessments, provide corrective instruction, and give students second chance to demonstrate success can improve their instruction and help students learn. To use classroom assessments to make improvements, however, teachers must change both their view of assessments and their interpretation of results. Specifically, they need to see their assessments as anintegral part of the instruction process and as crucial for helping students learn (Guskey, 2003).

Feedback is required (Schunk, 1994) because students need information about their accomplishments in order to grow and progress (Brookhart, 1997). Feedback related to assessment outcomes helps learners become aware of any gaps that exist between their desired goal and their current knowledge, understanding, skills, and guides them through actions necessary to achieve the goal (Ramaprasad, 1983; Sadler, 1989). However, Bos & Kuiper (1999) found that assessment usage did not have a direct influence on achievement in the majority of the education systems.

How important are classroom practices to maths achievement? Classroom assessment environment is an important factor within classes (Stiggins, 1994, Brookhart, 1997)and instructional activities are an important factor to maths achievement (House, 2002a; 2002b). When both are added together, how important each of them to mathematics achievement? Knowing the relative importance of classroom instructional practices and assessment to maths achievement will be important for informing practice.

Aim of the study

The aim of this secondary analysis study is to investigate relationships between classroom practices and mathematics achievement using data from the Third International Mathematics and Science Study (repeat) (TIMSS-R). In other words, it aims at answering the following question: What is the relative importance of instructional activities and classroom assessment environment to mathematics achievement?

According to related literature and common sense, the researcher assumes a model for the instructional process that constitutes the following sequential factors:

1. Teaching environment that includes quality of teaching, instruction time, and teaching style;
2. Opportunity to learn that constitutes quantity and quality of homework;
3. Decisions based on homework performance, which constitutes of passive and active decisions;
4. Quality of measures that include traditional and nontraditional means; and
5) Kind of feedback based on assessment outcomes, which constitutes active and passive feedback.

Significance of the study

This study is significant for the Jordanian context for several reasons: First, it is the first major research in Jordan investigating factors on classroom-level that have impact on mathematical performance, using a national sample within the framework of an international study. The findings will provide policy-makers, school principals and mathematics educators with information about classroom factors related to mathematics achievement.

Another area of significance is that since the research builds upon the TIMSS-R data, its results can be generalised to the country as a whole and provides data whereby comparisons can be made realistically with other countries.

Finally, this research has implications for other developing countries in the identification of factors influencing achievement on classroom level, within the developing world scenario.

Methodology

Sample

5030 thirteen-year-old eighth graders taught by 147 mathematics teachers from Jordan included in this study. They were from the TIMSS-R population (2) international sample that was conducted in 1999. The TIMSS-

R sample design was a two-stage cluster design and included the selection of schools during the first stage of sampling and then classrooms within schools during the second stage. Several types of information were collected as part of the TIMSS-R student and mathematics teacher questionnaires, including instructional and evaluation practices. This study examines data from teachers' and students' questionnaires, and student tests in mathematics.

Accordingly, the sample consists of all the 147 mathematics teachers that completed questions in the teacher's questionnaires related to this study and the 3,813 students that completed all the questions in the student's questionnaires related to this study and participated in the mathematics test.

Procedure

Considering the TIMSS-R questionnaires, it is not very clear which important factors have been operationalised. They do not contain well-tested scales necessary to operationalise all-important factors. This is the reason why the data analysis that was carried out is 'secondary' and also explorative in nature.

Secondary explorative data analysis can result in the conclusion that some predictor variables appearing to be important in relation to mathematics achievement from the literature could only be partially covered or not covered at all by the TIMSS-R questionnaires (Bos & Kuiper, 1999). The data exploration was carried out at student level. The teacher data was disaggregated to student level.

In order to define factors, there is a need to cluster items from TIMSS-R questionnaires. The student and teacher questionnaires from TIMSS were scrutinized to identify items or sets of items, which, as regards the content, could possibly be an operationalisation of selected factors. According to Postlethwaite and Wiley (1992) clustering of items should reflect meaningful homogeneity within clusters both conceptually and empirically. Conceptually means the factor must make sense, that it has a meaning in literature; empirically means the items must have meaningful loadings (greater than 0.4) on one factor in a principal component analysis and internal consistency (Cronbach alpha coefficient) at least 0.50

(Mason, Wong, & Entwistle, 1983).

Accordingly,the data analysis was conducted in two stages:

First stage: Data preparation (identifying measures of the study). This was conducted in the following steps:

1. Reversing the 4-point Likert-type scale items of students' questionnaires so that the more positive student responses indicating the more frequent practice were at the high end of the scale.
2. Using sampling weights (number of students in each class) in all analyses, and the student was the unit of analysis.
3. Conducting factor analysis on items that seems to contribute to instructional activities' or CAB' variables.
4. Selecting the items within each factor with loadings greater than 0.4 that reflect a meaning. This step meant that some items with loadings greater than 0.4 were not considered in the factor because they did not reflect a meaning, such as the item "to what extent is the task of 'keeping daily journals when giving students math homework' frequent" which was loaded on a factor that reflects "learnercentered" was omitted from that factor.
5. Calculating coefficients of internal consistency of items of each factor. This step meant that factors with Cronbach alpha less than 0.50 were not included in further analysis.

Students' performance on the TIMSS-R mathematics test was taken as the operationalisation of the variable 'mathematics achievement' without discussing its conceptual and curricular foundation. This score was developed from Rash model (Martin *et aI.*, 2000).

Table 1 list of explored factors and TIMSS questionnaire items.

Factors/items	Scale	Cronbach alpha
1-Instructional activities		
1) Teaching environment:		
1. Teaching style i) Learner-centered 1) Students work from worksheet on their own, 2) Students work on a mathematics project, 3) Students work in pairs or in small groups, 4) Students use daily problems when problem solving, 5) Check each other's homework, 6) Discuss practical problems, 7) Teacher asks students what they know related to a new topic, 8) Solve an example related to a new topic.	1- 4 1=never, 2= once in awhile, 3= pretty often, 4= almost always	0.88
ii) Teacher-centered 1) Teacher teaches students how to do mathematics problems, 2) Student copies notes from the board, 3) Teacher explains rules, 4) Student follows textbook when teacher teaches.	1- 4 1=never, 2= once in awhile, 3= pretty often, 4= almost always	0.83
2. Quality of teaching i) Process-oriented How often do you ask students to: 1) Explain reasoning behind an idea. 2) Use tables charts or graphs. 3) Work on problems with no obvious method of solution?	1- 4 1=never, 2= once in awhile, 3= pretty often, 4= almost always	0.75
i) Product-oriented How often do you ask students to: 1) Write equations to represent relationships. 2) Practice computational skills	1- 4 1=never, 2= once in awhile, 3= pretty often, 4= almost always	0.62
3. Instruction time Teachers were asked to report "How many minutes per week do you teach mathematics to your mathematics class?"		

Table 1.continued list of explored factors and TIMSS questionnaire items.

Factors/items	Scale	Cronbach alpha
2) Opportunity to learn:		
1. Quantity of homework 1) How often do you usually assign mathematics homework	1- 4 1=never, 2= less than once a week, 3= once or twice a week, 4= 3 or 4 times a week, 5=every day.	0.63
2) How many minutes of homework do you usually assign.	0= I don't assign hw, 1= less than 15 minutes, 2= 15-30 minutes, 3= 31-60 minutes, 4= 61-90 minutes, 5= more than 90 minutes	
2. Quality of homework i) Textbook based If assigning homework, how often do you assign: 1) Worksheets 2) Textbook problems 3) Reading in textbooks. 4) Writing short assignments.	1- 4 1=never, 2= once in awhile, 3= pretty often, 4= almost always	0.79
ii) Applied schoolwork If assigning homework, how often do you assign: 1) Small investigations 2) Long term individual projects 3) Long term small group projects. 4) Have students find uses of the content	1- 4 1=never, 2= once in awhile, 3= pretty often, 4= almost always	0.79
3) Kind of decisions based on homework performance		
i) Passive decisions How often do you: 1) Collect, correct, and keep homework assignments 2) Collect, correct, and return homework assignments. 3) Use homework to contribute towards students' grades	1- 4 1=never, 2= once in awhile, 3= pretty often, 4= almost always	0.67
ii) Active decisions How often do you: 1) Have students correct their own homework assignments in class 2) Have students exchange homework assignments and correct them 3) Use homework as a basis for class discussion. 4) Give feedback on homework to whole class.	1- 4 1=never, 2= once in awhile 3= pretty often, 4= almost always	0.80
2- Classroom Assessment Environment (CAE)		
4) Quality of assessment measures		
i) Traditional measures In assessment how much weight do you give: 1) Standardized test produced outside the school 2) Teacher-made open-ended tests 3) Teacher-made multiple-choice tests.	1- 4 1=never, 2= rarely, 3=sometimes, 4= almost always	0.72

Table 1.Continued list of explored factors and TIMSS questionnaire items.

Factors/items	Scale	Cronbach alpha
ii) Non-traditional measures In assessment how much weight do you give: 1) Homework assignments 2) Projects or practical exercises 3) Observations of students 4) Responses of students in class	1- 4 1=never, 2= rarely, 3=sometimes, 4=almost always	0.82
5) Kind of feedback based on assessment outcomes		
i) Active feedback How often do you use assessment information to: 1) Provide feedback to students 2) Diagnose learning problems.	1- 4 1=never, 2= little, 3=quite a lot, 4=a great deal	0. 71
ii) Passive feedback How often do you use assessment information to: 1) Provide grades for students. 2) Report to parents	1- 4 1=never, 2= little, 3=quite a lot, 4=a great deal	0.68

Second stage: Main analysis

6) Conducting a Blockwise Regression Analysis of blocks of predictors on criterion (maths achievement). In this method stepwise selection was used to select predictors for entry from each block. The five blocks of predictors were:

i. Teaching environment which includes

a) Teaching style:

- Learner-centered
- Teacher-centered.

b) Quality of teaching

- Process-oriented
- Product-oriented.

c) Instruction time (hours per week of teaching math).

ii. Opportunity to learn that includes:

a) Quantity of homework (amount of homework).

b) Quality of homework

- Textbook based
- Applied schoolwork

iii. Kind of decisions based on homework performance

- Passive decisions
- Active decisions.

iv. Quality of assessment measures

- Traditional measures
- Non-traditional measures.

v. Kind of feedback based on assessment outcomes

- Active feedback
- Passive feedback.

The dependent variable, maths achievement was regressed on the five blocks of independent variables in the order in which was presented earlier. When each block was entered, a Stepwise Regression Analysis was done on the variables included in it.Variables that met a pre specified criterion (F-to-enter/F-to-remove) were retained, whereas those that did not meet the criterion were discarded. This predictor selection process resulted in blocks composed of heterogeneous predictors (i. e. predictors whose intercorrelations are relatively small). Upon completion of the first stage, the analysis proceeds to a second stage in which a Stepwise Selection is applied to the predictors of the second block, with the restriction that predictors selected at the first stage remain in the equation. In other words, although the predictors of the second block compete for entry, their usefulness is assessed in light of the presence of firstblock predictors in the equation (Pedhazur, 1997). Once the second stage having been completed, a Stepwise Selection is applied to the predictors of the third block. The usefulness of predictors from the third block is assessed in view of the presence of predictors from the first two blocks. The procedure is repeated sequentially until the predictors from the last block are considered.

Results

To determine the relative importance of the different factors at classroom level to mathematics achievement a Blockwise Regression Analysis was conducted, where the variables of each block were entered in a Stepwise Selection. The variables were clustered in five blocks, the first three of them concerning instructional activities and the last two concerning classroom assessment. The instructional activities blocks were: teaching environment, opportunity to learn, and kinds of decisions based on homework performance. Teaching environment constitutes instruction time, quality of teaching, and teaching style. Opportunity to learn includes quantity and quality of homework. Whereas, blocks of classroom assessment environment were means of measuring educational outcomes and kinds of decisions based on assessment outcomes. For the sake of completeness the correlations with the variables that are not entered in the Blockwise Regression, correlations between criterion and predictor variables are reported in Table 2.

As for correlation coefficients, two points worth mentioning:

First: the majority of predictors are significantly inter-correlated with weak to high coefficients (-0.26 to 0.70, $p<0.05$). However, both teaching styles (learner- and teacher-centered) are high and significantly correlated ($r=0.70$), similarly with process- and product-oriented teaching ($r=0.56$). Whereas, textbook based homework is weakly and significantly correlated with applied schoolwork ($r=0.35$). Active feedback based on assessment outcomes is weakly and significantly correlated with non-traditional means of measuring ($r=0.31$) and with passive feedback (r=OA1). This collinearity suggests that, for instance, textbook based homework has much in common with other variables and may have very little information that is unique to it (Pedhazur, 1997). Whilst, some predictors have negative significant correlations with each other, such as hours of teaching math per week with: amount of maths homework ($r=-0.26$), active feedback based on assessment outcomes ($r= -0.18$), product-oriented teaching ($r=-0.17$), and process-oriented teaching ($r=-0.11$).

Table 2
Correlations between predictors' variables (instructional activities and classroom assessment) and the criterion(maths achievement)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Teaching math/hr/wk	1														
2. Learner centered	.14*	1													
3. Teacher-centered	.09*	.70*	1												
4. Process-oriented	-.11*	.04*	-.01	1											
5. Product-oriented	-.17*	.04*	.05*	.56*	1										
6. Amount of math hw	-.26*	-.03*	.10*	.08*	.13*	1									
7. Text-book based hw	-.11*	-.09*	-.04*	.05*	.05*	.15*	1								
8. Applied-school work	.14*	.20*	-.10*	.07*	.10*	-.02	.35*	1							
9. Passive feedback/homework	.05*	-.08*	-.04*	.21*	.16*	.12*	.28*	.28*	1						
10. Active feedback/homework	.00	.07*	.01	.10*	.07*	.17*	.33*	.19*	.11*	1					
11. Traditional measures	.03	.05*	.07*	.15*	.10*	.08*	.04*	.23*	.21*	.09*	1				
12. Non-traditional measures	-.04*	.10*	.11*	.17*	.11*	.33*	.22*	-.01	.24*	.00	.15*	1			
13. Active feedback/evaluation	-.18*	-.04*	.05*	.23*	.15*	.19*	.01	.14*	.24*	.05*	.25*	.31*	1		
14. Passive feedback/evaluation	-.01	-.02	-.02	.14*	.14*	.01	.09*	.11*	.26*	.11*	.25*	.17*	.41*	1	
15. Maths achievement	.19*	.29*	.24*	.13*	-.04*	-.09*	-.16*	.13*	-.05*	-.03*	.05*	-.03*	.12*	.09*	1
Mean	3.26	2.03	2.21	2.49	2.98	6.09	3.02	2.26	3.29	2.86	2.48	2.85	3.07	2.83	150.11
Standard deviation	1.19	0.26	0.25	0.67	0.63	0.77	0.54	0.64	0.38	0.47	0.50	0.46	0.45	0.52	4.69

*Correlation is significant at the 0.01 level (2-tailed).
Correlation Coefficients are approximated to two decimal places

Second: correlation coefficients between predictors and the criterion are weak (-0.16 to 0.29), although, almost all are statistically significant ($p<0.05$). For instance, students whose teachers used learner-centered approach are likely to achieve higher scores than their counterparts of teachers that used teacher-centered approach.

Moreover, students of teachers who indicated that they spent more hours per week teaching mathematics, used process-oriented teaching, or used active feedback based on assessment outcomes tended to achieve higher scores. However, there were significant negative correlations between some predictors and the criterion. For instance, students who are assigned textbook-based homework, more homework, or receive passive feedback based on homework performance tended to achieve lower scores in mathematics.

Table 3.
Summary of Blockwise Regression Analysis results of math achievement

Variable	Model R-Square	R-square change	β [a]
Instructional Activities			
1) Teaching environment			
1. Product oriented teaching	0.086	0.086*	-0.30*
2. Teacher centered teaching style	0.149	0.063*	0.22*
3. Weekly hours of teaching mathematics	0.181	0.032*	0.17*
4. Process oriented teaching	0.187	0.006*	0.11*
5. Learner centered teaching style			0.03
2) Opportunity to learn			
6. Textbook based homework	0.214	0.027*	-0.22*
7. Applied schoolwork	0.224	0.010*	0.11*
8. Amount of math homework			-0.02
3) Kind of decisions based on homework performance			
9. Passive decision			-0.01
10. Active decision			-0.02
Classroom Assessment Environment			
4) Means of measuring			
11. Traditional means of measuring	0.233	0.009*	-0.18*
12. Non-traditional means of measuring			-0.03
5) Kind of decisions based on assessment outcomes			
13. Passive feedback	0.293	0.060*	0.26*
14. Active feedback			0.02
* Significant at the 0.00 level			
[a] β values were approximated to two decimal places			

* Significant at the 0.00 level

[a] β values were approximated to two decimal places

Findings from Blockwise Regression Analysis of eighth graders mathematics achievement are summarized in table 3. In the first part of the analysis, the five "teaching environment" variables were considered. Product-oriented teaching entered the regression equation first and accounted for a statistically significant proportion of variance in mathematics achievement (8.6%). Teacher centered teaching style entered the regression equation second and explained a statistically significant proportion of the remaining variance (6.3%). Similarly, the following variables (weekly hours of teaching math and process oriented teaching) entered the regression equation and explained a statistically significant proportion of the remaining variance (3.2%, 0.6%, respectively) even after accounting for the effects of the preceding variables in the equation.

In the second part of the analysis, the three homework assignment variables entered into the regression equation after the effect of the first block (teaching environment) was controlled for. Textbook based homework was the first variable to enter the second block of the regression equation and explained a significant proportion of the variance in maths achievement (2.7%), even after the effect of the teaching environment (1st block) variables was accounted for. The seventh variable to enter the regression equation (applied schoolwork) explained a significant proportion of the variance (1%). However, amount of maths homework did not account for a statistically significant proportion of the variance.

In the third part of the analysis, the two variables related to the third block (kind of decisions based on homework performance) were entered into the regression equation. None of the variables (passive feedback and active feedback) contributed for significant proportion of variance after the effects of the first two blocks (teaching environment and homework assignments) were accounted for.

In the fourth part of the analysis concerning the classroom assessment environment, the two variables concerning block four, (means of measuring) were entered into the regression equation after the effects of the first three blocks were controlled for. Traditional means of measuring was the first variable to enter the fourth block of the regression equation and explained a significant proportion of the variance in maths achievement (0.9%); even after the effects of the instructional activities' variables were accounted for. However, non-traditional means of measuring variable was not significant.

In the fifth part of the analysis, the two variables of block five (kind of decisions based on assessment outcomes) were entered into the regression equation after the effects of the first four blocks were controlled for. Passive feedback based on assessment outcomes was the first variable to enter the fifth block of the regression equation and explained a significant proportion of the variance in maths achievement (6%), even after the effects of the first four blocks were accounted for. However, active feedback did not account for significant proportion of the variance. Finally, the overall Blockwise Regression equation that considered the contributions of the complete set of instructional activities' and CAB's variables accounted for significant proportion (29.3%) of the variance in eighth graders maths achievement ($F_{(9‘ 3804)}$ =174.42, p=0.00l).

The results of Blockwise Regression Analysis enable us to obtain an overall evaluation of the relative importance of the predictors (Pedhazur, 1997). Table 3 revealed that eight predictors contributed significantly to the variation in maths achievement; five of them contributed positively. Passive feedback based on assessment outcomes had the strongest association with maths achievement (β = 0.26) even after the effects of the first four blocks were accounted for. This means that it was the most important predictor. The next strongest predictor was teacher centered teaching style (β = 0.22); followed by weekly hours of teaching math (β= 0.17). Process oriented teaching and applied schoolwork share the same importance to maths achievement (β = 0.11), although the later entered the equation in the second stage after the effect of the first block was accounted for, accordingly, it could be said that giving students applied schoolwork is more important to maths achievement than process oriented teaching. Table 3 showed, also, that three predictors were negatively associated with maths achievement. Product oriented teaching (β = -0.30), textbook based homework (β = -0.22), and traditional means of measuring (β = -0.18). These suppressors control for irrelevant variance (pedhazur, 1997).

Conclusions and discussion

This study aimed at determining the relative importance of instructional activities and classroom assessment environment to student mathematics achievement. Results from Blockwise Regression Analysis identified eight variables from the five blocks that entered the regression equation and contributed significantly to the prediction of maths achievement. Six of these variables belong to instructional activities. Four of the variables (teacher centered teaching style, weekly hours of teaching math, process oriented teaching, and applied schoolwork) positively accounted for significant proportion of the variance in maths achievement, whereas, product oriented teaching and textbook based homework were suppressors.

The results showed, also, that two classroom assessment environment variables (passive feedback based on assessment outcomes and traditional means of measuring) significantly entered the regression equation, even after controlling for the effects of instructional activities' variables; the first variable contributed positively to the variance in maths achievement whilst the second was a suppressor.

Moreover, the results revealed that six variables in five blocks (learner-centered teaching style, amount of math homework, passive- and active-decisions based on homework performance, non-traditional means of measuring, and active feedback based on assessment outcomes) did not account for significant proportion of the variance. It would, however, be incorrect to conclude that these variables are not important determiners for maths achievement; but we can say that after considering the first block and/or blocks, the remaining variables add little or nothing to the prediction equation. Saying it differently, those variables may be deleted from the regression equation without substantial loss in predictability (Pedhazur, 1997).

There were several significant findings from this study. The first is that passive feedback based on assessment outcomes was the most important factor of the selected tested variables of instructional activities and CAE to mathematics achievement. This result supports Brookhart's (1997) result concerning the importance of CAE to achievement. This result could be understood in the light of teachers' practices concerning giving students their grades and reporting it to parents. This practice is prevailing, especially, in classes higher than the first three primary grades. Students are accustomed to be provided with their grades where they will try to look for their weaknesses and diagnose their problems in order to correct their learning, especially when an additional pressure is exerted on them from their parents that will pursue a follow up of their children's learning. This teachers' behaviour enables students to establish a new routine for themselves to monitor and correct their learning, with the help of family, peers, and sometimes their teachers. Saying it differently, due to parental press, some students will implement an external control to their learning in order to compete with their peers. This could lead to strong psychological rewards for both pupils and teachers (Nias, Southworth, & Yeomans, 1989). However, this result does not support Brookhart's (1997) claim that a student who receives active feedback, which could be used to improve performance is likely to feel empowered to do better next time, whilst, a student who receives passive feedback without information is likely to feel that the teacher has given him/her an external reward or punishment.

Another significant finding is that teacher-centered teaching was the second important factor to maths achievement. This finding supports research results indicating that teacher-centered teaching that involve less student participation have been found to be effective in some low-income countries (Lockheed & Zhao, 1993).

Product oriented teaching was negatively and significantly related to maths achievement. This result goes in line with the claim that the use of product-oriented approach enables students to reproduce material in a required form without analysis or integration, leading to low quality learning outcomes (Gordon and Debus, 2002), accordingly, decreases achievement (Guthrie, Schafer, Secker, & Alban, 2000).

Limitations and Implications

The findings of this study need to be reviewed with four of its limitations in mind. First, as the sample used in this study was comprised primarily of Jordanian eighth graders, it is not clear to what extent the findings can be generalized. However, research from multiple grades is needed to determine if similar findings would be observed. Second, since the data analysis that was carried out for this study is secondary, there is a need to conduct similar studies using well-tested scales for all the important factors to determine if similar fmdings would be attained. Third, the analysis and fmdings of this study are exploratory rather than definitive. This suggests that researchers should further pursue the relationship between the studied variables of this study in different subjects. Fourth, the selected (instructional activities and classroom assessment environment) variables of this study explained only 29.3% of the variance in math's achievement. This might be attributed not only to methodological limitations but also to the fact that some further variables at classroom or teacher levels might have to be included. Thus, further research is needed in an attempt to identify variables which could explain more variance.

The results provide insight into instructional activities and CAE that are associated with mathematics achievement. However, these results provide directions for further research. For example, additional study is needed to determine if similar fmdings would be observed in other countries that participated in TIMSS. Another direction for further research would be to examine Jordanian students who participated in the recent TIMSS-Repeat assessment to determine if the patterns seen for those students would resemble findings from this study.

There are two contributions of this study. First, several instructional activities and classroom assessment variables were identified that were significantly associated to math achievement. These results provide a number of directions for further research on quality of teaching, use of specific means of measuring, quality of assigned homework, kind of feedback based on assessment outcomes, or the interaction of two or more of them, when designing instructional or teacher training programs. A second contribution of this study is the demonstration of an instructional-assessment model that might have promise for assessing teaching/learning process. This model provides a framework that considers the relative importance of specific instructional and assessment activities to mathematics achievement that can be used to evaluate several types of instructional design activities and learning outcomes.

The outcomes of the current research indicate that considerable value lies in the careful construction of learning environments in teacher education, both pre- and inservice training. The nature of this task is complex, multifaceted and context specific, most likely requiring the development of unique solutions in each environment.Nevertheless, the current research demonstrates that such solutions can be developed and applied within the prevailing constraints of a pre-existing course, without the need for major redevelopment of course structures. What is needed are approaches that operate in a manner to transform the school culture from one that focuses on processing to one that focuses on invention in the interest of accountability (McDonald, 2003).

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