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Preservice Mathematics Teachers' Views on Using Instructional Rubrics in Materials Development Process

Matematik Öğretmen Adaylarının Materyal Geliştirme Sürecinde Öğretimsel Rubrik Kullanmaya İlişkin Görüşleri

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Abstract
Instructional rubrics are important tools of evaluation to support and monitor student development. The purpose of this study is to reveal the views of pre-service mathematics teachers on instructional rubrics in the materials development process. The data of the study were collected using a questionnaire from 70 respondents, out of whom 23 were interviewed. The results of the study indicated that the majority of the pre-service mathematics teachers found the use of rubrics necessary in their teaching processes. However, the difficulties experienced in preparing the rubrics, the formation of rubrics for tasks that support different skills, and the importance of being familiar with the student profile in the rubric development process were discussed. This study provides valuable insights regarding what can be done to support the development of pre-service mathematics teachers' instructional rubric use in tandem with the design of the lesson.

Keywords: Evaluation, pre-service mathematics teachers, materials development, instructional rubrics.

Öz
Öğretimsel dereceli puanlama anahtarları (öğretimsel rubrikler), öğrenci gelişimini desteklemek ve izlemek için önemli değerlendirme araçlarıdır. Bu çalışmanın amacı, matematik öğretmen adaylarının materyal geliştirme sürecindeki öğretimsel rubriklere ilişkin görüşlerini ortaya koymaktır. Çalışmanın verilerini, 23 öğretmen adayı ile yapılan mülakatlar ve 70 katılımcıdan toplanan anket verileri oluşturmaktadır. Çalışmanın sonuçları öğretmen adaylarının çoğunun öğretim süreçlerinde öğretimsel rubrikleri gerekli bulduklarını göstermiştir. Ancak rubriklerin hazırlanmasında karşılaşılan zorluklar, farklı becerileri destekleyen görevler için değerlendirme rubriklerinin oluşturulması ve değerlendirme sürecinde öğrenci profiline aşina olmanın önemi öğretmen adaylarınca tartışılmıştır. Bu çalışma, matematik öğretmen adaylarının dersin tasarımı ile bağlantılı olarak öğretimsel amaçlı rubrik kullanımı konusunda gelişimini desteklemek için neler yapılabileceğine yönelik önemli bilgiler sunmaktadır.

Anahtar Kelimeler: değerlendirme, matematik öğretmen adayları, materyal geliştirme, öğretimsel rubrikler.

1. Introduction

The point of view that relies only on using numbers in the evaluation of student development has now lost its validity. Given that one of the main objectives of an evaluation is to provide direction to the instructional process, monitoring and evaluating the process of students' learning can be seen as an important task. An evaluation that is performed based on the learning process can be defined as a process-based evaluation. While providing feedback for students about their learning, this process can also offer guidance to teachers for future instructional planning.

As an important element of a process-based evaluation, rubrics are tools that give direction to the instructional process (Danielson, 1997; Moskal, 2000). Rubrics are explanatory scoring schemes developed by teachers or other

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evaluators to direct the analysis of students' efforts or learning products and processes (Brookhart, 2003; Moskal, 2000). Aside from helping teachers to clearly show objectives and aims (Andrade, 2000), rubrics also help students recognize what they should know and how they should perform (Mabry, 1999). In this respect, as a form of information about the expectations regarding the tasks assigned to students, and to be used for self-evaluation, rubrics are an important factor of evaluation to support and monitor student development. The most important shared features of rubrics that can be developed for various reasons are their inclusion of the criteria to be measured and the degrees indicating various levels of performance (Andrade, 2000).

Moskal (2000) states that the most important benefits of rubrics are their ability to provide feedback for students who want to develop their performance and to test how much of the target performance has been achieved. In the existing literature, the contributions of rubrics to the instructional process are described as follows: (1) their use is easy and explainable (Whittaker, Salend, & Duhaney, 2001), (2) they allow teachers to explain their expectations more clearly (Erdem, 2007; Whittaker et al., 2001), (3) they provide students with informative feedback about the areas in which they are strong and in which they need to develop (Black & William, 1998), (4) they support learning and skill development (Erdem, 2007), and (5) they promote comprehension and thinking (Shepard, 2000). Thus, it can be maintained that the use of rubrics in the process of instructional design and evaluation goes beyond grading.

Rubrics serving the functions of teaching and learning (Andrade, 2000) can also be used as instructional materials and as tools to evaluate student performance. Andrade (2005) carried this perspective one step further and used the term "instructional rubrics" instead of "rubrics." The use of instructional rubrics in different classes is related to the purpose for which they are used. Such rubrics have more extensive objectives—such as supporting student development, providing peer evaluation, improving feedback-giving process, and enhancing self-evaluation—than rubrics focused on grading. In this respect, in an undergraduate class they can be used for both evaluating Preservice Mathematics Teachers (PMTs)' progress and success and providing useful information for their development. If the PMTs understand the rationale behind the use of instructional rubrics, PMTs have the potential to integrate their learning via instructional rubrics into their teaching processes in the future. Therefore, the purpose of the current study was to explore the views of PMTs on instructional rubrics. The study specifically focused on the views of PMTs regarding instructional rubrics as factors that influence the materials development process. Thus, this study sought to answer the following research question: What are the views of the PMTs on the preparation and use of instructional rubrics?

Method

Research Design

The aim of the current study was to explore the general views of PMTs on instructional rubrics in materials development process. In this study, the opinions of PMTs were investigated via interview and a small quest. Qualitative research based on code and categories provide presentation of research results (Merriam, 1998). Thus, this study can be identified as a basic qualitative research. First, a small-scale questionnaire was administered; then, interviews were performed with the students who participated in the study voluntarily.

Context of the Study

The study was conducted in the context of the Instructional Technology and Materials Development Course (ITMDC). The objectives of the ITMDC were as follows: to ensure that students can explain the features of instructional technologies and where these instructional technologies can be used in mathematics education; to help the teachers develop instructional materials; to enable them to evaluate the instructional materials developed by their peers; and to ensure that they can prepare and handle concrete materials to be used in mathematics education (Higher Education Council, 2007). During the ITMDC lessons, the PMTs were given opportunities to examine several samples of work. Within the context of the ITMDC, six different tasks were performed by the student groups and for all tasks the rubric to be used in the evaluation was presented together with the instructions for the task. After seeing the five examples of rubrics developed by the researcher for their assignments, in their last task the PMTs developed their own instructions and rubrics; therefore, they experienced the whole process of preparing an instructional rubric.

The preparation of the rubrics followed the stages proposed by Andrade (2000), and the researcher also added additional stages. Overall, the rubric development process went through the following stages: (1) determination of the best and worst performance levels in light of previous student performances; (2) determination of the performance criteria; (3) elaboration of the criteria in such a way that the criteria would not be confused with each other; (4) determination of the degrees for the performance; (5) determination of the scoring according to the degrees; (6) preparation of the draft rubric; (7) conducting reliability and validity studies of the rubrics; (8) using the draft rubric in evaluation; and (9) revising the rubric if needed.

In a typical rubric development process—for instance, for preparing a Prezi/PowToon/Emaze presentation— the first step is to determine and define the best and worst levels of performance in light of the previous performances of students; then, performance indicators are labeled from 1 to 4. Second, performance criteria were determined as follows: content elements, technical elements, and visual elements. Third, the criteria were elaborated so as not to be confused with each other using the following criteria 1) meeting 25% of the necessary conditions; 2) meeting half of the necessary conditions; 3) meeting 75% of the necessary conditions and 4) meeting all the necessary conditions. For the determination of the degrees for the performance and scoring according to the degrees, descriptors of the items for each performance were included. For example, the criteria for a 4-points evaluation were the following: selection of the objective to be achieved in the lesson, determination of the grade level and the time in which this objective will be addressed, determination of the purpose of the lesson, determination of the stages of the lesson, and determination of the flow of the presentation; the criteria for a 3-points evaluation were the following: accomplishing three of the aforementioned items; the criteria for a 2-points evaluation were the following: accomplishing two of the aforementioned items; and the criteria for a 1-point evaluation were the following: accomplishing one of the aforementioned items. After the completion of grading for the 5 sub-criteria of the 2 performance criteria, the draft version of the rubric was prepared. After conducting studies for validity and reliability, instructional rubric was used for the evaluation of the group presentations. Then, revisions were done if needed.

Study Group

This study was conducted with 70 PMTs from the Department of Mathematics Education at one of the top universities in Turkey. The ITMDC is a course taken by sophomore PMTs as a required course. Among the 70 PMTs, 7 were male. The role of researcher, in the scope of this study, was preparing the tasks and rubrics, evaluating the prepared rubrics and conducting interviews and the small quest. The PMTs were informed about the research process and were given consent forms. The consent forms included the information related to the willingness to participate in this study. Further, the consent form explained that there were no positive or negative effects due to the participation in this study on the success or failure of the ITMDC and that participation was not related to grading in the course.

Data Collection Process

The data were collected using a general questionnaire and the interview protocol prepared by the researcher. In order to gather information about the views of PMTs on using instructional rubrics, PMTs were administered a small-scale questionnaire to elicit their general views about the use of rubrics and their views about instructional rubrics in the context of the ITMDC. The questionnaire included 2 questions and was filled out in 30 minutes. The questionnaire comprised the following questions: “What is your view about rubrics in general?” and “What do you think about the rubrics used in the ITMDC?”

After the administration of the questionnaire, all the PMTs were asked to participate in an interview that included standard questions, and the ones who volunteered were interviewed. The PMTs were given an additional consent form prior to the interview to explain that their participation in the interview would not affect their assessment in the course and that it would not have any benefits or drawbacks. 23 PMTs volunteered to participate in the interviews. This interview was performed in order to elicit the PMTs’ views about the preparation and use of rubrics, the positive and negative sides of preparing rubrics, and whether they would use rubrics when they became teachers. The question asked in the interview was as follows: “Will you use rubrics when you become a teacher? Why?” Each interview lasted approximately 15 minutes. The interviews were conducted one-on-one in a setting where the PMTs felt comfortable. All the interviews were tape-recorded with the consent of the PMTs.

Data Analysis

In the analysis process, frequencies and percentages were derived for each type of answer. Further, in line with the data analysis stages proposed by Miles and Huberman (1994), the interview transcriptions were first read separately by the researcher and by an external researcher, who has PhD on mathematics education and was an instructor for the ITMDC before, possible code lists were generated. Then, the two researchers agreed on the codes and started to analyze the data according to these codes. In order to achieve open coding process, the researchers read the data carefully and independently, identified the statements relating to the categories, and assigned a code. Then, the researcher noted those codes, in such a way that each statement was organized under its appropriate code. For the first question, sample categories and sub-categories, without third-order codes, are given in Table 1.

Table 1
Sample Code List

Main Code	**Sub**-code	**Second**-order sub-code
Positive aspects	For the teachers	To the evaluation of learning
		To the planning of the instructional process
	For the students	In terms of sharing at the beginning of the study
		-cognitively (related to knowledge)
		-affectively (related to feelings and attitude)
		In terms of being evaluated by rubrics
	To the curriculum and the process	

Findings

The aim of the current study was to explore the general views of PMTs on instructional rubrics with a specific focus on regarding instructional rubrics as factors that influence the materials development process. Thus, the findings of the study were presented under three main categories corresponding, respectively, to the views of the PMTs on the preparation and use of instructional rubrics, the views of the PMTs on the preparation and use of instructional rubrics in the ITMDC, and the views of the PMTs on the use of rubrics when they become teachers.

Preparation and use of instructional rubrics

PMTs provided different definitions for the rubrics. The definitions given included the following: "[A rubric is] is a process of explicitly explaining the criteria" (PMT 12) and "rubrics are pre-prepared criteria to evaluate the material" (PMT 19).

The following definition was the most comprehensive definition of all the definitions provided by PMTs:

> The criteria enabling us to see our objectives, what is required to be done, and the extent to which what is required has been accomplished, how much we have satisfied the expectations, what our shortcomings are, what the causes of these shortcomings are, and what we should do and should not do when handling another material. (PMT 21)

According to the PMTs, the most important contribution of the instructional rubrics used in the ITMDC was that instructional rubrics helped PMTs better understand the expectations and direct their works in line with these expectations. Table 2 shows some examples of the most-mentioned views of the PMTs related to the instructional rubrics used in the ITMDC.

Table 2
Examples of PMTs' Views About Instructional Rubrics in the ITMDC

PMTs' views about the rubrics used in the ITMDC:	**f**	**PMTs**
helped me see the mistakes and deficiencies within the group.	5	5, 11, 12, 14, 20
helped me compare the works of other groups with my own.	2	5, 2
provided us with information about what should be done.	5	1, 4, 7, 13, 22
helped us to better understand the expectations; thus, we directed our works in line with these expectations.	10	1, 2, 4, 6, 9, 12, 13, 18, 20, 21
allowed the teacher to behave justly and transparently in grading.	6	8, 10, 14, 15, 17, 23
made the expectations clear and unambiguous.	5	5, 10, 14, 19, 22

Based on the information in Table 2, the PMTs saw rubrics as important tools during their learning process in order to better understand the expectations and conduct their work accordingly. In addition to this view, they supported the use of rubrics in the ITMDC because instructional rubrics they brought justice and transparency to evaluation and allowed PMTs to see their mistakes and deficiencies in their learning.

Regarding the use of the rubrics, the PMTs focused on three aspects: benefits to the teacher, benefits to the student, and benefits to the development of the curriculum and materials. In terms of the benefits of instructional rubrics, PMTs

mentioned the benefits related to the evaluation of learning and to the planning of the instructional process respectively. Table 3 shows the PMTs' views on the benefits that using rubrics has for teachers.

Table 3
Views on Preparing and Using Instructional Rubrics for Teachers

Benefits for the teacher	**f (%)**
related to the evaluation of learning	
• Just, consistent, and transparent evaluation.	57 (81%)
• Standard and consistent evaluation**.**	34 (49%)
• Accurate evaluation.	49 (70%)
• Practical, fast, and easy evaluation.	41 (59%)
• Multifaceted evaluation.	27 (39%)
related to the planning of the instructional process	
• Designing of a planned and extensive evaluation process.	21 (39%)
• Determination and clarification of expectations concerning different stages.	33 (47%)
• Guiding the instructional process.	51 (73%)
• Providing feedback to assess and document the progress.	39 (56%)
• Allowing the planning of feedback.	24 (34%)

The most emphasized aspect of instructional rubrics to the teacher regarding the evaluation of learning by PMTs was that they bring justice, consistency, and transparency to the evaluation process, make the evaluation accurate, and reduce the time allocated to evaluation. The PMTs underlined the aspects concerned with the planning of the instructional process as well. The most emphasized aspect in this regard was guiding the instructional process.

According to the PMTs, rubrics are beneficial to the students: sharing rubrics at the beginning of the activity with the students and evaluating the students' performances using rubrics has benefits for PMTs, Table 4 shows the PMTs' views on instructional rubrics in relation to the students.

Table 4
PMTs' Views on Instructional Rubrics in Relation to the Students

Benefits for the students	**f (%)**
Related to sharing rubrics at the beginning of the activity	
Aspects related to cognitive issues:	47 (67 %)
• Rubrics allow students to better understand the purpose of the activity.	
• Students can better learn the stages of what should be done in the activity.	39 (56 %)
• Students can clearly recognize expectations.	
• They help students to plan ahead.	55 (79%)
• They help students to engage in the activity in a conscious manner.	21 (30%)
• They raise students' awareness of which criterion is more important.	26 (37%)
• They help students not to become distanced from the objectives and content.	
Aspects related to affective issues:	32 (46%)
• They increase motivation and make students more willing.	28 (40%)
• They provide guidance for setting targets.	
• They encourage students to perform better.	
• They raise students' awareness of what they can achieve.	19 (27%)
• They encourage students to prepare their best work.	43 (61%)
• They increase students' self-efficacy.	31 (44%)
• They give some insights about the teacher's evaluation process.	22 (32%)
• They help students work effectively and systematically.	
• They help students understand how to work accurately.	

• They create opportunities for self-criticism and self-evaluation.	36 (51%)
	14 (20%)
	30 (43 %)
	24 (35%)
	16 (23%)
	17 (24%)
Related to being evaluated by rubrics	
• Students can learn where they have made mistakes.	46 (66%)
• Students know in advance how many points they will receive for their performance.	38 (54%)

Based on the views of PMTs, the main points regarding issues related to the students are the following: instructional rubrics allow students to understand the expectations of the teacher and the activity better; they allow students to conduct self-evaluations; they provide guidance on what should be done; and they raise students' awareness of what they did and what they did not do. In addition, rubrics are thought to be effective for increasing students' motivation, self-confidence, and willingness to work. It seems possible to classify the benefits of rubrics to the students into 1) the benefits of sharing the rubric at the beginning of the activity and 2) the benefits of evaluating using the rubric.

Aside from providing benefits for teachers and students, PMTs also think that instructional rubrics have some importance for the development of the curriculum and the instructional process. Table 5 shows the PMTs' views about the importance of rubrics for the curriculum and the instructional process.

Table 5
Views on Instructional Rubrics Regarding the Curriculum and the Instructional Process

Related to the curriculum and the instructional process	**f (%)**
• The developed materials comply with the objectives.	26 (37%)
• The developed materials respond to the needs of the students.	15 (21%)
• They direct the design of instruction.	12 (17%)
• They help determine the deficiencies of instructional materials.	18 (26%)
• They contribute to rendering instructional materials more suitable for use.	31 (44%)

PMTs mostly emphasized that instructional rubrics contributed to making the materials more suitable for use; that is, rubrics help in improving the materials. In addition to this, PMTs indicated that instructional rubrics help the developed materials comply with the objectives.

The use of rubrics when the PMTs become teachers

The PMTs' views about the use of rubrics could be categorized under two main headings, as (1) reasons for using instructional rubrics and as (2) challenges of using instructional rubrics. Table 6 shows the reasons given by the PMTs for using instructional rubrics when they become teachers.

Table 6
PMTs' Reasons for Using Instructional Rubrics when They Become Teachers

Reasons for using instructional rubrics	**f**	**PMTs**
• They help me see the state of the student during the term.	1	5
• They are necessary and useful for me to conduct evaluations in a convenient and practical manner.	6	7, 12, 14, 18, 22, 23
• They allow me to evaluate students from different perspectives.	3	6, 9, 11
• Preparing rubrics takes me a long time, but having rubrics shortens the time needed to evaluate.	4	1, 4, 15, 19
• They facilitate the completion of homework by students.	2	12, 3
• They guide students in doing an activity. Thus, students ask fewer questions.	1	21

The positive aspects of instructional rubrics most emphasized by the PMTs were that instructional rubrics are useful and necessary and that, although preparing the rubrics takes a long time, having rubrics in place shortens the evaluation time. The most cited issue was that instructional rubrics are necessary and useful for conducting evaluations in a convenient and practical manner.

The PMTs had positive views about the use of rubrics in general, but they thought that the preparation and the use of rubrics were challenging. Table 7 shows the reasons mentioned by the PMTs regarding those challenges.

Table 7
Reasons that Make the Preparation of Instructional Rubrics challenging

Challenges of instructional rubrics	**f**	**PMTs**
• Applying them to each exam and assignment can be difficult.	1	2
• Considering all the requirements, their preparation can be difficult.	2	8, 5
• They require considerable attention and effort.	4	18, 12, 5, 9
• Preparing a clear and comprehensible rubric for students is difficult.	3	11, 3, 7
• Revising them from another person's perspective is necessary.	1	14
• Considerable subject and content knowledge is needed.	2	2, 6
• Different rubrics need to be prepared for each task.	1	15
• Preparing the instruction is difficult.	2	4, 7
• Determining the limits of the criteria is difficult.	3	3, 5, 21
• Deciding which elements to include is highly challenging.	3	4, 9, 20
• Making the written expressions understandable for everyone is difficult.	2	8, 10

The reasons for the challenges of instructional rubrics were mostly related to the preparation process. Being obliged to prepare different rubrics for different tasks, the necessity of having subject and content knowledge, and making the rubrics comprehensible to students were the reasons that made the preparation of rubrics challenging for the PMTs.

Discussion

The purpose of this study was to elicit the views of PMTs on instructional rubrics as a factor affecting the materials development process.

When the general views of the PMTs about rubric were examined, it was clear that the most frequently mentioned issue was that instructional rubrics present a criterion for evaluation. It was an issue that PMTs cared about, both as students and as prospective teachers, to be clear on the criteria to evaluate their own studies. In addition, using specific criteria in assessment may make PMTs confident, especially given that they have little experience in teaching and assessment.

When PMTs' views about the rubrics in the ITMDC course were examined, it could be seen that instructional rubrics had an instructive role in understanding the expectations of the rubrics used in the lesson and guiding PMTs accordingly. In this respect, the rubrics used in ITMDC course were instructional rubrics for PMTs. The rubrics used in the ITMDC course played an important role for PMTs for both tracing their progress as students and as being a teacher.

The other two points that the PMTs put forward regarding the benefits of the instructional rubrics were that they prepared the ground for a transparent and fair assessment and showed the deficiencies of learning. The need to evaluate each student's work fairly and transparently according to certain criteria was an issue for the PMTs. Although not explicitly stated here, the importance they attached to this issue can also provide a solid background for accountability.

For PMTs, showing deficiencies by using instructional rubrics and directing the development of students may be due to the opinion that students can learn from their mistakes. This is another educative side of instructional rubrics. The fact that the PMTs evaluated the benefits of rubrics not only as prospective teachers but also from the perspective of students and the teaching program may be due to the fact that they defined themselves in the dual role as students and teachers.

For the PMTs, rubric preparation seems to require a considerable amount of time and effort. They think that deciding on the items for the rubric, determining the borders of the criteria, and developing a rubric that is clear and understandable to students are highly challenging task. The difficulties experienced in preparing rubrics were also evaluated in terms of preparing different rubrics for different tasks and in terms of the importance of being familiar with the student profiles in the process of rubric development.

All of these evaluations about PMTs' view about using rubric are in agreement with previous studies. The PMTs' views about the contribution of rubrics to the teaching process were the following: rubrics were easy to use and explained in the literature (Whittaker et al., 2001), they allowed teachers to express their expectations more clearly (Erdem, 2007;

Whittaker et al., 2001) and provided more informative feedback on the areas they needed to improve in (Black & William, 1998), supported learning and development of skills (Erdem, 2007), and supported the development of thinking (Shepard, 2000). Thus, the results of the study were consistent with the results of the previous studies. Besides, the study provides detailed information about use of instructional rubrics in materials development process and specific ways about how to use those rubrics for the development of PMT's.

Conclusion

The findings of this study revealed that a large majority of the PMTs found the use of instructional rubrics useful, were planning to use rubrics in their future professional careers, thought that instructional rubrics brought justice and transparency to evaluation, and believed that presenting rubrics together with materials development tasks helped them to be more organized and improved the quality of their works. Further, in the light of the results of this study, it can be stated that the PMTs held the view that when more concrete and detailed expectations are presented about the content of the tasks via instructional rubrics, they could produce more qualified work Moreover; such explanations provided them with guidance and motivated them.

All of these findings can be seen as concrete indicators of the benefits of rubrics for teachers who want to support the development of their students. Thus, the main difference between instructional rubrics and regular rubrics might be the capacity of the former to support the instructional process as emphasized in the study performed by the preservice teachers (Andrade, 2000). Although in this study rubrics, rubric development processes, and student views were addressed within the context of the ITMDC, the findings can provide insights for teachers who want to support PMTs' development in teaching and assessment. More importantly, this study can offer an example for future research aiming to investigate the design of a lesson in which instructional rubrics would be actively used, implementation stages of the lesson, and the development of PMTs in relation to the use of instructional rubrics.

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