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Teachers' Awareness and Perceived Effectiveness of Instructional Activities in Relation to the Allocation of Time in the Classroom

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ABSTRACT: The current study examined the time spent in various types of science instruction with regard to teachers' awareness of instructional activities. The perceived effectiveness of instructional activities in relation to the allocation of time was also examined. A total of 30 4th grade teachers (17 female, 13 male), from seven different primary schools, participated in the study. First, the teachers completed a questionnaire regarding student-centred and teacher-centred activities and their effectiveness. Subsequently, classrooms were videotaped during a 40-minute science lesson. The videos were coded for the type and duration of instruction and analysed. During science lessons, teachers misidentified almost half of the activities in the questionnaire as being student-centred, and rated these activities as more effective. Based on classroom observations, the teachers were found to primarily use teacher-centred instruction. Based on the classroom videos, it was found that teachers who were more aware of student-centred activities spent less time on teacher-centred activities. Additionally, teachers who found teacher-centred activities more effective tended to spend more time on teacher-centred activities and thus less time on student-centred activities and orientation.

KEY WORDS: Instructional time, student-centred, teacher-centred primary science, teacher awareness.

INTRODUCTION

Instructional time has attracted interest as an important school resource (Baker, Fabrega, Galindo, & Mishook, 2004). Research shows that time devoted to a subject-specific instruction is positively related to student achievement (Coates, 2003; Connor, Son, Hindman, & Morrison, 2005;

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Connor, Morrison, & Katch, 2004; Smith, 2000). Even though instructional time is often intertwined with the content and quality of lessons, it has become a focus of studies on school effectiveness (Lee, Smith & Croninger, 1997; Yair, 2000).

Several factors affect how teachers allocate instructional time in classrooms. Among these are, teachers' views of learning and teaching (Crawford, 2007), class size (Rice, 1999), resources, administrative support, student demographics (Lee & Houseal, 2003), and standardised testing (Marx & Harris, 2006; West, 2007). Teachers' views of learning and teaching are shown to be important predictors of classroom behavior (Haney, Lumpe, & Czerniak, 2002; Levitt, 2001; Pajares, 1992). Crawford (2007) described these views as the combination of teachers' knowledge and beliefs of scientific inquiry and the way children learn science.

Recent science education reform encourages teachers to shift their pedagogical practices from traditional teacher-centred instruction, such as textbook-based lectures with an emphasis on scientific facts, to student-centred, inquiry-oriented approaches that provide opportunities for problem solving and active participation by students (National Academy of Sciences, 2006; National Research Council, 1996). Minner and colleagues (2010), in an analysis of 138 studies, reported that science teaching strategies, which actively engage students, are more likely to increase understanding compared to more passive strategies. Von Secker (2002) reported that student-centred practices not only promote achievement for all students, but also reduce the gap among students with different demographics.

The move towards inquiry-based teaching focuses on students' prior knowledge and experiences, active construction of knowledge and social interaction (Marx & Harris, 2006). There are numerous studies that signify the importance of student-centred, inquiry-based strategies for improved student achievement (i.e. Lee, Deaktor, Hart, Cuevas, & Enders, 2006; Paris, Yambor, & Packard, 1998; Randler & Hulde, 2007; Schneider, Krajcik, Marx & Soloway, 2002).

Despite the introduction of such reforms, teaching practices still appear to be highly teacher-centred at all levels of schooling (Toh, Ho, Chew, & Riley II, 2004). Most teachers have limited knowledge of what student-centred science teaching is and are reluctant to implement it in their classrooms (Johnson, 2006). Due to the incomplete understanding of scientific processes, teachers do not know how to teach student-centred lessons (Anderson, 2002). In a large scale "Inside the Classroom" study, researchers found that only 35% of science lessons were student-centred, wherein students were engaged with the relevant scientific ideas. In the majority of lessons, teacher-centred practices were prevalent wherein students were passive (Weiss, Pasley, Smith, Banilower, & Heck, 2003).

In student-centred classrooms, instruction can be given to individuals or small groups and students and the teacher determine the direction of the lesson together. Students talk about the subject matter as much as the teacher. A variety of instructional materials is used by students, which allow them to roam around freely. Knowledge is constructed by learners, guided by the teacher (Toh, Ho, Chew, & Riley II, 2003). These classrooms motivate students to learn and enhance their confidence (Mumba, Banda, Chabalengula, & Dolenc, 2015).

Fullan and colleagues (2006) described classroom instruction as a ‘black box’ that needs to be examined more closely. How teachers allocate instructional time in classrooms is very critical (Fisher, 2009). The 2005 NAEP teacher survey in the US found that at the fourth grade level, one-third of science lessons included students reading from a science textbook with only about 25% included students doing hands-on activities. Another survey in 2000 showed that about one-third of instructional time in grades K-12 is spent on whole class lecture/discussion. Time spent in hands-on/laboratory activities was 30% in grades K-4, 24 percent in grades 5-8, and 22 percent in grades 9-12 (Banilower, Cohen, Pasley, & Weiss, 2010). However, these findings were based on survey data. In these types of studies, teachers may not reliably report the actual time they spend in particular practices (Mayer, 1999). Classroom observation is considered a more reliable source of obtaining data on instructional practices. Yet there are few observational studies drawing conclusions about classroom instruction undertaken by teachers, or allocate instruction time. This study aims to obtain reliable results, through classroom observation, indicating how primary teachers allocate time to science instruction. Furthermore, as investigating teachers’ views related to reform-based teaching is important as key components in delivering an effective instruction (Keys & Bryan, 2001). The current study thus focuses on time spent on various types of classroom instruction with regard to teachers’ awareness of instructional activities. The perceived effectiveness of student-centred and teacher-centred activities in relation to the allocation of time is also examined.

Research Questions

1. How much time is spent on various types of classroom instruction in primary science classrooms?
2. Is there any difference between the effectiveness scores of instructional activities rated by primary teachers?
3. Is there any relationship between teachers’ awareness of instructional activities and the time spent in various types of classroom instruction?
4. Is there any relationship between the effectiveness of instructional activities perceived by teachers and the time spent in various types of classroom instruction?

METHODOLOGY

The current descriptive study examines the relationship between primary teachers' perceptions of student-centred and teacher-centred science activities and their science instruction. Figure 1 represents the study variables and the relations that were examined.

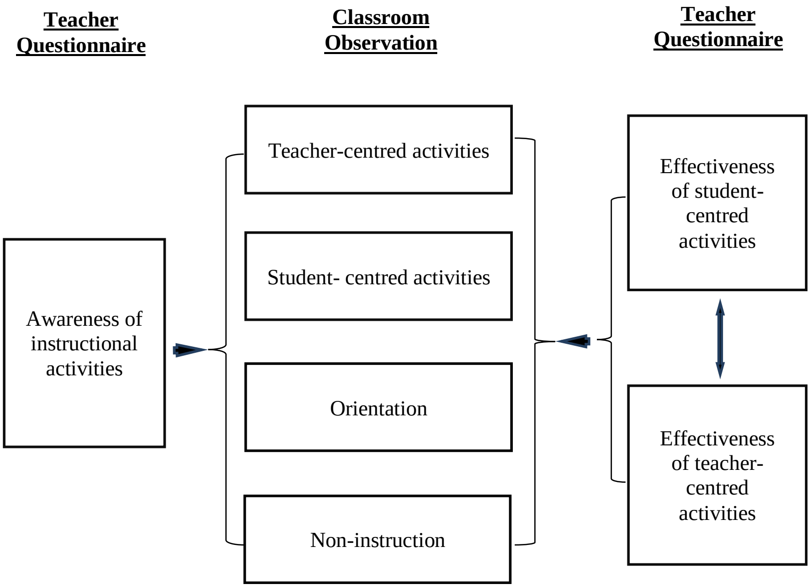

Figure 1 **Research Variables**

Participants

This study was part of a larger study on classroom discourse conducted in a North-western province of Turkey. The participants were 30 4th grade teachers from seven different primary schools. The study began with 31 teachers, although one teacher did not complete the questionnaire and was excluded from the study. There were 17 female and 13 male teachers with teaching experience ranging from 7 to 34 years. All schools were public schools in the city-centre with average class size of 28 students. After teachers filled out a questionnaire regarding student-centred and teacher-centred science activities and their effectiveness, their classrooms were videotaped during a 40-minute science lesson.

Data Collection

Data were collected during the fall semester of 2012-2013 academic year. Teacher questionnaires and classroom observations provided both the quantitative and qualitative data for this study.

Teacher Questionnaire

A two-tier teacher questionnaire was developed by the researchers, which aimed to measure the teacher awareness of student-centred and teacher-centred science activities and their self-determined effectiveness level. The instrument included 10 examples of student-centred activities and 10 of teacher-centred activities. In completing the questionnaire, teachers were first asked whether the activity, in their opinion, was student- or teacher-centred. The second tier of each item required teachers to rate the effectiveness of activities in science classrooms.

The validity of the items was determined by two university professors teaching science education programs Reliability of the first part was computed using the KR-20 reliability coefficient since these 20 items were dichotomous (1 for correct match; 0 for incorrect match). The KR-20 value was found to be 0.70 and was considered adequate for the study.

Teachers received an awareness of instructional activities score based on their responses to the first part of the questionnaire. The highest possible score on this part was 20. Some examples of the activities presented to teachers were as indicated in Table 1.

Table 1 Sample Activities Presented in Teacher Questionnaire

Activity	Student-cent.	Teacher-cent.
• Teacher calls on students who raise their hands to answer end of unit questions.		X
• Teacher hands over various objects to students and asks them to describe these objects by using their five senses.	X	
• Teacher asks a student to read the text out loud.		X
• Teacher asks students to predict the result of an experiment.	X	
• Teacher asks students to draw a microscopic image in their notebooks.		X
• Teacher takes the students to the school-yard and asks them to find and list living and non-living things.	X	

In the second part of the questionnaire, teachers rated the effectiveness of each activity on a 5-point scale. The effectiveness scores of student-centred activities and for activities that were teacher-centred were computed separately. Accordingly, the highest possible score for each group of activities was 50. Reliability was determined using Cronbach's Alpha since the items in this part of the questionnaire were in a Likert scale format. Accordingly, the Cronbach's Alpha value was 0.88, which indicates a high level of reliability.

Classroom Observation

Classroom observations were conducted by means of video recording. The research permission was received from the Ministry of Education and video recording dates were previously scheduled with the teachers. It was assumed that the teachers made special preparation for these lessons. The lessons were recorded by two professionals using wide angle cameras, so that all students could be observed as well as the teacher in each classroom. Video recordings were completed in two weeks and their duration ranged from 35 to 40 minutes.

All teachers taught the same topic - *Properties of Solids, Liquids, and Gases* within the unit *Matter*, specified by the national curriculum in this two-week period. The schools participated in the study used the same science textbook for 4^{th} grade.

Data Coding

A coding template for classroom videos was developed by the researchers. For this process, two of the actual classroom videos were coded in the presence of four researchers. The researchers discussed the types of instruction in the light of literature reviews and reached a common agreement. Then, the rest of the videos were shared among researchers and coded independently. Disagreements were discussed and clarified during weekly meetings. For inter-rater reliability, two videos were selected randomly and coded by each of the researchers. Total agreement on types of instruction was computed in percentages and as a Cohen's Kappa statistic. The average coding consistency was 87%, while the average Cohen's Kappa value was 0.80.

A three-second rule was used when coding videos. Activities that lasted less than three seconds were not coded. Six types of instruction were coded for all 30 lessons. The start and end time of each activity was recorded and the cumulative durations were calculated for each type of instruction. The types of instruction used are described below.

Teacher-centred Activities

Activities those were strictly directed by the teachers, such as lectures where talking was carried out, mostly by the teacher about subject matter, with very little or no participation of students, were coded as 'teacher-centred activity.' Activities where the teacher conducts an experiment or performs a hands-on activity before the class and simultaneously explains what she is doing (demonstration-lecture), or activities where teacher asks questions and students give answers orally or written for an extended period (questioning), or worksheet activities and games that involved asking questions by teacher were also included in this category.

Student-centred Activities

Activities where all or most students were actively involved, such as hands-on activities, group discussions, brainstorming, creative writing and peer learning were coded as 'student-centred activities.' When hands-on activities were carried out by an individual student, or group of students, before the whole class as a demonstration, the activity was coded as 'teacher-centred,' since the students were actually playing the teacher's role without any input from themselves.

Orientation

Teacher's directions about how to do an activity were coded as 'orientation.' Orientation could be on how to do a hands-on activity, how to complete a worksheet, or how to clean up and get ready for the next activity.

Non-instruction

Activities that did not include any academic content were coded as 'non-instruction.' Examples in this category were interruption of the lesson by a disruptive behaviour, or an extended amount of waiting.

Data Analysis

For data analysis, descriptive statistics, paired sample t-test and bivariate correlational analysis were conducted using SPSS 18. The effectiveness scores of student- and teacher-centred activities, rated by primary teachers, were compared through paired sample t-tests. The time spent on various types of classroom instruction in science, related to the teachers' awareness of instructional activities and effectiveness scores, were examined through bivariate correlation analysis.

RESULTS

The first research question seeks to answer how much time is spent on various types of classroom instruction in primary science classrooms. Table 2 shows that teachers in this study spent approximately 70% of instructional time on teacher-centred activities namely, lecture, demonstration-lecture, questioning, etc. Student-centred activities (11.6%) constituted as much time as non-instruction (11.8%). Finally, about 7% of instructional time is spent in orientation.

Table 2 Descriptive Statistics of Different Types of Instruction

	Min	Max	Mean (mins)	SD	%
Teacher-centred Ins.	6.8	32.3	23.9	6.8	69.3
Student-centred Ins.	0	13.2	4.0	4.7	11.6
Orientation	0	6.0	2.5	1.43	7.4
Non-Instruction	0.1	9.3	4.1	2.3	11.8
Total			34.46		100

Table 3 shows the descriptive statistics for teachers' awareness score of instructional activities, and effectiveness scores of these activities. Accordingly, teachers receive an average awareness score of 10.9 out of 20. Their average effectiveness score for the student-centred activities is 43.1 and the average effectiveness score for the teacher-centred activities is 41.5 out of 50.

Table 3 Descriptive Statistics of Awareness and Effectiveness Scores

	N	Mean	SD
Awareness of Instructional Activities	30	10.9	1.7
Effectiveness of Student-centred Activities	30	43.1	5.2
Effectiveness of Teacher-centred Activities	30	41.5	4.9

In order to examine whether there was any difference between the effectiveness of student-centred and teacher-centred activities according to teachers, which addresses the second research question, paired sample t-tests were conducted. The total effectiveness score of 30 teachers for student-centred activities was compared with the total effectiveness score for teacher-centred activities (see Table 4). Results showed that teachers rated student-centred activities significantly more effective than teacher-centred activities ($t = 2.15$, $p = 0.04$).

Table 4 Results of Paired Samples t-test.

	N	Mean	SD	df	t	p
Effectiveness of Student-centred Activities	30	43.1	5.2	29	2.2	0.04*
Effectiveness of Teacher-centred Activities	30	41.5	4.9			

*p < 0.05

The third research question examined the relationship between teachers' awareness of instructional activities and the time spent in various types of classroom instruction. Based on the questionnaire data, teachers were evaluated on their awareness of instructional activities. Their awareness scores were examined in relation to the use of time. Table 5 shows the bivariate correlation analysis results between the awareness scores and the time spent in various types of classroom instruction. Accordingly, as teachers' awareness score increased they spent less time in teacher-centred activities ($r = -0.488$) and more time in student-centred activities ($r = 0.60$). The correlation coefficients were significant at $\alpha = 0.01$ level.

Table 5 Results of Bivariate Correlation Analysis

	Teacher-centred Instruction	Student-centred Instruction	Orientation	Non-instruction
Awareness of Instructional Activities	-0.49**	0.60**	0.14	-0.01
Effectiveness of Student-centred Activities	0.24	-0.21	-0.20	-0.06
Effectiveness of Teacher-centred Activities	0.45*	-0.43*	-0.36*	-0.01

*p < 0.05, **p < 0.01

Finally, the fourth research question examined the relationship between the effectiveness of student-centred and teacher-centred activities perceived by teachers and the time spent in various types of classroom instruction. There were no significant correlations between the effectiveness of student-centred activities perceived by teachers and the use of instructional time. However, there were some significant correlations for teacher-centred activities. Teachers who perceived teacher-centred activities as more effective tended to spend more time in teacher-centred activities (r = 0.446) and less time in student-centred activities (r = -0.427) and orientation (r = -0.362). The correlation coefficients were significant at the $\alpha = 0.05$ level.

DISCUSSION AND CONCLUSION

This study was limited to 30 science classrooms from seven primary schools. Accordingly, the findings should be considered carefully before being generalized to all primary schools. However, findings from the classroom observations were consistent with previous studies that science teachers primarily use teacher-centred instruction in classrooms (Brown & Melear, 2006; Ogan-Bekiroglu & Akkoç, 2009; Uzuntiryaki, Boz, Kirbulut, & Bektas, 2010; Waight & Abd-El-Khalick, 2011).

Before the classroom observations, teachers answered a questionnaire that examined their perception of instructional activities. First, teachers were presented with specific science activities and were asked whether they were student- or teacher-centred. Then, they were asked to rate how effective each activity was in their science classrooms. Although teachers misidentified almost half of the activities, they rated those they considered as student-centred activities as more effective.

When classroom videos were observed, teachers' awareness of instructional activities was significantly related to their classroom behaviour. Teachers who were more aware of the instructional activities spent less time on teacher-centred activities and more time on student-centred activities. This observation indicated that when teachers lacked the necessary knowledge base about student-centred, inquiry activities, they might have problems in implementing this type of science activities in their classrooms. As Crawford (2007) indicated, teachers' knowledge of subject matter and pedagogical strategies in science teaching influenced how they structured their lessons and how they responded to student's queries.

Another finding was that teachers who rated teacher-centred activities as more effective tended to spend more time on teacher-centred activities, thus spending less time on student-centred activities and orientation. There was no relationship between the effectiveness of student-centred activities and time spent on various types of classroom instruction. It might be the case that even though teachers agreed upon the effectiveness of student-centred activities, they might not be implementing them in their classrooms. Another possible explanation might be the ceiling effect. The effectiveness scores of the student-centred activities were already very high and this might have caused deflation in the correlations.

Even though teachers regarded student-centred activities as more effective, it was evident in our study that they spent little time in this type of activity. Research indicated that teachers usually focused on classroom management and student involvement rather than integrating theory and practice in their teaching (Blumenfeld, Krajcik, Marx, & Soloway, 1994.) Therefore, teachers should be shown successful classroom implications of student-centred, inquiry-based activities so that this type of instruction could become more feasible in their minds (Crawford, 2007).

Professional development can be an effective tool in changing teachers' attitudes towards student-centred instruction as well as classroom practices (Kennedy, Smith, & Sexton, 2015; Supovitz, Mayer, & Kahle, 2000). Improving teachers' pedagogical content knowledge, which has been receiving increasing attention in recent years, helps them in deepening their understanding of the content and improving their instruction (Banilower et al., 2010). When planning for professional development in student-centred science teaching, it is important to focus on practical applications. Therefore, videos can be utilised to provide opportunities for teachers to reflect on classroom events (Borko, Jacobs, Eiteljorg, & Pittman, 2008; Lebak & Tinsley, 2010; Sherin & van Es, 2009). They help teachers to evaluate instructional techniques and the level of student engagement. They can also help observe the development of practice over the course of a period (Lebak & Tinsley, 2010). However, Johnson (2006) indicated that even with rich effective professional development, teachers may still encounter difficulties in implementing student-centred science in their classrooms. Administrative support and enriched resources are also needed (Johnson, 2006).

Researchers highlight the importance of collaboration among partners (Crawford, 2007; Feldman, Chapman, Vernaza-Hernández, Ozalp, & Alshehri, 2013; Marx et al., 2004). Researchers, teachers and administrators can collectively participate in projects geared towards using scientific inquiry effectively in classrooms and understanding the strengths and constraints associated with student-centred instruction. Finally, it is recommended that teacher educators model the design of student-centred science lessons in their method courses, even though the real world classrooms may be much different from the theoretical settings (Crawford, 2007).

Limitations

The main limitation of this study was that the sampling of each classroom was undertaken only once. The goal of this study was to reach as many classrooms as possible in order to examine the trends in primary science teaching. The types and durations of activities might be content specific and might not represent the general trend in each classroom. The goal was to obtain the broadest range of teachers in a single subject area. Repetition of sampling of a particular set of classrooms was sacrificed for sampling of an increased numbers of different classrooms.

Another limitation was that the teachers and students in the classrooms might not have behaved naturally due to the observer effect. This was noted as the main limitation in all observation studies (Daymon & Holloway, 2011). During a video recording, participants might be more anxious about the camera. This anxiety might be reduced by fixing the camera in one place rather than moving it around (Hancock, Ockleford, & Windridge, 2009). This procedure was employed in the present study.

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