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Interaction between Students' Motivation and Physics Teachers' Characteristics: Multiple Case Study


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Abstract

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Keywords

Physics Education, Teacher Characteristics, Student Motivation, Multi-Case Study, Situated Motivation

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Interaction between Students' Motivation and Physics Teachers' Characteristics: Multiple Case Study

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This study identified the process of interaction between students' motivation and characteristics of two physics teachers: one who exhibited effective physics teacher characteristics frequently and one who exhibited the characteristics rarely. The two case teachers were selected to predict contrasting and comparable results. The data gathered from the semi-structured interviews, follow-up interviews, direct observation, video recordings, and field notes were analyzed both by single case and by cross-case analysis to strengthen the findings from two case teachers. Findings indicated that teachers' characteristics like enthusiasm and giving examples from daily life increased students' motivation by increasing their attention and willingness to participate in the classroom discussion. Even though a teacher frequently exhibited the effective characteristics by providing every opportunity for their learning, students wanted a classroom environment where they could stay calm and be more passive. The students did not like to be constantly forced by the teacher to share their views. In the lesson of a teacher who rarely exhibited the effective characteristics, students demanded a classroom environment where they could be more active. The students were not satisfied when their teacher avoided asking questions or had difficulty in solving the problems. Students, in general, resisted the teacher's behaviors or characteristics when the teachers exhibited inconsistent behaviors. Keywords: Physics Education, Teacher Characteristics, Student Motivation, Multi-Case Study, Situated Motivation

Introduction

From the beginning of the 1990s, psychologists have referred to the influence of motivational elements on students' learning process as well as their cognitive development (Fischer & Horstendahl, 1997). Teachers' beliefs, perceptions, actions, attitudes, and interests toward science teaching, teaching techniques, and teaching behaviors in classroom practice are teachers' characteristics that affect students' motivation and learning (Fives, 2003; Opendakker & Damme, 2006). Therefore, students with high motivation to learn are likely to take care of their education, engage in any activities, and try to learn the concepts (Brophy, 2010; Saleh, 2014). When students have a lack of motivation there can also be a lack of intention and satisfaction, and this lack of motivation results in a decrease in their achievement (Brophy, 2010; Gagne & Deci, 2005; Sweet & Guthrie, 1996).

The motivation of students is one of the paramount factors that affect the learning process. If teachers give suitable feedback to the students on their level, initiate students' interest, make them understand the importance of the content, and have students share their ideas in classroom discussions, then the students' motivation increases as well as their

achievement (Glynn & Koballa, 2006; Smith & Schmidt, 2012). Therefore, possessing effective teacher characteristics is one of the crucial parameters that teachers exhibit to empower students to learn the course (Çakmak & Akkutay, 2016). Studies exploring the motivational outcomes should be conducted in the classroom setting where learners participate in the activities as indicated in a situated learning paradigm (Järvelä, Järvenoja, & Malmberg, 2012).

Fischer and Horstendahl (1997) indicated that observation of the learning process might help to recognize the relation between motivation and physics learning. They implied that analysis of a behavior or mode of expression either verbally or by gesture, was crucial to clarify the motivational constructs. In Turkey, high school students have generally negative views on physics learning (Dogan, Oruncak, & Gunbayi, 2002). Furthermore, in a large-scale study by Korur and Eryılmaz (2015) to gather the participants' views on physics teachers' characteristics in classroom environments in high schools of Turkey, almost half of the participants had negative views about their physics teachers in terms of motivating them to learn physics.

Many countries have been trying to develop their national framework of professional standards for teachers, including their qualifications and characteristics. There might be various reasons to establish these frameworks such as seeking to improve the quality of teachers, evaluating them, and just providing some guidance for administrators and academicians who monitor candidate's qualifications to teach subjects, for instance, physics. The primary common conclusion that can be drawn from the published reports is that teachers are accepted as the best motivators and teachers' characteristics are one of the crucial factors affecting students' learning and motivation (American Association of Physics Teachers, 2009; Australian Institute for Teaching and School Leadership, 2011; Milli Eğitim Bakanlığı, 2017; Organisation for Economic Co-operation and Development, 2013).

The most important outcome, actually, for such reports or studies is revealing the situations in classroom applications. Therefore, they are mainly aimed at analyzing how effective characteristics affect students' motivation and finding out the students' reactions and teacher-student interactions when teachers exhibit those characteristics. Furthermore, in defining effective teaching, Brophy (2010) implied that it should include complementary elements such as classroom management, curriculum, instructional features, and motivational strategies to support each other. Brophy described the situation by considering two teachers who were well-behaved in communicating to students but had varying motivational principles for students to learn (Brophy, 2010, pp. 35-40). While similar curricula, similar class routines, even similar student orientations, and the same course and learning activities were being planned, the classroom motivation outputs were very different. Because the teachers' motivational approaches can create contrary learning contexts in students, the motivational strategies of physics teachers and motivational reactions from their students have emerged as issues that need to be investigated.

In this study the characteristics of two physics teachers, one who exhibited effective teacher characteristics frequently and one who exhibited effective teacher characteristics rarely and sometimes negatively, were crucial to compare for the motivational outcomes of the students. Observing the courses of the teachers would give a chance to compare students' motivational outcomes with respect to both teachers. The results of this study were enriched regardless of whether a student's motivation increased or decreased because it was the relationship to the frequency of whether the teacher exhibited certain characteristics rarely or frequently. The effective physics teacher's characteristics were determined in a previous study by Korur and Eryılmaz (2012) and a natural extension was to investigate and to compare the motivational outcomes of students in a classroom environment where teachers frequently or rarely exhibited these characteristics. The teachers were selected based on

qualitative and quantitative sources of evidence, and the classroom observations, students' and teachers' interviews were made repeatedly over time. More specifically, this study attempted to answer the research questions below.

- (1) How does exhibiting the effective physics teacher characteristics frequently with students affect their motivation in physics classes?
- (2) How does exhibiting the effective physics teacher characteristics less frequently with students affect their motivation in physics classes?

Background

In the past, the general view that is unacceptable today was that motivation did not directly affect cognitive structure. Some paradigmatic changes in education explained the learning of students through constructivist educational research. These changes are cumulative and based on pre-existing situations thereby directing positive activities of teachers. However, in the school environment where the students spend most of the day, the interest of the social circle directly influences them. Even when the students are intrinsically motivated to learn, they tend to be more autonomous since instead of realizing the goals of the curriculum, they usually seek ways to appeal to their personal curiosity. It is difficult to create intrinsic motivation in class environment because first, it is compulsory for the students to continue the middle and secondary school education and it is controversial whether they all would prefer this if they were asked for their views. Second, teachers usually have to teach more than 20 students and meet their educational needs. For these reasons, it is quite possible that some of the students get distracted from the subject that is being taught. Third, classes are social circles. For this reason, failures of students often lead to not only personal frustration but also public embarrassment. Fourth, after students' performance or assignments on a course are graded, the school or performance reports are sent to their parents (Brophy, 2010). For these reasons, there is not a single factor that affects the motivation, attention, and focus of a student in a classroom. So students' motivation may be externally influenced by the curriculum, their grades, their parents' expectation of success, and their relationship with their friends. They also feel external control, so intrinsic and extrinsic motivation are not completely independent of each other (Deci & Ryan, 1985; Dörnyei, 2000). The main role of a teacher is to concentrate on helping students to accomplish curricular goals (Brophy, 2010, p. 11). On the other hand, it is also necessary to admit that the teachers, who put social interaction by exhibiting pedagogical and management characteristics in the classroom are indispensable to students' motivation. It is not always possible to motivate the whole class or to provide experiences that are enjoyable. If for some students, the influence of the factors other than the effective characteristics that a teacher exhibits is in the foreground, it will not be possible for the teacher to motivate them.

There are positive attempts to explain students' motivational constructs and effective teacher characteristics, but there is still a need to respond to the question, "How is student motivation affected by the frequency of exhibiting the effective characteristics of physics teachers?"

Theories of Motivation

Glynn and Koballa (2006) defined motivation as "an internal state that arouses, directs, and sustains students' behavior" (p. 25). Students' motivation can also be defined as "students' subjective experiences, especially those connected to their willingness to engage in learning activities and their reasons for doing so" (Brophy, 2010, p. 3). As McKeachie (1999)

discussed, teachers' enthusiasm in teaching and their concern about students' learning are obviously crucial motivators for students. Students' motivation can be improved directly by the teachers' willingness to construct teaching methods that support meaningful learning activities (Tuan, Chin, & Tsai, 2003). There is no single motivational outcome for students when the teacher exhibits a characteristic. Therefore, the motivational theories gained importance in terms of explaining the role of the teachers' characteristics on students' motivation (Brophy, 2010): (a) offering a mark to students who, for example, complete extra work for the extrinsic motivation (Brophy, 2010; Deci & Ryan, 1985); (b) encouraging students to ask questions without humiliation and willingly share their ideas and gain autonomy through intrinsic motivation or self-determination theory (Deci & Ryan, 1985; Gagne & Deci, 2005; Glynn & Koballa, 2006; Glynn, Taasobshirazi, & Brickman, 2009; Sweet & Guthrie, 1996); (c) arranging the task difficulty so they recall the knowledge and increase their self-confidence—attribution theory (Heider, 1958); (d) creating a competitive classroom climate that increases their interest and maintain attention to the subject and set goals (Locke & Latham, 2006); and (e) gaining their attention by doing experiments or using media to help them enjoy what they are doing and feel satisfied according to the Attention, Relevance, Confidence and Satisfaction (ARCS) model (Keller, 1983).

Classroom observations made in the light of these motivation theories will preliminarily suggest that they are not mathematical equations. In other words, the student may not show the expected motivational outcome in response to any characteristics that the teacher has exhibited (Korur, 2008). So, students have developed different motivational outcomes depending on their teachers' attitudes and characteristics they exhibited or depending on the frequency of exhibiting them. This can be explained by the situated motivation, which is valuable to explain the increase or decrease in students' motivation with respect to the situational conditions (Paris & Turner, 1994; Rannikmae, Teppo, & Holbrook, 2010). This motivation is stated as "situated" since "it is a result of cognitive appraisal that a student provides in a specific situation," "it is open to alteration by virtue of age, bias and defensive interpretation," "students create unique cognitive understanding of events and goals in different circumstances," and "it is mainly not stable" (Paris & Turner, 1994, pp. 222-227). When physics teachers exhibit their characteristics, the motivational responses of the students are completely unique to that situation. Although there are multiple motivational features explaining this phenomenon, it is appropriate to use a motivational theory to reflect the contextual situation. For these reasons, it becomes inevitable to analyze the students' motivational outcomes in terms of situated motivation in general.

Effective Physics Teacher Characteristics

In general, beginners in a physics course mostly have negative feelings towards physics, since they frequently have heard that physics is a very difficult subject (Lyons, 2006; Osborne, Simon, & Collins, 2003). Physics teachers' "undesired behaviors" (e.g., lack of readiness for the topic) and "lack of enthusiasm to teach" affected students' motivation negatively (Bayar & Kerns, 2015). On the other hand, enthusiastic teaching in physics instruction shows a positive relationship with students' interest (Keller, Neumann, & Fischer, 2014). Teachers can generate environments to enhance learning including a variety of tasks and activities. However, Paris and Turner (1994) indicated that for continuous motivation in the class activities, the key concepts of situated motivation are students' choices, challenges, control, and collaboration. Therefore, teachers' characteristics that support these aspects of motivation develop students' ownership, responsibility, and self-regulated learning. Students are less likely to capture effective learning strategies, seek help, or reflect knowledge when external motives such as grades on a test are provided or when they are based on the least

effort in a situation. Therefore, physics teachers' characteristics or behaviors have an effect on students' motivation and analysis of teachers' behaviors is crucial to interpret the actual classroom interactions between a teacher and students (Keller et al., 2014).

Effective teaching basically represents a process of transferring scientific knowledge, including experiments and in-class activities, to support their students' style of knowledge construction and to promote their learning and motivation (Aiello-Nicosia & Sperandio-Mineo, 2000; Kelly & Staver, 2005; Sperandio-Mineo, Fazio, & Tarantino, 2006). To date, the positive effects of teachers' characteristics on students' achievement and motivation have been analyzed across many different aspects, such as teacher preparation (Darling-Hammond, Chung, & Frelow, 2002; Korur & Eryilmaz, 2012); career plans (Ronfeldt, Reininger, & Kwok, 2013); pedagogical knowledge (Lederman, Ges-Newsome, & Latz, 1994); subject matter knowledge (Sperandio-Mineo et al., 2006); interactional behavior between teachers and students (Wubbels, Tartwijk, & Brekelmans, 1995); classroom management behavior and attitudes towards the discipline (Opdenakker & Damme, 2006); and answering students' questions related to physics, lecturing reluctantly, coming to the lesson prepared, being interested in some students more than the whole class, and giving lectures with appropriate details (Korur & Eryilmaz, 2009; 2012).

A qualitative study carried out by Witcher et al. (2003) used multi-stage concurrent mixed-methodological analysis to examine students' perceptions of the characteristics of effective college teachers. The students were administered a questionnaire asking them to identify, rank, and define three to six characteristics that they considered excellent college instructors possessed or demonstrated. The analysis of the data was carried out with a sequential qualitative-quantitative mixed analysis. Witcher et al. (2003) found that the application of student-centered methods in the class, possessing subject matter knowledge, humor in the class, being enthusiastic about teaching, and fair and respectful behaviors were shown to be the characteristics of effective teachers.

Alkhayyatt (2000) aimed to investigate students' perceptions of teaching characteristics of good teachers and to investigate the influence of those characteristics on students' motivation to learn through observations and interviews. Alkhayyatt involved only one teacher as the case teacher according to his relationship, beliefs of the school principal, views of the other teachers, and views of the students in the school. The six students of the case teacher were also included into the study. The interviews were carried out for seven weeks and they were taped. In the seven observations that Alkhayyatt conducted, he observed the interactions between the case teacher and the students without interrelating to the class. He divided the data into themes and analyzed those themes for each research question. Alkhayyatt showed that teachers' characteristics like enthusiasm, subject matter knowledge, and preparation for the lesson, use of examples, and use of experiments were the main characteristics of the teacher that influenced students' motivation. Moreover, according to the students' perceptions, teachers' characteristics like caring, humor in the class, organizing valuable activities, answering students' questions, and subject matter knowledge were the effective teacher characteristics regarding students' motivation to learn. In the present study, the physics lessons of two teachers were analyzed to determine the effects of teachers' characteristics on students' motivation by using a qualitative methodology, especially observing the interactions between teachers and their students' motivation.

The Effective Teacher Identification Questionnaire (ETIQ)

The Effective Teacher Identification Questionnaire was first developed by Korur (2008) to meet a criterion to select teachers who have effective physics teacher characteristics. Validity and reliability were established by Korur and the questionnaire

includes 38 items, a sample of which given in Figure 1. Teachers were asked to fill in a five-point Likert type scale and support their answers with examples from some of their applications in class activities. It was first administered to 51 physics teachers in Ankara, Turkey. The questionnaire was prepared to measure how often the teachers exhibited the characteristics in their physics classes.

EFFECTIVE PHYSICS TEACHER CHARACTERISTICS		No/Never	Rarely	Often	Frequently	Yes/Always
21. [I do demo experiments in the class.]	[Could you give examples? How often and for what subjects?]					
22. [I make the physics lesson interesting by giving examples from daily life.]	[Could you give an example?]					

Figure 1. Structure of the ETIQ

After teachers had completed the ETIQ, the researcher explained the aim of the study. Then 33 teachers voluntarily participated in the interviews. During the informal interviews, the teachers were asked about the examples that they had written in the questionnaire. I also contacted the principals, vice principals of the schools where those teachers worked and especially the students of the teachers in order to gather their views related to the teachers regarding those characteristics. They guided me in the selection process of the case teachers. Most of the teachers at this stage indicated that they would find it difficult, for various reasons, to participate in such a long study so that they were eliminated.

The items in the ETIQ were evaluated with respect to the five-point Likert type scale (from Yes/Always as 4 to No/Never as 0). The teachers having higher scores from the ETIQ indicated that they possessed and exhibited the characteristics frequently and those having lower scores represented that they possessed the characteristics, but they exhibited them rarely or negatively in their classroom experiences. For example, some of the teachers declared that doing experiments in the physics lessons increased students' motivation. However, they stated that they could not find enough time for laboratory sessions or even that they did not know how to carry out an experiment for most of the concepts in physics. I contacted all of the teachers and some of their students and I initialized informal interviews to identify whether they really possessed those characteristics and they frequently used those characteristics in the classroom. The interviews and the findings from the ETIQ provided an appropriate amount of data to select the teachers. Therefore, a total of 10 physics teachers, who scored between 92 (with one negatively) and 47 (with 16 negatively) from the ETIQ, were selected.

Methodology

The Researchers

Both of the authors of this study are from Turkey and have been studying in the field of physics education for years. As the first and corresponding author of this study, I studied students' perceptions with one of the largest samples in Turkey with 2177 students about the

effects of their physics teachers' characteristics on their achievement, motivation, and attitude, for my MS thesis 15 years ago. During my PhD, I wondered how physics teachers exhibited the effective characteristics that they possessed and how students responded motivationally to those behaviors. I am acquainted with the reactions, perceptions, and feelings of the students related to teachers' characteristics. Furthermore, through interviews, observations, and research journals, I enriched my knowledge about effective physics teacher characteristics and the effects of teachers' characteristics on students' achievement and motivation. This study was structured by this idea and it was produced from the qualitative part of the doctoral dissertation written by the first author. The second author was the supervisor of these studies and we both have studied in this field for years. He was a member of a committee who prepared the first framework of physics teachers' qualifications in Turkey.

Research Design

When observing the course of a teacher who rarely exhibits effective characteristics, there would be a chance to compare students' motivational outcomes with respect to the other teacher who frequently exhibits the effective characteristics. In this particular study, a multiple case-holistic design was utilized (Bogdan & Biklen, 1998; Yin, 2009). The key feature of multiple case-holistic design is to collect data separately from the cases related to the same research problem and then to compare the results to find out whether a student's motivation increases or decreases related to the teacher exhibiting certain characteristics rarely or frequently (Yin, 2009). In fact, conducting observations with two teachers was chosen since the frequencies of exhibiting effective characteristics were integrated and compared to draw general conclusions from the details of applications of both teachers (Yıldırım & Şimşek, 2016). Multiple-case study is used "to build a general explanation that fits each individual case, even though the cases will vary in details" (Yin, 2009, p. 142).

At first, data were collected from two physics teachers by using the same types of measuring tools such as observation checklists or interview forms, and then they were analyzed with similar analytic technique for both teachers. The findings were compared and generalized to the theory simultaneously. Therefore, the qualitative interpretations of this study were related to students' motivational outcomes by utilizing a cross-case analysis for frequency of exhibiting the effective characteristics of two physics teachers.

The Research Planning and Coordinating Committee of the Ministry of National Education reviews proposals, instruments, and checks that the proposed research includes proper informed consent and ensures the safety of the students and teachers involved. They inform the researchers about any possible difficulties and risks that the researchers could face within the research site. To apply the study, a legal permission paper signed by the Minister of National Education was given.

The Participants—The Rationale to Select the Two Case Teachers

In terms of the selection of the case Merriam (1998) stated that researchers should "establish the criteria that will guide case selection and then select a case that meets those criteria" (p. 65). The cases should also be carefully selected to produce contrasting results but for predictable reasons (Miles & Huberman, 1994; Yin, 2009). The teachers of this study should possess effective physics teacher characteristics, but it is crucial to determine whether they exhibit them frequently or rarely in the classroom.

Ten teachers were observed by one of the researchers for two class hours (block or separate) for two weeks in order to decide whether they applied most of the 38 effective

physics teacher characteristics in class activities and whether the interactions in the class provided the necessary data to enable me to generalize the findings to the theory. Therefore, the two teachers were selected from the 10 physics teachers on the basis of the ETIQ test, observations, informal interviews with two of them and their students and school administrators, and their willingness to participate. Teacher 1 (T1) possessed and exhibited effective physics teacher characteristics frequently. She was a physics teacher and seemed very enthusiastic about teaching physics. In the questionnaire, she declared that she frequently used daily life examples and media in physics class. Teacher 2 (T2) possessed the characteristics, but she exhibited them rarely or sometimes negatively. She indicated that she could not exhibit the positive characteristics on all lesson days but mostly she had pleasant interactions with student. They both had been working in a public school and they were almost the same age.

The selection of the students for the interviews was based on the researchers' observations. I tried to include students who were a part of the classroom discussions and had a good interaction with the teacher and also those who stayed passive during the lesson. The students participated in the interviews voluntarily. The grade levels of the students that I observed were the same. The students that I observed were also informed about the study. I declared that any notes, audio tapes, and videotapes that I took from the interviews and observations would be kept confidential and pseudonyms or numbers would be used instead of their names to keep their identities secret. For example, S1-1 denotes the first student of T1 and S2-1 denotes the first student of T2. The interviews were carried out with five students of T1 who were S1-1, S1-2, S1-3, S1-4, and S1-5 and two students of T2 were S2-1 and S2-2.

Field Entry

The researchers were not acquainted with the teachers before the study. As the first author of this study, I met them when I started to administer the questionnaire. The first field entry was not easy. I needed to follow various procedures and obtained an official permission document to carry out the case study in those two public schools. The school principals were informed about the study and they asked to see the permission document. After I had been granted their permission, I informed the teachers again about the study. I got their permission and the first entry to the field took place during the initial observations in the preliminary part of the qualitative study.

At the beginning, it was explained to the teachers and the students that any kind of participation was completely voluntary, and they could withdraw without penalty at any time. In all of the observations, the researchers specifically focused on the observable characteristics of the teachers, teachers' interactions with the students, and students' interactions with their friends, and how effective physics teachers' characteristics and students' motivation affected each other in class.

Data Collection Instruments

Using multiple sources of evidence is crucial for comparing the findings from the different sources in order to understand the events that the researcher has studied (Creswell, 2012). In this study the data collection instruments were (a) open ended interviews, (b) focused interviews, (c) direct observations, (d) descriptive field notes, and (e) visual recordings. Table 1 presents the time duration for these instruments for both teachers.

Table 1.
Data collection instruments and time table.

Time Duration	Hours	Teacher	Sources of Evidence
6 months (11 weeks)	12 class hours (80 mins each)	Teacher 1	Direct Observation Descriptive Field Notes Open-ended interviews Video-recording (5 weeks)
4 months (10 weeks)	10 class hours (80 mins each)	Teacher 2	Direct Observation Descriptive Field Notes Follow-up interviews Second observer (2 weeks)
At the end of the observations	35 mins	Teacher 2 & Two Students	Focused Interviews
	50 mins		
	45 mins 60 mins	Teacher 1 & Five Students	Focused Interviews

Interviews. There were mainly two types of interviews. First, the informal open-ended interviews (follow-up) focused mostly on individual students to find answers regarding the facts of a situation on events which had occurred in the class during the observations. They were carried out by the first author of this study, especially after the observations for T2. When the researcher faced an unusual interaction between students and the teacher, he immediately used open-ended interviews with those students or the teacher during the break. Informal interview data consisted of my jotting down notes and memos from casual conversations between me and individuals or small groups that took place during class and after class. The following is an example from an open-ended interview question:

R: How was your motivation affected by the question of the teacher?

S2-21: The teacher answered the question superficially. I am curious about some questions and sometimes I ask immediately. I think the teacher had difficulty in answering. The response that she gave did not satisfy me. (p. 98)

The focused (semi-structured) interviews that were also open-ended in nature were used to interview all of the participants for a short period of time by following a certain set of questions derived from the study. They were also carried out by the first author of this study. Their students were also interviewed as a group on the same day. I interviewed with the teachers, as Creswell (2012) suggested, by using an Interview Protocol of Teacher1, and an Interview Protocol of Teacher2. The main questions for both protocols were the same, but the sub-questions (the probes) derived from my observations related to the teachers' characteristics and students' motivation. Both protocols included the same seven interview questions derived from the five effective physics teacher characteristics analyzed in this study. There was also a heading, an opening statement, and enough spaces after each question for the reflective notes and interviewer's comments.

The interview with T1 was carried out in her office in the school. She seemed relaxed in her answers. The entire interview with her was audio-taped. A very detailed knowledge about her characteristics and her interactions with students' motivation was gathered during the interview. The interview with T2 was carried out in the staff room of the school. She ignored some of the sub-questions. I contacted her twice to arrange the interview, but she did not accept because of lack of time. On my third attempt she agreed to do it but stated she only had 25 minutes to complete it.

In the students' interviews, the Interview Protocol of Students was applied to the students of T1 and T2. It included nine questions, together with the teachers' main seven questions, without adding the sub-questions. The questions were revised by taking into account that they would be asked of the students. The students were interviewed as a group, but I tried to collect their ideas one by one from all of them. As a group they felt more relaxed, I let them freely explain what they thought. The teacher and student version of the protocols, given in Appendices A and B, also included the demographic questions for the teachers and their students respectively. The interviews were audio-taped, and they were transcribed within two weeks.

Observations and field notes. The direct observations were the main part of the data collection process. An Effective Physics Teachers' Characteristics Classroom Observation Checklist (11 pages total) was prepared including all of the observable effective characteristics and students' motivation, as shown in Figure 2.

EFFECTIVE PHYSICS TEACHERS' CHARACTERISTICS CLASSROOM OBSERVATION CHECKLIST

Name of person observed	Location of class within the module (e.g. week number within the total weeks)											
Class/Level of Physics	Type of class (lecture, lab, computer lab...)											
Title of the subject	Number of students											
Observation Number	Name of observer and date											
Teacher's Characteristics Item	Observation Record (Do students seem motivated to learn the subject matter? Do they have positive attitude? How does the teacher implement desired characteristics or behavior in the class to motivate their students? ...)	Possessing the given characteristic. (Not Demonstrated-ND, Weak-W, Average-A, Good-G, Fully-F)	Time duration that shows the given characteristics.									
			5	1	1	2	2	3	3	4	4	
1.36. Lecturing reluctantly. (Does the teacher seem interested in the subject matter and the students?) (Dersi içten gelmeyerek (isteksiz) anlatması)			0	5	0	5	0	5	0	5	0	5

Figure 2. Sample item from the Effective Physics Teachers' Characteristics Classroom Observation Checklist

The main reason for designing and using a checklist was to keep records properly during the observations and to concentrate on similar characteristics for the two case teachers during the observations. The observations focused on both students' and teachers' in-class activities and both teachers' observable characteristics and their students' motivation. I observed the class of T1 and T2 once a week for 11 and 10 weeks respectively. The class hours were blocked hours, that is, one 80-minute period instead of two separate 40-minute periods, so my observations continued throughout each 80 minutes. For every 10 minutes, by dividing the total class hour into eight sections, detailed field notes were taken. Especially for the lessons that I could not use video-recording, I took descriptive field notes and tried to write down everything that I collected from the interactions, speech, writings, students' behaviors, teachers' behaviors, and what had occurred in the classroom. To increase the reliability of evidence for observational data and to decrease the subjectivity threat, it is useful to observe the lesson of the case teacher with multiple observers (Yin, 2009). Therefore, a second observer, a friend of one of the researchers who was also acquainted with this study, was added. The second observer was also a physics teacher and he knew about the nature of qualitative methods, especially data collection through observation. He was also informed by me about T2 and her class and the possible events that he could face during the data collection. He collected the observation notes using the same checklist.

During the observations of both teachers, I avoided talking to T1, T2, or their students in order to feel free to observe and write down my notes. In all of the observations, I sat at the back of the class in order not to disturb any kind of interaction or affect the students' concentration negatively. I specifically focused on the observable characteristics of effective physics teachers, teachers' interactions with the students, and students' interactions with themselves and how effective physics teachers' characteristics and students' motivation affected each other in the class. The physical setting of the classrooms was almost the same. Physics lessons of 10th grades were observed for T1 with 41 students and for T2 with 19 students.

Strategies for Handling the Qualitative Data

Coding the data. In this study, the authors started to think about the data coding while reviewing the literature and collecting the data. They were already familiar with the teachers' characteristics and teachers' characteristics theories. The theoretical framework of this study, the key behaviors, actions, or interactive activities for both the teachers and the students, and the research questions were used to form a "start list" of codes, sometimes called predefined codes. The researchers became experts in their coding process and the start list also helped them to create new codes (Miles & Huberman, 1994, p. 58). The start list for coding this research included six a priori codes for both teachers' characteristics/behaviors and students' respective motivational outcomes such as willingness to participate, an increase in awareness, engagement in learning physics, or self-actualization.

The interview data and the observations were transcribed verbatim in order not to lose any valuable information during the data analysis. First, all of the data were read, and the observation videos were watched. Secondly, the first interview with T1 and with the students of T1 and the initial field notes which had been gathered from the observations of the lessons of T1 and T2 were analyzed by considering what the content was all about. Third, new codes were defined and a list of all the topics by considering characteristics was made. The first three stages were repeated twice, and I grouped the new codes and revised the predefined ones. There were, in fact, three draft versions of the coding list before the final form. The abbreviations for the codes, which were used throughout the coding process, were created. The codes for students were coded with "S" as the first letter of student and for teachers they were coded with "T" as the first letter of teacher. Identifying the specific codes was more challenging work for me than identifying the general codes. Each characteristic or teachers' behavior was matched to a motivational outcome which originated from the theory in related literature. Actually, students' motivational responses to some of the effective physics teacher characteristics could not be evaluated by a single code from one motivational theory. Therefore, more than one code representing several motivational theories with respect to teachers' corresponding characteristics are represented in Table 2. Finally, the codes were revised when I started to implement a thorough analysis. This systematic process of data analysis was offered by Creswell (2012). The codes for students such as "willingness to do things by themselves (SDT)," "feeling anxious (SA)," "feeling rejected (SR)," "unable to construct clear understandings (SUCU)," "being unconcerned/uninterested (SUCI)," "being concerned/interested (SCI)," "paying attention (SHA)," or "willingness to solve/answer (SWA)" represent the motivation of the students based on the related motivational theories. The codes for teachers including "providing study skills (TSS)," "avoiding confusing students' minds (TMS)," giving lecture with appropriate details (TOD)" are specific codes for the first very general characteristics of "giving the lecture with appropriate details." Then the raw data (totalling 142 pages including the excerpts from observations, field notes, and interviews) were used as supportive evidence. The codes represent the words and phrases

assigned within the all of the raw data, including observation and interview transcripts. See Figure 3 for our coding process from an excerpt of the raw data, page 49.

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bir öğrenciye sordu. <u>Öğretmenin seçtiği sorular bir önceki dersin tekrarını kapsadığı gibi bu derste işleyecekleri</u> konu ile bağlantılı bazı sorular da soruyor. Birkaç öğrenci defterlerine açıp bakmaya çalışıyorlar ama sınıf genelinin kitap ve defterleri kapalı.	TPPN
S: " <u>Bilemiyorum hocam</u> " dedi. Başka bir öğrenciye doğru yöneldi.	SUCU
T: "Sen söyle" dedi.	TEP
S: " <u>Avnu gibi sanki hocam şekilleri aynı.</u> "	SUCU
T: "Peki o zaman kuvvet yazalım" dedi ve tahtaya büyük harflerle yazdı. Bir önceki dersin tekrarı yaklaşık 15 dakika kadar sürüyor.	
14:25	
Öğrenciler defterlerini açıyorlar. Öğretmen kuvvetin tanımını yazdırıyor.	
T: " <u>Kuvvet ile yapacağımız bütün işlemler vektörlerle yaptığımız işlemlerin aynı olacak</u> " diyor. Öğretmen sınıfta hareketsiz kalmıyor, sıraların arasında dolaşarak dersi anlatıyor. <u>Bu arada pencere kenarında oturan iki öğrenci bir şeylerle uğraşiyor. Öğretmen bunlardan birisini kaldırıp,</u>	TPF
T: " <u>Evet S1-9 bana günlük havattan bir örnek bir kuvvet örneği verebilir misin?</u> " diye soruyor. Öğrenci elini masaya bastırarak	SUCI
S: " <u>İşte öğretmenim bu kuvvet mesela</u> " diyor.	TRC
T: " <u>Evet, güzel. Başka</u> ", diye soruyor. Öğrenciler bir süre sessiz kalıyorlar daha sonra bir öğrenci,	SCI
S: " <u>Yerçekimi kuvveti</u> " diyor, başka bir öğrenci.	TEP
T: "Evet ağırlık yani. Başka. Erkekler futbola pek aramız yok herhalde." dedi.	SWA
Bir erkek öğrenci,	TRC
S: " <u>Topa uygulanan kuvvet mi hocam?</u> "	TRC
T: "Evet, tabii ki. İtme kuvveti, veya" <u>eline bir kağıt alıp bunu yırtarak,</u>	
T: " <u>Bunu çekerek yırtıyorum, çekme kuvveti</u> " diyor. <u>Öğrencilerin tamamı öğretmeni gözleri ile takip ediyorlar.</u>	TRC
14:35	SHA
T: " <u>Arabaya motorun uyguladığı kuvvet olabilir, yani günlük havatta her an karşılaşılabirsiniz</u> " dedi.	TRC

Figure 3. Excerpt from the raw data, in original language (Turkish).

To summarize, all of the analysis in the qualitative part of the study was completed with five characteristics and 15 specific codes of characteristics for teachers and 26 motivational codes for students. After the codes were constructed, I started to label the raw data with the characteristics. I used different coloured pens for different characteristics and respective codes.

All of the raw data were analyzed for both T1 and T2. The passages in the raw data were carefully identified and they were labeled with their respective specific codes for each of the characteristics. The field notes and transcribed parts of the video recordings were coded with frequencies of codes with respect to the characteristics are given in Table 2 for T1 and T2, respectively. The peer examiner also carried out the same coding process. The number of each of the occurrences in the raw data labeled by me and the peer examiner were almost the same. Furthermore, the total of the occurrences for each code and the total number of characteristics were almost the same. Therefore, during the qualitative data analysis, I concluded to use my own scores in the total and characteristics total columns in Table 2.

Table 2.
List of the specific codes and their frequencies for the lessons of T1 and T2.

Teachers' characteristics	Teachers' Behavior/Action/Interaction (as specific codes)	Code	Teacher 1		Teacher 2	
			f	Tot.	f	Tot.
1. Giving the lecture with appropriate details	Providing study skills	TSS	6		5	
	Avoiding confusing students' minds	TMS	18	46	2	15
	Giving lecture with appropriate details	TOD	22		8	
2. Giving examples from simple to complex	Providing problem solving strategies	TPSS	11		2	
	Providing help	TPH	16	37	7	28
	Providing feedback	TPF	10		19	
3. Making the physics lesson interesting by giving examples from daily life	Providing links between prior and new knowledge.	TPPN	15		6	
	Providing links between real life and concepts	TRC	19	52	11	21
	Providing scientific truths (overcoming misconceptions)	TPST	18		4	
4. Asking questions to the students to enhance active participation	Encouraging students to participate	TEP	63		22	
	Encouraging students to ask questions without feeling humiliation	TEH		64		24
			1		2	
5. Getting angry with students' mistakes and shouting at students who are disturbing the classroom atmosphere	Shouting	TS	0		12	
	Getting angry	TGA	0	22	4	33
	Slapping	THIT	0		1	
	Warning the students	TWS	22		16	

Table 2 indicates that the most frequently occurring code, 63 times, for T1; and 22 times, for T2, was “encouraging students to participate” (TEP). The frequency scores of “0” in Table 1 indicated that the characteristics were not observed. The TS, TGA, and THIT had zero occurrences for T1. Except for the fifth characteristic, the codes related to occurrences of the characteristics had lower values for T2 than T1, implying that T2 exhibited the effective characteristics less frequently than T1 did.

Data analysis. Data analysis is a very complicated and arduous process of qualitative studies. In fact, it is related to the nature of the qualitative study. The main considerations are the people and their interactive activities. Therefore, data collection and data analysis processes include very difficult stages like reading, rethinking, and rewriting, and these stages “do not occur in a vacuum; lots of activity occurs simultaneously” (Meloy, 2002, p. 141).

The data collection process included multiple sources of evidence for both T1 and T2. For T1, I had the data of interviews with her and her students, as well as field notes and video recordings from her lessons. For T2, the data included the transcripts of the interviews with her and her students and field notes taken during her lessons. I analyzed the data for each case teacher separately with respect to the characteristics as a single case, and then a comparison was held for differences in the students' motivational outcomes for each characteristic

exhibited by T1 and T2. Each code corresponds to an effective characteristic. The process of data analysis is given in Figure 4. One peer examiner, who was a physics teacher, also analyzed the data and findings from the study and knows about the nature of the qualitative study. The peer examiner read and coded all of the raw data for both teachers, and he gave me comments related to the data analysis part, interpretations, and conclusions. Since two coders coded all of the raw data, inter-rater reliability was calculated by using the formulae below (Miles & Huberman, 1994).

$$T(\text{percentage}) = \frac{\text{Consensus (N}_a\text{)}}{\text{Consensus (N}_a\text{)} + \text{Dissidence (N}_d\text{)}} \times 100$$

Reliability of the coding process by two coders was found as 91.8%. This value was above 70%, the raw data of this study can be considered to have been reliably coded (Miles & Huberman, 1994). The general explanations and interpretations that were matched from two case teachers strengthened my findings even further (Merriam, 1998; Yin, 2009). After the data analysis process, especially in the excerpts from the interviews, the students' names were replaced with numbers.

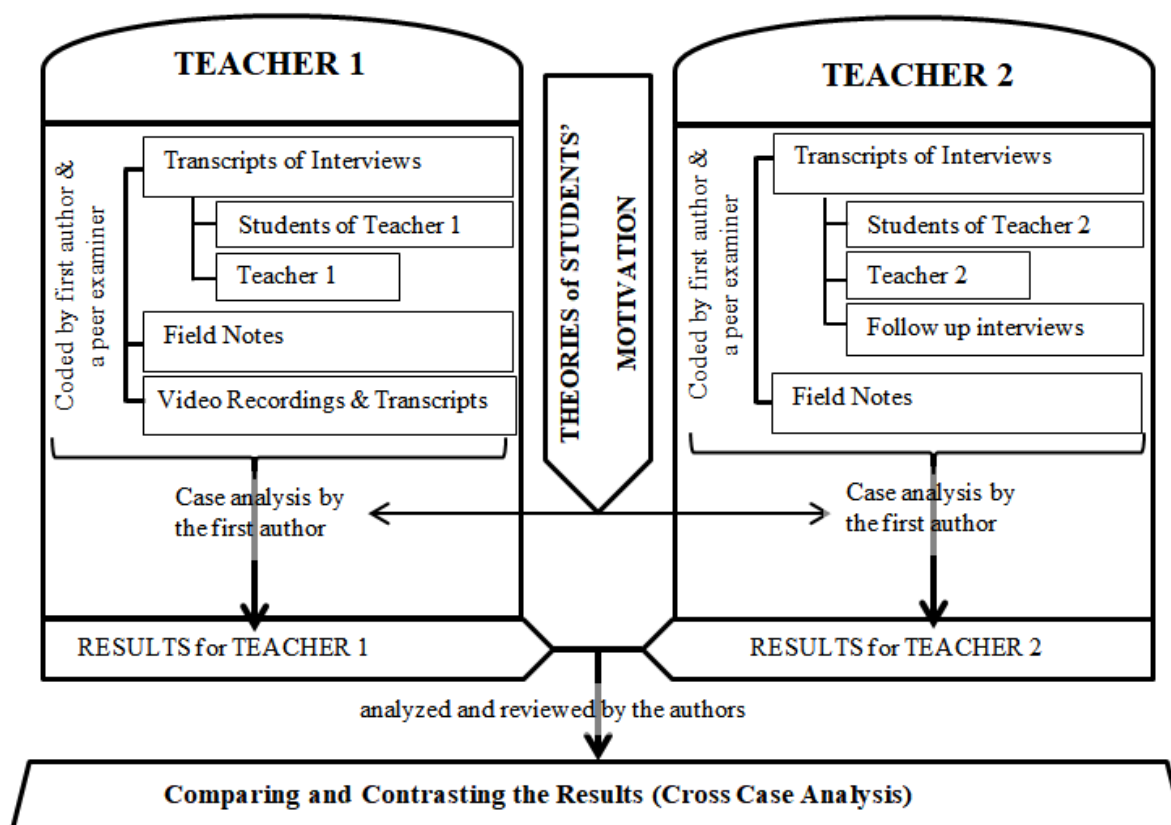


Figure 4. The process of presenting the qualitative data.

As the nature of the qualitative study, the main considerations are the people and their interactive or linked activities. The in-class interactions between students and teachers were determined mostly from the in-class observations. I was able to synthesize the data within each characteristic to draw a strong conclusion about the interactions between students and teachers who possessed effective characteristics. Within each characteristic, I have firstly discussed the interview findings for one teacher. For example, I asked students “when the teacher gives you examples from simple to complex, how does this affect your motivation”? I

gave the answers of the students of T1, like “[When we] start from the simple ones, I become more self-confident. I see I can do the simple one, so [I am able to] solve the difficult ones, it is better.” Secondly, I gave excerpts from the observation results collected and derived from the characteristics in order to prove or support the situation. For example, in the excerpt of observations for T1, she offered a problem-solving strategy for a simple example of dynamics concept and then she applied the same strategy in the solution of a complex example. Thirdly, the same process was also carried out for T2. Finally, I have discussed the theoretical framework related to the characteristics. The main concern in the literature for this example should be mainly using feedback, providing help, and using external motives. A summary of the results was used to conclude the interaction between effective physics teacher characteristics and students’ motivation for T1 and T2 respectively. Both teachers definitely accepted that giving examples from simple to complex increased students’ motivation, and they both applied this characteristic. Finally, as in the nature of the cross-case analysis, the results of both teachers were compared and contrasted. For example, T1, by offering a problem-solving strategy, managed to motivate her students while solving examples from simple to complex. Even T2 and her students admitted that solving examples from simple to complex increased the motivation; the observations for T2 clarified that it was not the case. T2 did not give proper feedback or external motives as T1 did while solving examples from simple to complex, so for her students, motivation decreased. The analysis was carried out for each of the five effective physics teacher characteristics in this manner.

As recommended by Merriam (1998) and Patton (2002), the data were collected through several sources (observations, field notes, and interviews) in order to strengthen the validity of analysis. Then, the transcripts of interviews and field notes were returned to the participants for further revisions and confirmation. Both authors, to check the interpretations and conclusions, also analyzed the data and results of the study. The long-term observations increased the internal validity of the findings. In order to control the researcher bias, the authors tried to remain as nonjudgmental as possible throughout the research process and report.

Results

Students’ motivational outcomes were generally analyzed when the teacher exhibited the given effective characteristic. Table 3 indicates how the motivation of students (supported by one situated motivation and one other related theory, if any) increased or decreased when the teacher exhibited the given characteristics. The table was prepared by considering the multiple sources of data; five of the most frequently observed characteristics were analyzed with cross-case analysis in order to draw correct and consistent interpretations.

Table 3.

The interaction between the effective physics teacher characteristics and students’ motivation.

The characteristics / Related Motivation Theory	Teachers (How teacher exhibit the characteristics...?)		Students’ situated motivation (What is the effect on motivation...?)	
	Teacher1	Teacher2	Students of Teacher1	Students of Teacher2
Giving the lecture with appropriate details (61 occurrences)	<ul style="list-style-type: none"> • providing revision before the lesson • emphasizing the details as a part of the lesson as a natural part of the 	<ul style="list-style-type: none"> • providing new examples but overload students with details • not adjusting details according to 	<ul style="list-style-type: none"> • self-actualized • willingness to participate • increase in interest • increase in awareness 	<ul style="list-style-type: none"> • unable to construct clear understandings • decrease in awareness • decrease in

Challenge (situated) + Self Determination Theory (SDT)	<p>physics lesson</p> <ul style="list-style-type: none"> identifying their lack of knowledge preparing students for new concepts avoiding overloading students with details adjusting the details to the students' levels 	<p>students' levels</p> <ul style="list-style-type: none"> not giving the appropriate details at the right time and right place 	<ul style="list-style-type: none"> engaged in learning physics working together <p>INCREASE in motivation</p>	<p>interest</p> <p>DECREASE in motivation</p>
Giving examples from simple to complex (65 occurrences)	<ul style="list-style-type: none"> provided new examples to maintain students' engagement identified the learning difficulties during problem solving make students aware of the subject providing help/feedback for solution of the problems offering a problem-solving strategy 	<ul style="list-style-type: none"> not offer problem solving strategy not offer proper connections with the subject Allowed students to confuse their knowledge not arrange the difficulty level of examples 	<ul style="list-style-type: none"> willingness to solve not feel anxious increase in interest <p>INCREASE in motivation</p>	<ul style="list-style-type: none"> difficulty in solving complex problems unwilling to solve problems by themselves decrease in interest <p><i>(At first for simple problems no effect, but decrease in motivation for complex ones)</i></p> <p>DECREASE in motivation</p>
Challenge (situated) + SDT	<ul style="list-style-type: none"> giving example from daily life for all subjects providing link between prior knowledge and new knowledge providing links between real life and concepts providing scientific truths 	<ul style="list-style-type: none"> providing links between real life and concepts encouraging students to find examples from daily life make students aware of the subject 	<ul style="list-style-type: none"> willingness to participate (voluntarily participate) engage in lesson by finding examples from daily life enjoy the task increase in interest /attention become self-determined <p>INCREASE in motivation</p>	<ul style="list-style-type: none"> willingness to participate increase in interest/attention paying attention more willingness to share their ideas engage in lesson by finding examples from daily life <p>INCREASE in motivation</p>
Making the physics lesson interesting by giving examples from daily life (73 occurrences)	<ul style="list-style-type: none"> giving example from daily life for all subjects providing link between prior knowledge and new knowledge providing links between real life and concepts providing scientific truths 	<ul style="list-style-type: none"> providing links between real life and concepts encouraging students to find examples from daily life make students aware of the subject 	<ul style="list-style-type: none"> willingness to participate (voluntarily participate) engage in lesson by finding examples from daily life enjoy the task increase in interest /attention become self-determined <p>INCREASE in motivation</p>	<ul style="list-style-type: none"> willingness to participate increase in interest/attention paying attention more willingness to share their ideas engage in lesson by finding examples from daily life <p>INCREASE in motivation</p>
The characteristics / Considered Motivation Theory	Teachers (How teacher exhibit the characteristics...?)		Students' situated motivation (What is the effect on motivation...?)	
	Teacher1	Teacher2	Students of Teacher1	Students of Teacher2
Asking questions to the students to enhance active participation (88)	<ul style="list-style-type: none"> sustaining curiosity encourage students to ask questions without feeling humiliation 	<ul style="list-style-type: none"> nominated students whose interest decreased encouraged students to participate allow students to 	<ul style="list-style-type: none"> increase in interest paying attention more willingness to participate become concerned about the subject 	<ul style="list-style-type: none"> increase in self-confidence willingness to participate increase in interest <p>INCREASE in</p>

occurrences)	• encourage students to participate	ask questions • make students aware of the subject	• increase in self confidence INCREASE in motivation	motivation
Collaboration (situated) + Intrinsic Motivation				
Getting angry with students' mistakes and shouting at students... (55 occurrences)	• warned the students (to keep them awake) immediately after they exhibit undisciplined behavior • warned the students, without getting angry, shouting or giving punishments	• shouting at students • getting angry to students faults • allowing nagging criticism • not consistent in her behaviors (<i>sometimes ignoring unintended behavior, sometimes she shouted for the similar behavior</i>)	• paying attention • listening intently • increase in attention INCREASE in motivation	• attribute their failure to teacher's shouting • feeling anxious/rejected • unconcerned/uninterested • making noise • discussing with each other DECREASE in motivation
Control (situated) + SDT				

Giving the Lecture with Appropriate Details

T1 declared that she recapped with the students by (a) telling the students to close their notebooks, (b) asking them questions related to the main concepts of the previous lessons, (c) trying to encourage all the students to participate in the discussions, and (d) nominating students whom she thought were low-motivated. She achieved this by asking questions like “What else?”, “[Can] you tell me what your friend has missed?” (p. 46 from the “Raw Data”). She gave proper details as part of her physics lessons, which students usually accepted. T1 reminded her students constantly about details such as “identifying the units,” “scientific notations,” “vector notations,” and “mathematical interpretations while drawing graph.” Ensuring that they paid attention to them strengthened her students’ self-confidence, and thus caused an increase in their motivation.

On the other hand, T2 was not able to determine which details were important in physics. She had problems in adapting mathematical knowledge to physics. At this point, we should indicate that the derivative concept is not included in the 10th grade physics or mathematics curricula. An excerpt from the observations follows:

T2: The derivative of velocity is acceleration or the derivative of displacement is velocity. (p. 111)

In the interviews, students of T2 thought that studying mathematics was important, but it should be given appropriately. T2 did not convey the information in the right way and at the right time; there was a decrease in the students’ motivation. ST2 said:

S2-2: Before she taught us motion, our teacher tried to explain a bit about derivatives to us. ...I don't know but it seemed then as if it was just a detail because we didn't really use it again in later lessons. (p. 36)

A follow-up interview is crucial to understand whether students could link the derivative with the concept of linear motion.

Researcher: So when you are given a graph or a formula, can you use a derivative to make some conclusions?

S2-12: We might be able to use it, but only if the question is not too difficult. I don't know if we have applied it fully in any kind of questions. (pp. 112-113)

In another days of observations, the following excerpts clarify my interpretations related to this characteristic.

S2-1: "Miss, how do we find the volume of objects without a fixed geometrical shape? I mean can we do it without a liquid?" he asked. The question was not related to the subject being explained, but the teacher did not refuse it.

T2: "I don't know, can we find it without liquid?"

T2: "You can't find it at your level this means," she said. (p. 101)

S2-21: "Do they see the Great China Wall nearer from space because there are water particles in the atmosphere?" he asked.

T2: "Is it related to refraction, I mean, is it because of this? Does anyone have any idea about this?"

The teacher waited a while and then one student answered: "Space is one and air is almost one [refracting index], so according to this it wouldn't change much," he said.

T2: "It would seem closer than it is," she said, without giving any further explanation. [She was not really sure]. (p. 96)

Students should know the ways of finding the volume of objects at ninth grade, since they learned various methods at the middle school level. The students were not rejected, and their questions were taken into consideration. However, this would not provide them with a chance to learn meaningfully, since the teacher would make the students search the answer for the questions she did not know. When the teacher did not easily answer the students' questions related to physics, their self-confidence decreased and their motivation was affected negatively. They could not construct clear understandings T2 tried to teach the derivative concept from mathematics as an appropriate detail, but students of T2 could not construct clear understandings, and it seemed that the students' were confused. Finding the volume of irregular shaped objects without liquid or viewing the China Wall from space (concept of apparent depth) were related to appropriate details. However, when the explanations did not incorporate sufficient details, the students did not participate in further discussions in the class. So the concepts became a challenge for the students, thereby decreasing their motivation. The effects of the characteristics were explained in terms of the self-determination theory that mainly emphasizes students' satisfaction, competency, autonomy, and relatedness need (Brophy, 2010; Deci & Ryan, 1985; Gagne & Deci, 2005; Sweet & Guthrie, 1996).

Giving Examples from Simple to Complex

T1 stated that "giving examples from simple to complex" would have an effect on students' motivation, but she thought that adjusting the level of the examples in heterogeneous classes was very difficult. To overcome this, she offered a problem-solving strategy, which identified basic steps. With the help of this strategy, most of the students could handle even some of the complex problems. Students said:

S1-1: If we solve the simple one first, motivation increases. If we start from the complex one, we mix them up.

S1-4: [When we] start from the simple ones, I become more self-confident. I see I can do the simple one, so [I am able to] solve the difficult ones; it is better. (p. 24)

During the lesson in the following week, an excerpt from the observation indicated T1 emphasized the problem-solving strategies. She continuously implied the strategy in the solution of a complex example, too.

T1: If you face a question from dynamics concept, what would be the first thing you would do?

T1: Firstly, you apply the basic principles of dynamics to the whole system. By considering all the forces causing motion, you will find the acceleration of the system. Then you will draw free body diagrams for the other objects in the system and then for each component you will apply the basic principles of dynamics. Do you understand? (pp. 86-87)

Related to “giving examples from simple to complex,” T2 indicated that students’ motivation depended on the examples that she solved. A student of T2 stated that T2 gave the examples from simple to complex, and they thought that they could easily understand in this way.

S2-1: When I can solve the easy ones, I feel more confident. I see what I can do and what I have difficulty with. It’s obvious how much of the subject I have understood. If we can understand all the examples, we think we have understood the subject. (p. 37)

In the interviews, both T2 and her students indicated the motivation definitely increased when T2 solved the examples from simple to complex (p. 18). T2 mostly gave the examples from simple to complex, but the number of students who raised their hands to solve the examples decreased when it came to the complex examples. She chose the first examples from easy ones that could be done by referring to one equation or explanation of the concept, but second and third examples required some application of the students’ knowledge. The students of T2 sometimes had difficulty in solving the problems from simple to complex when there was a lack of external motivation such as: providing help, giving feedback, and offering problem solving strategies. The students of T2 could not construct clear understanding in students.

The teacher started to solve the question and she said:

T2: “How many questions have we solved about the center of mass? You can’t even do this.” She explained the answer to the question within one minute (p. 104).

T2: “Let’s write down some examples, so that we’ll remember them better.”

The students wrote the example in their notebooks. The teacher was trying to make students see the connections between the examples, but they were having difficulty in this [second observers’ notes].

T1 managed to handle the negative effects of a crowded class by providing motives like providing help and giving feedback as well as a strategy for problem solving. Therefore, the students’ motivation with T1 increased, but the students’ motivation with T2 decreased. In fact, it can even be said that this teacher exhibited this characteristic, but without the

considered external motivation, the students' motivation, would decrease (Brophy, 2010; Tuan et al., 2003).

Making the Physics Lesson Interesting by Giving Examples from Daily Life

T1 stated that she always tried to find examples related to real life. T1 thought that by giving those examples she made the lesson interesting and enjoyable in order to support meaningful learning. Students of T1 stated that to understand the real-world applications would only be possible with those examples. S1-2 stated that "we imagine things that we've seen in real life . . . we see those things outside of school, every time we see them, we remember our lessons" (p. 29). When T1 provided examples from daily life, the students started to participate in the discussions in the class and focused on the lesson.

T2 emphasized the importance of real-life examples. She said those examples really affected students' motivation. She said the motivation of students directly increased. Students of T2 strictly emphasized almost the same points as T2. They said they could link concepts to real life. T2 thought in the same way as T1 and she said, "The students can visualize the concepts. Otherwise the lesson is abstract" (p. 19). When T2 gave examples from daily life, the students started to participate in class discussions and enjoyed them. The students of T1 and the students of T2 were willing to participate in lessons, and they also gave examples from daily life. Even if there was an increase in the students' motivation with both teachers, it was observed that T1's students were more enthusiastic about learning physics than those of T2.

Asking Questions to the Students to Enhance Active Participation

T1 and students thought that this characteristic increased their motivation since students' interests were alive throughout the lesson. In the interview, T1 claimed that in order to achieve fully motivated students in the class, a teacher should apply more than one method. She said:

T1: Actually, it only lasts a short time. It's a mistake to think that everything you do will keep the students' interest alive [throughout the lesson]. (pp. 10-11)

Students of T1 claimed that their self-confidence increased when they were able to answer the questions. They stated that they participated more, and they were able to stay awake in the lesson. T1 was quite active in the class. Sometimes she tried to make the students more active, but they chose to watch their teacher passively. There were many examples for this characteristic, but the following passages from the field notes was especially thought provoking.

T1: "OK, S1-5 what can we say about your position? Describe it with reference to the board." She seemed very enthusiastic and energetic as she spoke to a student in the middle row.

S1-5: "It is 6 from the front of the board or 6 from the back," he said.

T1: "Yes, well done. It can be described like this. We need to have a reference point. S1-5 come here. Now S1-5 made a displacement." All the students watched these events carefully and most of them followed the teacher with their eyes and they stayed rather passive. (p. 72)

T2 stated that she nominated some students to answer questions so that they would participate in the class discussions. She stated that it increased the motivation of a student who could answer the question. Students of T2 also indicated that they could understand the concepts when they answered those questions:

S2-1: It affects us positively. Everyone in the class thinks they are about to be asked a question. Everyone listens more carefully and is motivated in the lesson.

S2-2: When the teacher brings the subjects to our level, we understand them more easily. If the questions include details from the subjects, then this makes us more motivated. (p. 42)

During the observations, T2 asked questions related to the examples and she encouraged the students to participate in solving the questions. Students got used to answering the teacher's questions. The following passages from the field notes of the second observer identify the situation.

The teacher writes [an] example on the board, but it is similar to the first two examples. Student S2-3 wants to come to the board to answer the question. . . . The teacher allows another student to speak . . . who answers the question correctly (p. 138). The teacher writes a new question. The students write down the question. This time the teacher calls S2-3 . . . He starts to answer the question, but teacher helps him when he gets stuck. Despite this help, student S2-3 does not find the correct answer. The teacher explains to him again and asks him to try again. (pp. 138-139)

The way of approaching the “active participation” was a bit different for the two teachers. The frequency of occurrences for the active participation in the class of T1 was almost three times greater than that of T2. Even if there was an increase in the students' motivation for both, I observed that T1 was quite enthusiastic about teaching physics and usually forced the students to participate in classroom activities and discussion. T1 was able to make the students in the whole class participate in the discussions. However, T2 explained the topics/subjects only on the board. As Paris and Turner (1994) stated, social interaction in the classroom forms collaboration. However, students' situated motivation can make them resist the teachers' behaviors, so neither teacher achieved the motivational outcomes that they expected. This was especially the case for T1.

Getting Angry with Students' Mistakes and Shouting at Students Who Are Disturbing the Classroom Atmosphere

During the observations and interviews, it was decided that T1 did not exhibit this characteristic. Students of T1 declared that T1 did not shout, get angry, or punish the class. T1 mostly preferred warning students gently when she faced an unwanted behavior and, in doing so, she took care not to hurt the students.

On the other hand, T2 accepted that she got angry or shouted sometimes, but she said that the students knew the reason for her anger. Students of T2 echoed that T2 sometimes shouted when she was angry. They also stated that when she was angry in the lesson, they got bored and, whether she had a valid reason or not, their willingness to participate decreased.

S2-1: When she shouts, the lessons are difficult to get through . . .

S2-2: I get really bored in that lesson period [when she shouts]. At least for that lesson, nothing the teacher does seems attractive to me.” (pp. 43-44)

T2 sometimes ignored some students who did not participate in the discussions, and she sometimes did not warn the students who caused disruptions in the class. However, sometimes she became very angry with undisciplined behaviors and shouted at the students. The students' willingness to share their ideas and their interest decreased.

S2-3: Miss, all of my friends were standing up.

T2: Don't speak, just sit down! (pp. 114-115)

The teacher has been sitting at her desk since the beginning of the lesson.

On another day, for almost the same kind of undisciplined behavior, T2 did not give the same response. That time she only warned the students. So she sometimes warned and sometimes shouted at the students who caused disruptions in the class.

T2: My children, look here . . .

[The students are discussing the answer amongst themselves. The teacher is quiet at first and then says “Sshh!” (pp. 121-122)

T2: At this point, pay attention to the concepts. The speed that makes the object cross the river and the speed that changes position in a horizontal way are different from each other.” [The girls sitting in front of me are talking amongst themselves and are not very interested in the lesson, but she did not warn them]. (pp. 124-135, pp. 128-129)

T2 did not hit any students during my observations, but, just once, she (gently) slapped the face of a student. The student seemed to be unaffected since she smiled during this interaction. She did not aim to slap him because of her anger. But her reactions varied.

The teacher came next to S2-16 and said,

T2: “Your notebook is not complete” and slapped his face.

S2-16 grinned and said, “It is complete, Miss.”

T2: “So where is all this?” she asked, indicating the board.

S2-16: “It's all here, Miss. It's all the same,” he said.

T2: “Oh, come on,” she said. (p. 140)

In summary, T1 had a gentle approach to warning students who were disobeying. She did not get angry or shout and she had “control” of the lesson. Therefore, the students were quiet and paid attention to the lesson. On the other hand, T2 was not consistent in her behaviors. Students of T2, feeling rejected and anxious in the classroom, made noise when they had the opportunity, and their interest decreased. Teachers should have autonomy to achieve the lesson goals, which is the “control” aspect of situated motivation (Paris & Turner, 1994). It is also possible that students could attribute their failure to the teachers' behaviors, like, “I have failed since the teacher always shouted at me” or “I do not listen to the teacher since she humiliates me in front of my friends” (Fives, 2003; Hufton, Elliot, & Illushin, 2002).

Theoretical Interpretations, Conclusions, and Implications

Teachers are the major components in effective teaching to increase the students' motivation by utilizing an optimal program to find appropriate methods to motivate their

students (Brophy, 2010). From another point of view, effective teaching is a personal effort on the part of a teacher and depends on her/his ways of teaching—whether he/she incorporates innovative practices into the lesson, for instance (Çakmak & Akkutay, 2016). Teachers, by exhibiting effective characteristics, create every opportunity for the students to increase their motivation (Brophy, 2010; Keller, 1983). Teachers' characteristics like enthusiasm, use of examples, and ability to construct of problem-solving strategies for physics problems increase the students' motivation. This result is correspondingly supported by the results of Alkhayyatt (2000).

There were some limitations specific to the qualitative case study approach of this study. As in most of the case studies, it is almost impossible to provide generalizability of the findings in this case study to the other settings. As Yin (2009) suggested, a replication strategy, defined as the results from one setting of a qualitative study also being comparable with the results from another setting, is carefully included instead of sampling logic. The cases should be carefully selected to predict contrasting results for predictable reasons (Miles & Huberman, 1994; Yin, 2009). The teachers were selected throughout a systematic process in order to obtain comparable and contrasting results. It was supposed that teachers in the selected case might accurately reflect the behaviors, characteristics, or responses of other physics teachers possessing the effective physics teacher characteristics. One of the limitations in my data presentation is that the translations of the field notes and interviews from Turkish to English are my own. A bilingual English teacher, who is British, helped me in the proof-reading process and worked on the translations to minimize mistakes. The main limitation resulted from data analysis. The data collected from all sources of evidence were coded by a single coder. I possessed some experience as a researcher in this field, but this was my first attempt to carry out a case study. I consulted with my peer examiner and the second author about every part of the data collection and data analysis. My 12 years of experience as a physics teacher strengthened me in dealing with classroom activities, contacting the teachers and the principals, and being a part of the classroom during the data collection. One of the study's strengths is that a draft report related to the findings from interviews and observations was read by the participants in a process offered by Patton (2002) to satisfy analytical triangulation. They accepted and signed what we had reached as a conclusion after the data collection process. Another limitation for data collection was related to interview findings since it was not clear whether the open-ended question that was presented to teachers and students was understood in the same way by each of the respondents. In order to reduce the effect of this limitation, the interview protocol for teachers and students were prepared separately with a systematic process that was finalized at the end of three drafts.

Despite these limitations, this study adds a crucial dimension to the literature on interactions between students' motivation and physics teachers' characteristics. In previous studies, researchers mainly concentrated on teachers' characteristics like enthusiasm and giving examples from daily life to increase students' motivation by increasing their attention and willingness to participate in the classroom discussions (Opdenakker & Damme, 2006; Witcher et al., 2003). Furthermore, it is implied that rather than teachers possessing subject matter knowledge (Aiello-Nicosia & Sperandeo-Mineo, 2000; Sperandeo-Mineo et al., 2006), students' motivation is affected by teachers' autonomy (Ronfeldt et al., 2013) to make instructional decisions that are related to students' learning outcomes. It is not quite outstanding to conclude that students' motivation increases when a teacher frequently exhibits positive effective characteristics and students' motivation decreases when a teacher rarely exhibits positive, effective characteristics. This study finds that most students are not intrinsically motivated to engage in learning physics, when the teachers do not exhibit the main characteristics. Therefore, this study did not only emphasize the main concerns related

to effective teacher characteristics, it also implied that some characteristics were crucial to ensure that teachers could transfer their knowledge effectively.

The students' situated motivation might be manifested in the way of resisting the existing environment, which is also an indicator of students' unawareness of their own situations. Even though a teacher mostly exhibits the positive effective characteristics by providing every opportunity for the students' learning, students want a classroom environment where they can stay calm and be more passive. They were sure that the teacher would do everything for their learning. The students do not like to be constantly forced by the teacher to share their views. For example, the students of T1 did not like to be compelled by their teachers to actively participate in classroom discussions. However, making all students in class participate in the discussions motivated more effectively than merely interacting with few students on the board.

In the lesson of a teacher who exhibits some of the negative characteristics, students demand a classroom environment where they are more active. The students are not satisfied when their teacher tends to avoid asking questions or has difficulty in solving the problems. When the teacher prevents the students from asking questions or leaves their questions unanswered, the motivation of students decrease, as was observed for the students of T2. The results were partly supported by the findings of Järvelä et al. (2012) who indicate that situated motivation factors are "contextual indicators," that were the characteristics that teachers exhibited in the class.

The behaviors and characteristics of teachers can alter students' motivation. In general, this was not the case. In fact, situated motivation could be "unstable" and "contextualized" as emphasized by Paris and Turner (1994, pp. 215-216). Therefore, sudden changes in the behaviors of the teacher would not affect the motivation of the students drastically. T2, for example, usually exhibited the negative characteristics that decreased students' motivation. One of the reasons could be the students of T2 may not expect those positive characteristics from the teacher. Another reason could be that the same motivations did not have the same effect on students' motivation since the teacher was not consistent in her behaviors. Students did not concentrate on the subjects that the teacher explained; therefore, they might resist or miss the teacher's positive behaviors or characteristics exhibited in the classroom.

Future studies may focus on high and low achievers. A similar study could be applied to groups of high and low achievers in physics to ascertain how/if their motivation levels directly interacted with teachers' effective characteristics exhibited in the classroom.

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Appendix A

Interaction Between Students' Motivation and Physics Teachers' Characteristics: Multiple Case Study (The Interview Protocol of Teachers)

RESEARCH QUESTION

How students' motivation is affected by frequency of exhibiting the effective characteristics of physics teachers?

PURPOSE

The main purpose of this study is to investigate interaction between the characteristics that effective teachers possess and students' motivation in physics. The characteristics were observed in the class by the researcher. The purpose of these interviews is to support/identify how and under what conditions the frequency of exhibiting those characteristics affect students' motivation.

School: K** Date and Time: *** (interviewer): (T1)

INTRODUCTION

Hello, my name is Fikret KORUR. I am here to talk to you about your effective characteristics. Those characteristics will mostly be observed by me to find out whether or not these characteristics affect the students' motivation. However, your personal reflections

and thoughts are crucial for the progress of the study. The interview will be semi-structured, which means I will ask the questions and you will answer and if there are some points that I want you to make clear, I will ask additional questions related to that item. The main focus of my questions will be related to how, under what conditions and how much time you can motivate your students with your effective characteristics. I plan to use my findings in education faculties as a course for prospective teachers, in the selection of physics teachers with a project with YOK and the MEB. Your name and school and the information given to us will be kept in secret.

- Do you mind if I tape our conversation, and do you have enough time to carry on study for the following 50 minutes?
- Do you have any further questions for me?

OK, lets' start with questions and please be relaxed in answering. What I want to do is to get your own ideas. There is no correct answer for the following questions, and the only answer is what you think and what you want to say.

INTERVIEW QUESTIONS (with prompts of situations from the observation of this teacher)

1. I observed that you made physics lessons interesting and enjoyable by giving examples from daily life. How and why do you think the examples affect students' motivation?
2. How is the students' motivation affected when you answer the students' questions related to physics easily? I observed that you paved the way for the students to ask questions. But how do you manage to get back to the subject when the number of questions increase and you get off the point? What do you think that how your this method (technique) affects motivation of the students? How do you enhance active participation?
3. I never observed a student that disrupted the environment (atmosphere) of the classroom. Sometimes, there was a humming noise in the classroom, but you managed to catch the students' attention by setting the tone of your voice. How and why do you think getting angry with or shouting at a student for a mistake he has made would affect the motivation of that student or the class?
4. When you give examples from simple to complex for the students, how does this affect their motivation?
5. I observed a few times that when the students could not understand a subject, you tried to tell it again by using equipment you found in the classroom. How and why is your students' motivation affected when you give your lectures with the appropriate details?
6. You start the lesson by reviewing the previous lesson and you continue reviewing, generally not longer than 15 minutes, till you feel that the students are ready for the lesson. How and why would keeping the students' interest alive throughout the lesson affect their motivation?
7. While you were teaching physics, I never observed that you were reluctant to teach. How and why does your enthusiasm for teaching affect the students' motivation?

Appendix B

Interaction Between Students' Motivation and Physics Teachers' Characteristics: Multiple Case Study (The Interview Protocol of Students)

RESEARCH QUESTION

How students' motivation is affected by frequency of exhibiting the effective characteristics of physics teachers?

PURPOSE

The main purpose of this study is to investigate interaction between the characteristics that effective teachers possess and students' motivation in physics. The characteristics were observed in the class by the researcher. The purpose of these interviews is to support/identify how and under what conditions the frequency of exhibiting those characteristics affect students' motivation.

School: K** Date and Time: *** Interviewee: Five Students of T1

INTRODUCTION

Hello, my name is Fikret KORUR. I am here to talk to you about your effective characteristics. Those characteristics will mostly be observed by me to find out whether or not these characteristics affect the students' motivation. However, your personal reflections and thoughts are crucial for the progress of the study. The interview will be semi-structured, which means I will ask the questions and you will answer and if there are some points that I want you to make clear, I will ask additional questions related to that item. The main focus of my questions will be related to how, under what conditions and how much time you can motivate your students with your effective characteristics. I plan to use my findings in education faculties as a course for prospective teachers, in the selection of physics teachers with a project with YOK and the MEB. Your name and school and the information given to us will be kept in secret.

- Do you mind if I tape our conversation, and do you have enough time to carry on study for the following 50 minutes?
- Do you have any further questions for me?

OK, lets' start with questions and please be relaxed in answering. What I want to do is to get your own ideas. There is no correct answer for the following questions, and the only answer is what you think and what you want to say.

INTERVIEW QUESTIONS

1. How and why does your teacher's giving you examples from daily life when teaching, affect your motivation?
2. How is your motivation affected when your teacher gives answers easily to your questions about physics subjects?
3. How and why do you think your teacher's getting angry with or shouting at a student for a mistake s/he has made would affect the motivation of that

- student or the class?
4. When the teacher gives you examples from simple to complex, how does this affect your motivation?
 5. How is your motivation affected when the teacher gives the subject matter with appropriate details?
 6. How is your motivation affected when a subject which is not understood by you is repeated by teacher considering your question? How and why is your motivation affected when your teacher prepares a base for you to be able to ask questions?
 7. Can your teacher keep your interest alive throughout the lesson? How and why does this affect your motivation?
 8. Which of your teacher's characteristics do you think make her a good motivator?
 9. How and why does your teacher's reluctance / enthusiasm when teaching affect your motivation?

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