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Maths Instruction in Vocational High School from Teachers and Students' Eyes: A Different Kettle of Fish

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Date of publication: June 24th, 2020
Edition period: June 2020-October 2020

To cite this article: Ozdemir, H. (2020). Maths Instructions in Vocational High School from Teachers and Students' Eyes: A Different Kettle of Fish. *REDIMAT – Journal of Research in Mathematics Education*, *9*(2), 196-214. doi: 10.17583/redimat.2020.3796

To link this article: http://dx.doi.org/10.17583/redimat.2020.3796

REDIMAT, Vol. 9 No. 2 June 2020 pp. 196-214

Maths Instructions in Vocational High School from Teachers and Students' Eyes: A Different Kettle of Fish

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(*Received: 06 October 2018; Accepted: 17 April 2020; Published: 24 June 2020)*

Abstract

Mathematics course in vocational high school education is significant worldwide to equip vocational students with the technical and personal skills that are required for the effective workforce as discussed in the context of Science, Technology, Engineering and Mathematics (STEM) education. The present research sets out to investigate Turkish maths teachers' believes and instructional practices through comparing vocational students' perceptions for mathematics instruction and the researcher's observation in a state vocational high school. A total amount of 20 maths teachers and 161 students participated in this longitudinal study (n=181). Mixed methods were used, and three types of data were collected: questionnaires, interviews and observation. The findings indicated that maths teachers' belief and practices were not consistent when compared with the questionnaire and interview data collected from vocational students, and also observation carried out by the researcher.

Keywords: mathematics education, vocational high school, vocational students, beliefs and practices

ISSN: 2014-3621
DOI: 10.17583/redimat.2020.3796

REDIMAT, Vol. 9 No. 2 June 2020 pp. 196-214

Enseñanza de las Matemáticas en la Escuela Secundaria Profesional Según Profesores y Alumnos: Una Perspectiva Diferente

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(*Recibido: 06 Octubre 2018; Aceptado: 17 Abril 2019; Publicado: 24 Junio 2020)*

Resumen

El currículo de matemáticas en la educación secundaria profesional es significativo en todo el mundo para equipar a los alumnos de estudios profesionales con las habilidades técnicas y personales necesarias para una fuerza laboral eficiente, tal como se ha debatido en el contexto de la enseñanza de Ciencia, Tecnología, Ingeniería y Matemáticas (STEM). El presente estudio se propone investigar las opiniones y prácticas docentes de profesores turcos de matemáticas, en comparación con la percepción de los alumnos de enseñanzas profesionales sobre la enseñanza de las matemáticas y la observación del investigador en una escuela secundaria profesional estatal. En este estudio longitudinal participaron 20 profesores de matemáticas y 161 alumnos (n=181). Se emplearon métodos mixtos en la recogida de los tres tipos de datos siguientes: cuestionarios, entrevistas y observación. Nuestros hallazgos indican que las opiniones y prácticas de los profesores de matemáticas no son coherentes al compararse con los datos de cuestionarios recogidos de los estudiantes de enseñanzas profesionales, así como con la observación realizada por el investigador.

Palabras clave: educación matemática, instituto de formación profesional, a los alumnos de estudios profesionales, las opiniones y prácticas

ISSN: 2014-3621
DOI: 10.17583/redimat.2020.3796

Subject specific belief, such as belief about mathematics, could pave way for elucidating the complicated issues concerning how students learn. Since the 1980s, researchers in education have been discussing that belief is one of the best indicators for the decisions that teachers make and their behaviour while teaching. Thus, teachers' belief should become a significant focus of the educational investigation, including mathematics (Pajares, 1992). There is a consensus in the literature that to gain knowledge of mathematics, students must learn key concepts and correct procedures to address the problems they encounter during mathematics education. Teachers' belief and practices for mathematics instruction should be considered for a meaningful and effective learning milieu to foster mathematics education. In this context, published studies discussed that teacher's belief and practices about the teaching and learning mathematics are significant for efficient mathematics instruction (see Handal & Herrington, 2003).

Given the importance of the maths education described above, various studies have been undertaken in the literature since 1980s. For example, in an early study, Schoenfeld (1989) investigated aspects of the relationship between students' belief about mathematics and their mathematical performance (n=230). The findings were surprising as students reported that mathematics is mostly memorizing, however, mathematics is also a creative and useful discipline because, by means of maths, students learn to think. Some studies found out the inconsistencies between teacher's mathematics belief and teaching practice (see Raymond, 1997), while some research although very few showed consistencies (see Kaplan, 1991; Peterson et al., 1989; Stipek et al., 2001) as well as potential ignorance of new ideas or inappropriately integration of new ideas into existing practice while teaching mathematics (Borko et al., 1997).

Using four video-taped classroom episodes with a focus on interactions between the teacher and the students, Taylan and da Ponte (2016) investigated a teacher-researcher's pedagogical content knowledge that was teaching 5th-grade mathematics in the scope of a university-school partnership project. Their findings indicated the need for "revoicing" to scaffold students learn the proper use of mathematical language; when students gave an incomplete answer to a maths question, maths teacher should guide them rather than thinking that the answer is wrong and also the maths teachers should be aware that when the classroom discourse becomes

confusing, maths teacher should ensure that students understand the task given by the teacher. In a comprehensive study, through employing audiotaped interviews, observations, document analysis and survey, Raymond (1997) explored relationships between a beginning elementary school teacher's belief and mathematics teaching practices. Raymond's findings showed that teachers' belief and practice were not completely consistent. However, teachers' practice was more closely related to teachers' belief about mathematics content than to teachers' belief about mathematics pedagogy. Belief about mathematics teaching and learning was less traditional than maths teachers' actual teaching.

In a case study on two elementary private school teachers, i.e., one teacher from third grade and one from second grade, Kaplan (1991) investigated the consistency between belief and practices of two elementary mathematics teachers through interviews and videotaping classroom behaviours. Kaplan divided belief into two categories: *surface belief* that referred to "all general statements made during the interviews about overall pedagogical philosophy or principles of mathematics education" and *deep belief* that is defined as "expressed by each teacher were identified through the holistic evaluation of the interviews" (p. 121). The findings of two cases as maths teachers, who are Joan and Nomi (pseudonyms), showed that teachers' deep belief systems were better predictors of pervasive classroom practices than are surface belief, but that surface belief may be better predictors of superficial classroom practices than of more pervasive classroom practices. Joan's surface and deep belief differed considerably. Compared to interview data, classroom behaviour data showed that her lesson presented a picture of a more constructivist-oriented. Her communication with the students in class revealed how her empiricist core is associated with pervasive practices. Kaplan suggested that surface belief could be more easily modified to accommodate new ideas although they are not necessarily consistent with classroom practices. Compared to Joan, Nomi was more consistent across all conditions. Her trend in the interview data toward empiricism was consistent with her superficial classroom practices in the way she physically set up her classroom and also with her deep belief as reflected in her communications with students. Also, the proportion of observable constructivist behaviours of Nomi was consistent with both her statements of deep and surface belief. Both Joan and Nomi tended to be empiricists in their pervasive classroom

practices but they also tried to pervade constructivist approaches to their students' mathematics experiences.

One of the most comprehensive studies was conducted by Stipek et al., (2001) who investigated belief and practices of 21 fourth- through sixth-grade elementary school teachers regarding mathematics with the involvement of 437 students. The researchers used a survey to reveal belief about mathematics and teaching both at the beginning and end of the school year, which included 57 statements. Data for teacher classroom practices were collected through video and also teachers completed a questionnaire for their criteria on their formal evaluation of the students, such as effort and relative scores. Students also completed a survey, at the beginning and the end of the school year, on their competence in mathematics and about how much they enjoyed doing mathematics. Regarding teachers' belief, findings revealed five types of belief were strongly associated with each other (p. 222): "(1) mathematics is a set of operations to be learned; (2) students' goal is to get correct solutions; (3) the teacher needs to exercise complete control over mathematics activities; (4) mathematics ability is fixed and stable; and (5) extrinsic rewards and grades are effective strategies for motivating students to engage in mathematics". As for belief and practices, the findings indicated that teachers who held traditional belief tend to use more traditional practices and highlighted performance (e.g., good grades) rather than learning and understanding. A surprising finding was that these teachers gave students fairly less autonomy. Regarding the findings for teachers and students' self-confidence and enjoyment, teachers' enjoyment of mathematics did not predict students' enjoyment at the end of the school year. However, teachers' self-confidence as mathematics teachers was significantly correlated with students' perceptions of their competence as mathematics learners. For this finding, Stipek et al., (2001) suggest that teachers might have influenced students' belief.

Previous published studies are highly insightful, however, limited to traditional high schools although various concerns have been discussed about the effectiveness of 'vocational' as well as academic classes to equip students with the needed academic skills (see Bottoms, 1992) given that *vocational education* requires interdisciplinary approach (i.e., vocational/content courses tend to include maths and physics knowledge). In a longitudinal research Mane's (1998) findings highlighted that employers now are not looking for workers with a good general education and are not willing to

teach the occupation specific skills necessary to do the job, which calls for revisiting the classroom practices and interdisciplinary teaching in high schools. High school students who do not plan to attend college full-time are advised to start developing vocational skills before they graduate from high school. These findings contradict the oft repeated claim that employers now seek workers with a good general education and are happy to teach the occupation specific skills necessary to do the job. High school students who do not plan to attend college full-time would be well advised to start developing skills in a well-paying occupation before they complete high school. Also, many employers are looking for employees who studied and have an ability to apply mathematics in new contexts (ACME, 2011) given that poor literacy and numeracy skills could do harm people's lives and their employment (CBI, 2007).

It is also notable that based on the Copenhagen Process the European Commission highlights vocational education and training to make the courses relevant to labour market through various attempts, i.e., European Centre for the Development of Vocational Training (Cedefop) and European Training Foundation (ETF) and calling for cooperation within the EU countries and also countries outside the EU. Mathematics is fundamental to science and technical courses because students must know mathematics to use vocational skills effectively, i.e., without knowledge of mathematical formulas, students cannot understand physics. Despite the significance of vocational education worldwide, surprisingly, maths teachers' belief and practices regarding maths education in vocational high schools are overlooked, which remained little investigated. Also, as reviewed above, previous studies tended to investigate maths teachers' beliefs about mathematics teaching and classroom practices through qualitative case studies of one or a few teachers (see Thompson, 1992) or surveys. To the best of our knowledge, there is a paucity of research on mathematics education in vocational high schools and also mixed method has been rarely used to find out maths teachers belief and practices. As an attempt to remind the European Commission's call for maths education in the vocational school, including teachers' belief and classroom practices as well as vocational students' opinions, as well as to fill the gap described above, the present research has been designed. This study sets out to find out maths teachers' belief and classroom practices as well as vocational students'

opinions and researcher's observation for mathematics instruction in a state vocational high school in Turkey.

Method

Research Setting

The present research was conducted in a vocational high school in Turkey. In contrast to traditional high school curriculum, vocational school curriculum highlights training to equip vocational students with the necessary sills for the work life (Canning, 2013; Lauglo & Lillis, 1988). The need for qualified staff for workforce is increasing. It is notable that vocational students in Turkey are not selected on the basis of an academic achievement or aptitude and most of the vocational students are disadvantaged in terms of socio-economic background, i.e., many of the children from poor families or families with limited education and opportunities. All in all, vocational education is very different from traditional education and deserves to pay attention to meet the need for potential skilled workers worldwide.

Participants

In a state vocational high school in Turkey, 20 maths teachers and also 161 vocational students, who were studying in 9th, 10th, 11th and 12th grades, participated in this longitudinal study, making 181 volunteer participants in all. The year of experience of the teachers to teach maths ranged from 4 to 28. The participants represent the whole population in question. All of the participants were provided with information on the research aims.

Data Collection and Data Analysis

Through combining qualitative and quantitative methods, a mixed method was used in this research to better understand and explain the results of this study (see Creswell, 2009). Specifically, three types of data were collected for this study: (i) structured questionnaire, (ii) structured interview and (iii) semi-structured observation, for triangulation of data and to collect data from all of the stakeholders in the study, including, mathematics teachers, students

and the researcher. Thus, extensive data were obtained over two years. The underlying reason why mixed method was used that the present research sets out to reach valid and reliable data given that collecting data through using different types of instruments could help us to gain a better understanding of the research problem and we can benefit from the strengths of both qualitative and quantitative data (Tashakkori & Teddlie, 2003).

Questionnaire and Interviews

The structured questionnaire, which was used both for the maths teachers and vocational students, was piloted and refined and also examined by two educational researchers in a state university to build questionnaire items and design in a proper format. The questionnaire included 10 questions about maths and maths teachers' teaching. The first six questions were asked to find out the teachers and students' perceptions on maths courses and the last four questions were mainly about teachers' practices.

Two questions were present for maths teachers in the structured interview on their own practice while teaching maths:

(i) What is your reaction when your students solve a maths question correctly?

(ii) What is your reaction when your students solve a maths question wrongly?

Students' interview was regarding on the maths courses and maths teachers' practices in the vocational school. The interview questions were similar to the questions teachers responded, which were reported above:

(i) What was your maths teacher's reaction when you answered a question rightly? Please, explain through providing an example in light of your experience.

(ii) What was your maths teacher's reaction when you answered a question wrongly? Please, explain through providing an example in light of your experience.

(iii) What do you think about your maths teacher's knowledge and competency to teach maths?

Verbatim interviews were audiotaped and transcribed (Creswell, 2005). Interviews were used to validate other methods, in the present study questionnaire and observation, and to go deeper into individual responses to compensate for the potential missing points that the questionnaire revealed.

The interview data were analysed through content analysis to find the most frequent and salient themes to elucidate compatible and incompatible themes in students and teachers' data. The questionnaire data were analysed through calculating percentages for each question.

Observation

Because of the potential benefits of observation to reveal non-verbal behaviour in the natural setting in the vocational high school (Bailey, 1994), the observation was performed for the validity of the research findings in this study, which included observing teachers' maths course. Rather than relying on second-hand explanations, the observation enabled to look directly at what is taking place in situ. The semi-structured observation was significant to compare teachers and students' perceptions through "gathering 'live' data from naturally occurring social situation" (Cohen, Manion & Morrison, 2008, p. 396) to provide valuable insights into the accounts of teachers and students.

Results and Discussion

Questionnaire Results

There were 10 questions in the questionnaire. The questionnaire results revealed some similarities and differences between teachers and vocational students' perceptions about maths, maths course and also maths teachers' practices (see Table 1 and Table 2). Regarding the two items, there was a strong agreement among teachers and students. Almost all of the maths teachers (95%) but one teacher and most of the vocational students (86.9%) stated that in maths courses, it is significant that students understand the concepts and the aim of the question while solving the maths questions. A possible explanation for this agreement could be that students seem to be in favour of a process-oriented assessment rather than product-oriented assessment. Many students (64.6%) and almost all the teachers (95%) stated that maths is a tool through which students learn on their own, discover and use his/her creativity, which is inconsistent with Schoenfeld's study (1989). These findings suggest that most of the students and teachers are likely to be in favour of a deeper learning in maths rather than memorizing and doing

some arithmetic operations. Both teachers (70%) and students (48.5) agree that math ability may change later with environmental effects. The finding may imply that some students are likely to be unaware concerning constructivism, student-centred education and learner autonomy. 90 students (60%) expressed that maths course must be student-centred. This finding showed two different aspects of education, namely teacher control versus some student autonomy in maths education. Since 2005, although a constructivist based curriculum development approach has been used in Turkey, unfortunately, constructivism has not been used in practice by most of the teachers (but see Korkmaz, 2001; Yıldırım, Ozden & Aksu, 2001).

Most of the teachers (70%) were in favour of the idea that maths course should be in control of the teachers although there are teachers (60%) who expressed student centeredness. There were a few teachers who were unsure regarding who should take in charge of maths course. As for vocational students, 59% of the students were not in favour of the idea that math course should be in the control of teacher and 54.7% students were in favour of student-centred maths courses. This finding could somehow be consistent with Yılmaz's (2007) research in Turkish education context that found out that students had difficulty to take in charge of their own learning responsibility, i.e., learner autonomy (see Oxford, 2003, for learner autonomy).

It is surprising that most of the teachers (60%) agree that mathematics is a set of operations, while 55.3% students did not agree with this statement. Another different perception was that 60% of the maths teachers and only 36.5% students think that 'in maths courses, it is significant that students give correct answers while solving the questions' and mathematics is a set of operations. Regarding the item Math ability is inborn ability, there were different opinions: 40% of the maths teachers were unsure and 35% did not agree and 25% agreed. As for vocational students, 45.3% did not agree, 16.8% were unsure and 37.3% agreed.

Table 1.
Maths teachers' response to the questionnaire.

	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
1. Mathematics is a set of operations.	0	5 25%	3 15%	6 30%	6 30%
2. Mathematics is a tool through which students learn on their own, discover and use his/her creativity.	0	0	1 5%	10 50%	9 45%
3- In maths courses, it is significant that students give correct answers while solving the questions.	5 25%	12 60%	2 10%	1 5%	0
4. In maths courses, it is significant that students understand the concepts and the aim of the question while solving the questions.	0	1 5%	0	9 45%	10 50%
5. Math ability is inborn.	1 5%	6 30%	8 40%	4 20%	1 5%
6. Math ability might change later with environmental effects.	0	2 10%	4 %20	11 %55	3 %15
7. Math course should be in the control of teacher.	0	2 10%	4 20%	10 50%	4 20%
8. Math course should be student-centred.	0	2 10%	6 30%	11 55%	1 5%
9. I can understand all of the maths course materials.	0	2 10%	4 20%	10 50%	4 20%
10. I rely on my teaching method.	0	0	5 25%	11 55%	4 20%

The differences were mainly on the items 9 and 10 where the vocational students' perceptions were inconsistent with teachers' perceptions. First, most of the teachers' self-evaluation in terms of their comprehension of

maths course materials was very high (70%), while according to some students (61.5%), there were problems. Second, 75% of the teachers reported that they relied on their teaching methods, while many vocational students (53.4%) students expressed that they were not satisfied with their teachers' teaching methods. A notable finding was students' response about being unsure both for the ninth (21.7%) and tenth (19.3%) items.

Table 2.
Vocational students' response to the questionnaire.

	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
1. Mathematics is a set of operations.	38 23.6%	51 31.7%	17 10.6%	28 17.4%	25 15.5%
2. Mathematics is a tool through which students learn on their own, discover and use his/her creativity.	21 13%	31 19.3%	3 1.9%	58 36%	46 28.6%
3- In maths courses, it is significant that students give correct answers while solving the questions.	52 32.3%	74 46%	18 11.2%	12 7.5%	4 2.5%
4. In maths courses, it is significant that students understand the concepts and the aim of the question while solving the questions.	6 3.7%	10 6.2%	4 2.5%	62 38.5%	78 48.4%
5. Math ability is inborn.	29 18%	44 27.3%	27 16.8%	33 20.5%	27 16.8%
6. Math ability might change later with environmental effects.	26 16.1%	32 19.9%	25 15.5%	46 28.6%	32 19.9%
7. Math course should be in the control of teacher.	37 23%	58 36%	22 13.7%	26 16.1%	17 10.6%
8. Math course should be student-centred.	18 11.2%	24 14.9%	20 12.4%	56 34.8%	32 19.9%

Table 2.
Vocational students' response to the questionnaire (.../...)

	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
9. I think my maths teacher can understand all of the maths course materials.	41 25.5%	58 36%	35 21.7%	21 13%	6 3.7%
10. I rely on my maths teacher's teaching method.	39 24.2%	47 29.2%	31 19.3%	21 13%	13 8.1%

Interview Results

To gain in-depth information about teachers' belief and practices, students were asked three questions in the interview associated with their maths teachers' reaction when students solve a math question teacher asked (see Table 3).

Table 3.
Salient themes in the interview data from vocational students.

Interview Questions	Themes	N	%
Question 1- What was your maths teacher's reaction when you solved a question rightly? Please, explain through providing an example in light of your experience.	►Maths teacher became happy, praised and awarded me.	127	78.9%
	►Maths teacher did not react.	15	9.3%
	►Students who reported that they did not solve any math question and did not respond to interview question.	19	11.8%
Question 2- What was your maths teacher's reaction when you solved a question wrongly? Please, explain through providing an example in light of your experience.	►Maths teacher was positive, put effort for our motivation and learning.	66	41%
	►Maths teacher did not do anything to address when I answered the maths question wrongly.	58	36%
	► Students who reported that they did not solve any math question	19	11.8%

Table 3.
Salient themes in the interview data from vocational students (…/…)

Interview Questions	Themes	N	%
	and did not respond to interview question.		
	►Maths teacher got angry, teased me and gave punishment.	18	11.2%
Question 3- What do you think about your maths teacher's knowledge and competency to teach maths?	►No incompetency	61	37.9%
	►Paucity of maths knowledge and inability to teach maths.	53	32.9%
	►Incompetency regarding not involving students into the maths course or no action to make students enjoy the maths course	24	14.9%
	►The physical and personal weaknesses of the maths teacher	17	10.6%
	►There are problems.	6	3.7%

Interview Question 1- What was your teacher's reaction when you solved *a maths question correctly? Please, explain through providing an example in light of your experience.*

Students' interview data showed two salient themes for the reaction of the teacher when students answered a question correctly as follows: (i) teacher's positive feedback and award and (ii) teacher's non-responsiveness. 79.5% of the students reported that maths teacher was very happy when they answered the question correctly and showed very positive response, such as through embracing, giving awards in different ways, including good comments like well done or congratulations and giving plus marks. However, some students (8.7%) reported that teacher did not react and only said correct answer and moved to another question.

Interview Question 2- What was your maths teacher's reaction when you solv*ed a maths question wrongly? Please, explain through providing an example in light of your experience.*

It is notable that when we compare students' perceptions with teachers' practice and reports, there were various inconsistencies in the interview data,

particularly on the teacher's reaction when the students answered a math question wrongly. For this question, data analysis indicated three strong themes as follows: (i) teacher's non-responsiveness to compensate for the students' paucity in math knowledge, i.e., asking the question to another student; (ii) giving punishment through negative behaviour, i.e., getting angry, discouraging comments, "I would be surprised if you could solve the question" or that " you may answer in another question, what redundant people you are!"; (iii) positive reaction to help students to learn and increase motivation, i.e., teacher's explanation for students' mistakes and help students find the correct answer. This finding echo Taylan and da Ponte's (2016) research that calls for scaffolding students in maths course when students gave partial answers to a maths question.

In addition to these two questions, students were asked a further question to mirror their perceptions in depth:

Interview Question 3- What do you think about your maths teacher's knowledge and competency?

There is an association between maths teacher's knowledge and effective maths education. Consisted with the questionnaire results, students' perceptions and observations on maths teachers' competence included many criticisms both on the teachers' teaching styles and personality (see Guler &Celik, 2018 about findings on the maths teachers who were lack of content knowledge about linear and non-linear functions in maths). Some extracts that showed the most highlighted salient themes in the interview data for the incompetency of the math teachers are provided below:

Student 3: Maths teachers were solving the questions wrongly.

Student 97: Although some teachers had the maths knowledge, they did not have teaching skills. They were only teaching and did not give us an opportunity to solve the questions and we could not share our questions and opinions.

Student 11: The teacher was very old, and it was challenging for us to understand what he/she taught.

Student 32: The teacher was not willing to teach, and the math course was boring.

Student 51: The teacher did not know how to teach maths.

Student 88: Teacher's teaching method was wrong. Thus, the maths topics were not clearly thought.

Student 145: Maths teachers did not know the course contents, so the courses were very superficial.

The problems students reported highlight lack of teaching skills among maths teachers and also paucity of subject knowledge, which needs to be further researched.

In the same vein, the maths teachers were asked similar interview questions as self-reflection concerning themselves and practices as follows to compare students and teachers' perceptions. It is surprising that teachers' responses in the interview and questionnaires were a reflection of an ideal atmosphere of teaching and inconsistent with students' responses.

Interview Question 1- What was your reaction when your student solv*ed a question correctly? Please, explain through providing an example.*

Teachers' reports were full of positive statements both for the correct and wrong answers students gave when asked a question in math. The themes under teachers' reaction for correct answer were in line with students' reports. Teachers commented that when students solve the maths questions correctly, they feel happy and satisfied. Maths teachers reported that they provide positive feedback and award. Some extracts from the interview data:

Maths teacher 3: I became happy because when my student answers the question, I understand that the topic addressed during maths course is understood and I congratulate my student and even gave a good mark from performance.

Maths teacher 12: I assess positively in the performance form.

Maths teacher 17: I congratulate with supportive and motivating sentences.

Also, some maths teacher expressed that they feel happy and satisfied when students solve the questions:

Maths teacher 1: I become happy and reflect my happy mood to the classroom.

*Interview Question 2- What was your reaction when your student solv*ed *a question wrongly? Please, explain through providing an example*.

In contrast to most of the vocational students' answers regarding maths teachers' reaction, almost all of the teachers claimed that they were constructive even students cannot answer the maths questions or solved a question wrongly. Maths teachers claimed that they used two types of coping

strategies: The first strategy most maths teachers explained was revising the maths course topic addressed in the classroom associated with the question and trying to teach the parts that students have not learned when students could not response their questions.

Some extracts from interview with maths teachers:

Maths teacher 7: I question why students could not solve the question I asked. I try to identify how this happened and help the students to answer correctly.

Maths teacher 11: I get upset and try to repeat the math subject the question I asked is associated.

Maths teacher 20: I solve the question and then ask another question to control whether the student understood.

Second strategy maths teachers stated they used was guiding students towards the correct answer and help to answer the question. Some extracts from interview with maths teacher:

Maths teacher 2: I ask different questions to make students understand their wrong answer and help to solve the maths question I asked.

Maths teacher 5: I say that the answer is wrong and ask him to come in front of the board and we solve the question together.

Maths teacher 14: I am aware that wrong answers of students are as significant as correct answers. Thus, instead of saying "wrong", I say "what about following this or that way" to guide my student to find how to solve the question I asked.

Maths teacher 19: I explain student where the mistake is and ask the student to try to solve the same question again.

Observation

Researcher's two years of observation confirms the data on maths instruction collected from vocational students. For example, it was observed that when students come to the teacher's room in the vocational school, some teachers do not allow students to ask questions maybe because of their fear not to be able to solve the questions students asked among their colleagues and they may think that this could be face-threatening. Because the research setting is a vocational high school and the students tend to have lower math ability compared to other types of schools in high education, teachers appear to be unwilling to teach and improve themselves. Also, when students, who are

preparing for the university examination, asked the questions to the maths teachers, some teachers could not solve and showed the door to the students and some teachers asked the question to other maths teachers. There were complaints among the students in the classroom and among the teachers in the teachers' room that the physical and pedagogical inadequateness in the vocational school affects maths education negatively. Observation results were inconsistent with maths teachers' belief and practices but support vocational students' perceptions. This finding is consistent with many of the previous studies (Clark & Peterson, 1986; Raymond, 1997; Thompson, 1984).

Pedagogical Implications for Mainstream Math Classroom

Given the literature and findings discussed above, the stakeholders in education, including headmasters, teachers, students and parents, should be consulted to assess the math instruction process for more effective student-centred education. A systematic needs analysis is needed to address the needs, expectations and also problems encountered to teach maths effectively. Vocational students should be encouraged to achieve higher academic and vocational maths skills that are needed to join the workplace.

The weakness or criticisms raised by both teachers and students should be welcomed and discussions for the enhancement of maths teaching during education should be handled critically in a constructive way. As the research conducted by Borko et al., (1997) suggests teachers could change their practices when we situate the change process in the actual contexts where new ideas are implemented is an effective strategy.

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