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Pre-engineering students' perception of mathematics teachers' knowledge and instruction

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ABSTRACT

The prime aim of the study was to investigate and understand first-year pre-engineering students' perceptions about mathematics teachers' knowledge and instruction. A case study method was employed as a mode of inquiry and a Likert-type survey for data collection. Participants included 158 first-year pre-engineering students and five mathematics teachers from Assosa University, Ethiopia. IBM SPSS statistics 20 was used to analyze the quantitative survey data, and open-ended qualitative questions were analyzed by creating common themes. The mean score for each category of teachers' knowledge was computed. Accordingly, the higher mean was obtained for subject matter knowledge, and the lower mean was obtained for instructional representation and strategies category. The study revealed that students believe their teachers' subject matter knowledge is constructive. Students have confidence in their teachers' subject matter knowledge. However, students also believe that their teachers' teaching methods and overall instructional strategy should be improved. Finally, we proposed that students' evaluation of their teachers' knowledge can develop higher education teachers' professional growth to improve engineering students' mathematics teaching and learning.

Keywords: students' perception, teachers' knowledge, instruction, subject matter knowledge, instructional representation and strategies

INTRODUCTION

Many educational variables impact students learning in the classroom, including students' awareness of the adequacy of the classroom environment, pre-instructional strategies, formative testing, teaching style and instruction, representations used, and examples provided (Byers et al., 2018; Fraser, 2012). Several studies have been conducted to track the factors that can influence students' learning outcomes. Many of the factors listed above are similar to basic knowledge studies that teachers need to know (Shulman, 1986, 1987).

Many researchers have defined and classified teacher knowledge differently and with various conceptualizations. In the mid-1980s, Shulman (1886, 1987) conceptualized a teacher knowledge framework as a teaching knowledge base. Pedagogical content knowledge (PCK) is the most widely researched and practical knowledge base among the various knowledge categories (Shulman, 1986, 1987). PCK is defined as the knowledge base required for effective teaching. PCK is that unique blend of content and pedagogy that is only available to teachers (Shulman, 1987).

Cochran et al. (1993) extended the concept of PCK by using the term *'pedagogical content knowing,'* which was developed based on a constructivist understanding of the teaching and learning process. In this expanded version of PCK, teachers' PCK is defined as an actively evolving knowledge of pedagogy, content, students, and context. According to Ball et al. (2008), PCK is one of the mathematical knowledge for teaching domains in mathematics education. Ball et al. (2008), with the main sub-domains of the PCK framework, argued that knowledge of content, students, teaching, and content and curriculum are essential areas of knowledge for teachers at all levels.

Perception is the process of recognizing and interpreting stimuli registered by the senses (Rookes & Willson, 2005). It is learning, memory, and expectations, rather than passive sensory input, shaping perceptions. Goldstein and Brockmole (2016) stated that perceptions create an experience of the environment and enable people to act within it. Students' perceptions of a mathematics teacher's knowledge should confirm ideas about perceiving or viewing the teacher's knowledge. Examining students' perceptions of teachers' knowledge is essential because it provides a wealth of information for understanding students' thought processes and classroom processes.

THE PROBLEM STATEMENT

The continual professional development of university teachers has received much attention in recent years in different countries (Chadha, 2021; Jang, 2011; Jang & Chen, 2013). In Ethiopia, the higher diploma program (HDP) is available at all higher education institutions. The HDP's goal is to enhance the quality of higher education through a licensing program that focuses on developing the skills and professionalism of university teachers. However, there is evidence that many college and university teachers with extensive subject knowledge do not teach effectively (Clarke & Hollingsworth, 2002; Jang et al., 2009; Major & Palmer, 2006). The reasons for this are that, unlike primary and secondary school teachers, college and university teachers are not required to obtain a teaching certificate (Jang, 2008a, 2008b, 2011), and university teachers require more pedagogical knowledge in addition to subject knowledge (Hashweh, 1987; Lenze & Dinham, 1994).

It has been argued that students' perception of teachers' knowledge and instruction impacts the career development of teachers. For instance, end-of-semester or course evaluations by students can be used to improve teachers' teaching methods and styles. However, caution must be exercised because student evaluations of teaching encourage poor teaching and contribute to grade inflation (Stroebe, 2020). From the student's point of view, a good teacher knows the subject well, explains things clearly, makes the subject interesting, teach students based on their understanding level, provides regular feedback, provides additional student support, has a good sense of humor, and is fair and consistent (Jang et al., 2009). However, previous studies of learning environments have seldom examined how students perceive teachers' knowledge and instruction.

Research mainly focuses on identifying the nature and substance of teachers' knowledge, identifying the difference and similarities between expert and novice teachers' knowledge as they enter the teaching, and suggesting ways to enhance teachers' professional development through pre-service and in-service modalities. The vast majority of research on teachers' knowledge has been conducted from the teachers' perspective (Xu, 2020). From the perspective of students, there is very little research available. Because students are exposed to various teachers in various subjects over a long period, they can be considered experts in various modes of teaching (De Jong & Westerhof, 2001). Students' perceptions and insights have been regarded as valuable and meaningful feedback for improving teachers' teaching effectiveness (Jang et al., 2013). Using students' perceptions, researchers and teachers can better understand the perceived instructional and environmental influences on students' thought processes (Tuan et al., 2000). Few studies have been conducted on how university students perceive their teachers' knowledge (Jang, 2011; Jang et al., 2009, 2013).

Pre-engineering students'[1] mathematics achievement has been low based on our experience and observation as insiders to the university. Without a strong mathematics background, learners usually struggle with other engineering subjects, resulting in shallow satisfaction with the overall engineering program (Mulugeta et al., 2015). Furthermore, insufficient mathematical abilities present a widespread problem throughout engineering undergraduate programs (Mulugeta et al., 2015). Students may even believe that mathematics is not an integral part of engineering education (King & Cattlin, 2015). The value of mathematics for engineers, on the other hand, is undeniable. To this end, teachers' knowledge and instructional strategy are critical in engaging students in classroom discussions and demonstrating how mathematics is applied in engineering professions.

This study investigates and understands first-year pre-engineering students' perceptions about their mathematics teachers' knowledge and instruction. In this study, students' perceptions of their teachers' knowledge and instruction were measured using features of the teacher's knowledge related to instruction, representation, and subject matter knowledge. Assessing a student's perception of a teacher's knowledge allows teachers to understand better how their knowledge is recognized in their teaching and how their teaching can be improved based on these students' perceptions. To this end, the study addressed the following two research questions:

1. What are the pre-engineering students' perceptions of mathematics teachers' knowledge and instruction?
2. What are teachers' reflections on their students' written responses to the survey's open-ended questions?

METHODS

The case study method was used to assess students' perceptions of their mathematics teachers' knowledge and instruction. The study used both quantitative (Likert-type scale survey) and qualitative (open-ended questions at the end of the survey) components, as well as teachers' reflection on students' written comments at the end of the survey (using probing questions like students commented on aspects you need to improve–what can you say about it?). The survey was carried out at the end of the semester.

Sample

Five mathematics teachers teaching the course "*Applied Mathematics I*" for pre-engineering students and their students (N=158) at Assosa University, Ethiopia, willingly partake in the study during 2020/21 academic year. Seven teachers were teaching the course in total. One was a recent BSc degree holder who was not considered due to a lack of teaching experience, and the

[1] Upon admission to the College of Engineering, the students are allowed to take some fundamental engineering knowledge, and common courses from the five-year BSc program, which is meant for taking the fundamental engineering courses and preparing the students to examine their interest in the discipline after completing the orientation. http://213.55.89.249/pre-engineering-school

Table 1. Demographic characteristics of students in five classes (N=158)

Sex	T_{01}	T_{02}	T_{03}	T_{04}	T_{05}
Male students	12	15	16	14	13
Female students	20	17	15	18	18
Total	**32**	**32**	**31**	**32**	**31**

Table 2. Profile of participant teachers

Code	Sex	AR	ACR	EL & AS	YT	Professional development
T_{01}	M	27-30	Lecturer	BSc+MSc (modeling)	1+5	• Become a teacher at a university, holding a BSc • Took HDP in 2020/2021 academic year
T_{02}	M	37-40	Lecturer	BEd+MSc (algebra)	0+14	• Become a teacher at a university, holding MSc • Took HDP training • Took JICA training
T_{03}	M	27-30	Lecturer	BSc+MSc (differential)	2+4	• Become a teacher at a university, holding a BSc • Took HDP in 2020/2021 acdemic year
T_{04}	M	37-40	Lecturer	BEd+MSc (differential)	7 8	• Become a teacher at a university, holding MSc • Took HDP training
T_{05}	M	27-30	Lecturer	BSc+MSc (numerical)	2+1	• Become a teacher at a university, holding MSc • No pedagogical training

Note. AR: Age range; ACR: Academic ranking; EL&AS: Educational level & area of study; YT: Years of teaching (school & university); HDP: Higher diploma program; JICA: Japan International Cooperation Agency

Table 3. Structure of SPOMTKI survey in the SMK & IRS for students (N=158)

Scale name	Number of items	Examples of items
SMK	12	My teacher has a strong content knowledge of mathematics (SMK1) My teacher explains the contents of mathematics clearly (SMK5)
IRS	18	My teacher uses different teaching activities to promote my learning of mathematics (IRS1) My teacher uses familiar analogies to explain concepts of subject matter (IRS7)

other, a female, was on maternity leave. Thus, only five teachers were taken. Their identities were coded as T_{01}, T_{02}, T_{03}, T_{04}, and T_{05}. **Table 1** describes the demographics of the students, and **Table 2** describes the profiles of the five participating teachers.

Research Instrument

The study adapted an instrument from “students’ perceptions of college teachers’ PCK” (Jang et al., 2009), “university students’ perceptions of instructor’s TPACK” (Chang et al., 2015), “middle school students’ perceptions of mathematics teachers’ PCK” (Xu, 2020), and “student perceptions of teachers’ knowledge” (Tuan et al., 2000) survey as a tool for data collection. The instrument is then named ‘students’ perception of mathematics teachers’ knowledge and instruction (SPOMTKI), which is used to investigate first-year pre-engineering students’ perceptions about their teachers’ knowledge and instruction.

The Likert-type survey consisted of 30 items divided into two categories; subject matter knowledge (SMK), which contains 12 items, and instructional representation and strategies (IRS), which contains 18 items of practices that might take place in the “*Applied Mathematics I*” course. Only two categories (SMK and IRS) were used for this study because they were the most significant ones identified in the literature (Chang et al., 2015; Jang, 2011) and were the most relevant to the overall study.

SMK refers to students’ perceptions of how well the teacher demonstrates the discipline’s purpose, subject matter, and idea. Students’ perceptions of the teacher’s use of a representational repertoire include analogies, metaphors, examples, and explanations, and the extent to which the teacher selects teaching tactics that challenge students’ initial concepts and activities for instruction referred to as IRS.

Table 3 describes the structure of the SPOMTKI scale as having two categories; SMK (12 items) and IRS (18 items), and sample items in the two categories.

Students were asked about their level of agreement or disagreement regarding how often each practice took place, on a five-point Likert-type survey, and an open-ended question about the overall strength and the aspects/points their teachers need to improve.

All survey data was coded. IBM SPSS statistics 20 was used to conduct a quantitative survey analysis. The internal consistency reliability of students’ responses to mathematics teachers’ perceptions of their knowledge and instruction was calculated. Cronbach’s alpha coefficient value of 0.86 was obtained on the survey tool, suggesting that students responded to this survey with a relatively high degree of consistency. Data from the quantitative survey were supported by open-ended qualitative questions, which are analyzed by generating common themes. Teachers’ reflections on students’ feedback were also used to collect qualitative data.

Ethical issues were considered when collecting data in the field and when analyzing and disseminating reports. To participate in the study, both teachers and students signed a consent form voluntarily. We collected the data by developing rapport with study participants and maintaining trust by explaining that the study would not harm them. Regarding confidentiality and involvement of any deception activity, we have shared our notes and all information with participants to avoid misinterpretation of the data. We used pseudonyms to protect the identity of the participants and assured them that the information would be used exclusively for research purposes.

Table 4. Students' perceptions of teachers' knowledge and instruction (N=158)

No	Items	SD	D	N	A	SA	M	SDV
1	My teacher has a strong content knowledge of mathematics.	5	19	28	52	54	3.83	1.124
2	My teacher does not have a strong content knowledge of mathematics.	10	30	31	34	53	3.57	1.299
3	My teacher makes mathematics interesting.	5	14	37	50	52	3.82	1.086
4	My teacher makes mathematics boring.	9	25	47	45	32	3.42	1.147
5	My teacher explains contents of mathematics clearly.	3	22	40	50	43	3.68	1.077
6	My teacher cannot explain contents of mathematics clearly.	8	25	27	48	50	3.68	1.217
7	My teacher selects appropriate content for students.	7	19	42	60	30	3.55	1.068
8	My teacher does not select appropriate content for students.	9	18	43	48	40	3.58	1.152
9	My teacher knows how mathematics is related to engineering.	9	28	33	52	36	3.49	1.188
10	My teacher did not show us how mathematics is related to engineering	14	30	33	41	40	3.40	1.292
11	My teacher knows answer to questions that we ask about mathematics.	5	18	34	54	47	3.76	1.097
12	My teacher did not know answer to our questions about mathematics.	10	17	37	42	52	3.69	1.215
Subject matter knowledge (SMK)							**3.61**	**0.61**
13	My teacher uses different teaching activities to promote my learning of mathematics.	15	26	46	28	23	3.24	1.175
14	My teacher did not use different teaching activities to promote my mathematics learning.	10	23	48	43	34	3.43	1.164
15	My teacher uses a variety of teaching approaches to teach different topics.	12	25	50	37	34	3.35	1.200
16	My teacher uses a single teaching approach to teach different topics.	12	36	50	37	23	3.15	1.156
17	My teacher understands my mathematics needs.	12	22	48	46	30	3.38	1.165
18	My teacher did not understand my mathematics needs.	13	26	48	35	36	3.35	1.231
19	My teacher uses familiar analogies to explain concepts of subject matter.	11	23	49	44	31	3.39	1.161
20	My teacher uses unfamiliar analogies to explain concepts of subject matter.	7	25	44	45	37	3.51	1.144
21	My teacher's teaching methods keep me interested in mathematics.	14	28	56	36	24	3.18	1.159
22	My teacher's teaching methods makes me to dislike mathematics.	10	29	57	28	34	3.30	1.181
23	My teacher provides opportunities for me to express my point of view.	18	20	47	47	26	3.27	1.214
24	My teacher does not allow me to express my point of view.	7	25	54	29	43	3.48	1.177
25	My teacher helps me increase my interest in mathematics learning.	10	22	53	40	33	3.41	1.151
26	My teacher does not help me increase my interest in mathematics learning.	13	18	52	29	46	3.49	1.250
27	My teacher uses multimedia or technology (e.g. PowerPoint) to express concept of subject.	33	29	50	21	25	2.85	1.332
28	My teacher did not use multimedia or technology (e.g., PowerPoint) to express concept of subject.	16	26	51	25	40	3.30	1.289
29	My teacher shows us activities that I can use to continue my mathematics study.	13	28	59	30	28	3.20	1.172
30	My teacher did not show us activities that I can use to continue my study of mathematics.	14	21	45	31	47	3.48	1.285
Instructional representations & strategies							**3.32**	**0.59**
Perceptions of teachers' knowledge & instruction							**3.47**	**0.53**

Note. *SD: Strongly disagree; D: Disagree; N: Neither agree/disagree; A: Agree; SA: Strongly agree; M: Mean; SDV: Standard deviation

RESULTS

This section discusses the study's findings on students' perceptions of their teachers' knowledge and instruction. We will discuss why the five teachers differ based on student responses to the survey in the following section. The descriptive statistics for students' perceptions of teachers' knowledge and instruction are shown in **Table 4**. Accordingly, the average students' perception of teachers' knowledge and instruction was nearly 3.5 (between neither agree/disagree and agree) (M=3.47), with mean values of SMK (3.61) and IRS (M=3.32). **Table 4** also shows that the mean scores for the SMK (M=3.61, SD=0.61) categories were higher than the mean scores for the IRS (M=3.32, SD=0.59) categories when comparing the five teachers.

In the SMK category, students agreed that their teachers had strong content knowledge of mathematics and made mathematics enjoyable (106) 67.1% and (102) 64.6%, respectively; however, students disagreed that their teachers showed them how mathematics is related to engineering (44) 27.8%. In the IRS category, students agreed that their teachers use unfamiliar analogies to explain subject matter concepts (82) 51.9%; however, they disagreed that their teachers use multimedia or technology to express the concept of the subject (62) 39.2%. The remaining items fall into the "neither agree/disagree" and "agree" categories. From the two categories of teachers' knowledge and instruction discussed, SMK was higher, while IRS was perceived to be lower, making it difficult to understand the lesson and ultimately impacting their learning. In aggregate, approximately 31.7% of students strongly agreed that their teachers' SMK or IRS were good. However, the remaining (68.3%) believed that their teachers' SMK and IRS are insufficient and that a professional development program for teachers is needed to address the issue.

Table 5 shows the descriptive statistics (average means and standard deviation) for each of the five teachers' vis-à-vis students' responses to the two categories of the survey. As we can see from **Table 5**, all five teachers in each of the two categories have an average mean score higher than the mean score of 3.0. The mean score of T_{02} is the highest in the SMK category, while that of teacher T_{03} is the lowest. Similarly, teacher T_{04} has the highest mean score in the IRS category, and teacher T_{03} has the lowest.

Portrayal of T_{01}

The data in **Table 5** shows that T_{01} had a high mean score on SMK (M=3.71, SD=0.49), followed by IRS (M=3.3, SD=0.39) categories. These ratings indicate that the survey items investigated were in the scope of "neither agree/disagree" and "agree." Students rated T_{01}'s SMK as rich and encouraging, as depicted in **Table 5**. However, they noted that his knowledge of instructional representations and strategies had to be improved. In the open-ended questions, the students gave positive feedback on the overall strength of T_{01}'s and some suggested areas where he should improve. Students thought T_{01} had good subject matter

Table 5. Students' responses for the five teachers

Teacher	Category	Number of students	Mean	Standard deviation
T_{01}	SMK	32	3.71	0.49
	IRS		3.3	0.39
T_{02}	SMK	32	3.82	0.51
	IRS		3.41	0.65
T_{03}	SMK	31	3.25	0.47
	IRS		3.16	0.33
T_{04}	SMK	32	3.77	0.49
	IRS		3.5	0.75
T_{05}	SMK	31	3.5	0.84
	IRS		3.21	0.68

Note. SMK: Subject matter knowledge; IRS: Instructional representation & strategies

understanding and pedagogical skills. Furthermore, some students believe that the teacher is both enthusiastic and self-confident. Some students voiced their opinions toward teacher T_{01} regarding the suggested areas he should improve, including decreasing the speed of teaching, using his own time solely, providing students with opportunities to express their points of view, and using various forms of technology accessible. The teacher commented on students' feedback, particularly on the areas that needed improvement, saying, "students had a wide range of opinions. Some students dislike the course, while others enjoy it. There is no time available to do what students had suggested."

Portrayal of T_{02}

T_{02} has a high mean score on SMK (M=3.82, SD=0.51), followed by IRS (M=3.41, SD=0.65) categories. The rating values suggested that the investigated questions fall into the "neither agree/disagree" and "agree" categories. Students rated T_{02}'s SMK as rich and inspiring. They did say, however, that his IRS could be improved. The students gave positive feedback on T_{02}'s overall strength in the open-ended questions. Students generally believe that T_{02} understood what he was teaching and had an excellent understanding of the pedagogical skills needed to teach the subject. Some suggested areas that he should improve include using different technologies available, providing more examples, and giving different classroom activities to enhance what students are learning. The teacher reflected his views on student feedback, particularly on areas of improvement, and said: Due to COVID-19 interruption, there was not much time to practice examples, do classroom activities, and use technology.

Portrayal of T_{03}

The data in **Table 5** shows that T_{03} relatively high mean score on SMK (M=3.25, SD=0.47), followed by IRS (M=3.16, SD=0.33) categories. Students rated T_{03}'s SMK as acceptable and encouraging. However, they noted that his knowledge of the IRS needs some improvement. In the open-ended questions, the students provide positive feedback about the overall strength of T_{03}. Students generally said that T_{03} has good knowledge of mathematics and his teaching method makes them interested in learning. In addition, some students believed that the teacher was disciplined, came to class on time, and covered all topics in the unit.

On the other hand, students also suggested areas of improvement they need from the teacher, including reducing the teaching pace, improving the teaching techniques, being prepared to teach all topics, using different techniques, using his knowledge correctly, and avoiding teaching by a projector and give good grades. When the teacher was allowed to reflect on students' views towards him, particularly on the areas of improvement, he argued that he had no trouble teaching different topics and used his knowledge and capacity to teach the subject. He said he uses a projector because of time shortage due to COVID-19. He finally confessed that he would improve his pedagogy due to the ongoing HDP module he is completing.

Portrayal of T_{04}

T_{04} also has a high mean score on SMK (M=3.77, SD=0.49), followed by the IRS (M=3.5, SD=0.75). Students rated T_{04}'s SMK as acceptable and inspiring. However, they noted that his knowledge of the IRS needs improvement. Written responses from students about T_{04} strengths indicate that he has good knowledge of mathematics and uses various teaching methods to explain contents to students. In addition, he uses a variety of learning activities to explain, and the students found his teaching methods attractive and unreserved sharing of his knowledge. Similarly, some other students shared their views on areas the teacher needs to improve: teaching pace and speed in the classroom, focusing on vague concepts, and classroom management. When the teacher was given a chance to reflect on students' views, he argued that students do not have enough time to practice and, in some cases, ambiguity may be related to students' background knowledge.

Portrayal of T_{05}

According to the data in **Table 5**, T_{05} also has a relatively acceptable mean score on SMK (M=3.5, SD=0.84), followed by IRS (M=3.21, SD=0.68). Students rated T_{05}'s SMK as solid and encouraging. However, his knowledge of the IRS is not as encouraging and positive in the eyes of his students. According to students' comments, T_{05} is an interesting and the right teacher for the mathematics course. On the other hand, students comment on some areas for improvement, including using different books and reference materials rather than relying solely on handouts, work activities from the handout, and adequate preparation prior to the class. The teacher was asked to reflect on students' view, particularly on the areas of improvement, and he argued that the students' attitude is highly different. Some students do not like the course, and some do. The survey provides information on whether the student's learning style matches the teacher's way of teaching.

DISCUSSION

The study aimed to investigate and understand students' perceptions of university mathematics teachers' knowledge and instruction while teaching the "*Applied Mathematics I*" course to pre-engineering students. The following section discusses students' perceptions of teachers' knowledge and instruction, the teacher's response to the survey's remarks, and the reasons for the discrepancies among the five teachers in terms of the two SPOMTKI categories.

As shown in **Table 5**, the mean score of the five teachers was higher than the average mean score. However, there were significant individual differences between the mean scores of the five teachers in the two categories of the SPOMTKI (SMK and IRS) instrument. For example, in the SMK category, T_{02} had the highest mean score (M=3.82, SD=0.51), and T_{03} had the lowest mean score (M=3.25, SD=0.47). Looking at the profiles of participating teachers in **Table 1**, T_{02} becomes a university teacher after completing a MSc. having 14 years of experience and taking both HDP training and JICA training, which can contribute to having the highest SMK mean score. Likewise, T_{03} becomes a university teacher after completing a BSc degree, having six years of experience, and taking HDP in the same year when this study was conducted can contribute to the lowest mean score. Having pedagogical training and more years of experience contributes significantly to having a greater SMK as students perceive. These results are in agreement with the literature. If the teacher does not possess the required knowledge of the subject matter in his area, teaching cannot be effective (Ntibi et al., 2020).

As shown in **Table 5**, in the IRS category, T_{04} had the highest mean score (M=3.5, SD=0.75), and T_{03} had the lowest mean score (M=3.16, SD=0.33). When we see the profiles of the participating teachers from **Table 1**, T_{04} becomes a university teacher after completing his MSc, completed HDP training, and has 15 years' work experience, which contributes to having a high mean score in the IRS category. T_{04} had a BEd his first degree, and T_{03} had BSc in his first degree, which may contribute to their high and low IRS, respectively. These results indicate that more experience and pedagogical training contributed significantly to the IRS category of the instrument. Teaching experience and pedagogical training play a substantial impact on the professional growth of teachers (Jong et al., 2005; Major & Palmer, 2006; Van Driel et al., 2001).

When we compare written comments from students, T_{02} received the slightest criticism compared to T_{03}, indicating that students' responses to open and closed-ended questions were consistent. Similarly, the IRS category for the teachers with the highest and lowest mean scores on the survey is the same. Students' written feedback has given teachers insight into their students' perception of their knowledge and pedagogy.

During the discussion with teachers, we observed that teachers tend to accept most of the comments and critiques from their students and promise to improve in general and their classroom instructional practices in particular. T_{03}, for instance, reflected that because he is taking the HDP, he will improve his teaching strategies. Based on the findings, we can conclude that student evaluations of teaching should be used for ongoing professional development and teaching improvement rather than evaluating teaching performance (Ministry of Education, 2021). To that end, by understanding students' perceptions, we can use the survey to determine whether the teacher met the expected goal (Halim et al., 2014). On the other hand, traditional end-of-semester evaluations produce little feedback and are too late to assist instructors in making teaching improvements (Jang, 2011) and should thus be used in the middle of the semester. Nilsson (2008) asserted that a teacher's reflection could positively impact a teacher's knowledge base.

As per the information in **Table 4**, SMK (M=3.61, SD=0.61) is a higher mean score than IRS (M=3.32, SD=0.59) based on descriptive statistics from the SPOMTKI survey in two categories. This is consistent with the findings of Major and Palmer (2006), who noted that university teachers have more content knowledge than instructional knowledge. Although studies have focused on the knowledge of primary and secondary school teachers, there is still a need for examples and theory in the context of teachers with more mathematical preparation and older students with diverse and complex experiences in learning mathematics (Hauk et al., 2014). The most critical factors influencing students' academic achievement, according to students, were subject mastery and appropriate instructional strategies (Ntibi et al., 2020).

CONCLUSION AND IMPLICATIONS

One hundred fifty-eight students from five sections filled out a survey about their perceptions of mathematics teachers' knowledge and instruction. Overall, students provided positive feedback on the survey items. For example, while teachers' differences could be explained by their preparation, experience, and professional development, all students agreed that teachers have sufficient knowledge of the mathematics they teach. Students also agreed that they understood and followed the classroom instructions. According to students' perceptions, all five teachers have a high mean score in the SMK category and a low mean score in the IRS category.

We found that university students' perceptions of mathematics teachers' knowledge and instruction varied. The fact that all of the five teachers teach a similar course and the students were in a similar group necessitating that it would be beneficial for the five teachers to collaborate and learn from one another. Researchers can use the survey developed in this study to understand students' perceptions and, as a result, determine whether or not teachers met the expected goals (Jang, 2011; Tuan et al., 2000). The assessment of teachers' knowledge by students is not limited to a few observations or interviews but is based on the opinions of all students (Jong et al., 2005). However, quantitative survey data cannot portray the factors influencing teachers' professional development, nor can it be used to assess content-specific details (Chang et al., 2015). The researchers gathered additional qualitative data to cross-validate the research findings, including open-ended student opinions.

Based on these findings, it is suggested that teachers attend conferences, seminars, and workshops to improve their subject knowledge and the way they present content to students. In this study, the survey investigation was conducted at the end of the semester, but it would be better if it were done at the beginning, middle, and end of the semester to allow the teacher to grasp students' needs and ideas. Furthermore, teachers or researchers should encourage students to respond to the survey's open-ended questions to explain their quantitative scores.

The study did, however, have some limitations. The study focuses on students' (N=158) perceptions of mathematics teachers' (N=5) knowledge and instruction for practical and manageability concerns in the "*Applied Mathematics I*" course. This limits the study's generalizability to some extent. Furthermore, because the study is exploratory, experimental conclusions cannot be drawn at this stage. Future studies may employ experimental designs with student-perceived SPOMTKI instruments to obtain more reliable results. Further studies are needed to track teachers' knowledge and instruction in various universities across Ethiopia.

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