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# Mathematics Teachers' Self-Efficacy Beliefs Survey in all Levels of Education in Bukidnon, Philippines

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## ABSTRACT

The quantitative study was undertaken to examine the teachers' self-efficacy beliefs in Mathematics in all levels of education in Bukidnon, Philippines. A Mathematics Self-Efficacy Beliefs Questionnaire developed by Benjamin (2003) and Bandura (1994) on a five Likert scale was adopted. Before the use of the questionnaire, it was tried out to thirty (30) Mathematics Teachers not included in the study. The questionnaire was found valid and reliable with alpha reliability coefficient of 0.75 which indicates the instrument is reliable. The instrument was administered to 160 Mathematics teachers from the elementary, secondary, and tertiary levels. Their responses were analyzed using factor analytic method. A principal factor with iteration was employed. Likewise, varimax rotation method was also used. Results of the study show five factors with eigenvalues greater than one emerged from the factor analysis of the Mathematics teacher's response to the self-efficacy beliefs scale. These factors will inform the administrators on the teacher quality and effectiveness/self-efficacy in Mathematics teaching. Understanding the self-efficacy beliefs can be useful to teacher education programs in improving teaching effectiveness and beliefs of teachers in the educational system.

**Keywords:** *self-efficacy beliefs, factor analysis, eigenvalues, varimax rotation*

## INTRODUCTION

From the standpoint of human welfare, teaching is one of the most important professions. Teaching is also one of the most technical, difficult and challenging professions. It is also considered as the greatest of the arts because the medium is the human mind and spirit. Also, teaching as a profession requires strong and adequate preparation through attendance in a teacher training institutions.

In the study of Shavelson and Stern (1991), the teacher has changed from a paradigm on methodological framework of technical rationality, which was dominant up to the 1970's to one of "thinking teachers." Teachers instead of being technicians who apply instructions, are constructive who process information, make decisions, generate routines and practical knowledge, and have beliefs that influence their professional activity to a great extent as a consequence of pedagogical content knowledge. The teacher thinking paradigm has evolved recently toward a higher degree of compromise with the specific content that teachers teach (Anderson & Mitchener, 1994; Marcelo, 1993).

Sherman (1994) considers that together with general psycho-pedagogical knowledge and knowledge of the subject matter, teachers develop specific knowledge, which he termed pedagogical content knowledge, concerning the form of teaching their subject. The teacher is the mediator who transformed content into depictions comprehensible to the students. Teachers' strategies depend very much on the material being taught and their classroom practice and activities on the subject the reason being that any given material has certain associated beliefs and traditions about how to teach best and learn it (Stodalsky, 1991).

Several studies reported that the beliefs of a teacher in its capacity to teach influence their classroom practices. Researches in education further suggested that teachers' beliefs relate to their classroom practice (Thomson, 1992; Fang, 1996 & Kagan, 1992). More so, Broply & Good as cited by Fang (1996) stressed that a better understanding of teachers' beliefs system or conceptual base will improve the instructional effectiveness. It has claimed that teacher' beliefs in their abilities to instruct the learners influence the academic performance which are strong indicators of instructional effectiveness.

Bandura, in the study of Harms and Knoblock (2005) proposed that individual's beliefs or efficacy expectations are major determinants of activity choice, willingness to extend effort and persistence in works. Therefore, beliefs systems are described as dynamic in nature, undergoing change and restricting as individuals evaluate their beliefs against their experiences (Thomson, 1992). Moreover, Pajares (1992) contend that teacher's beliefs influence their perceptions and judgments, which, in

turn, affect their behavior in the classroom. Furinghetti (2007) also point out, that teachers' beliefs are part of the knowledge for teaching, organized into a dynamic system, and in a dialectic relationship with practice.

Richardson (1996) highlights three major sources of teachers' beliefs: personal experience, experience with schooling and instructions, and experience with formal knowledge – both school subjects and pedagogical knowledge. It is argued that teachers may have been influenced by the way they acquired work-related knowledge in their first occupations, although without direct observations of their practice, it is impossible to confirm this according to Robson (2002).

Likewise, Posner, Strike, Hewson & Gertzog, as cited by Mira (2001) suggested that for existing beliefs to be replaced or reorganized, new beliefs need to the intelligible and appear plausible. In addition, the beliefs that teachers hold about the subject he is teaching and how it is learned is certainly influenced by the approaches he has learned from courses along this subject (Herrington & Cockcroft, 1992).

Munby (1994) stressed that poor teaching practices are linked to inadequate teacher beliefs about the subject matter. This is substantiated by Zallman and Emanual (1992) in their study that shows an evidence that teachers' beliefs influence their instructional practice and academic performance among the learners. The studies of Herrington and Cockcraft (1992) as well as that of Kajolan (1991), strongly support those classroom teachers' beliefs about the subject they are teaching being related to the way teachers teach the subject, and teachers' general classroom practice, Likewise, Richards and Killer (1994) point out that teachers adherence to a particular set of teaching beliefs/efficacy may affect instructional effectiveness among the learners.

A large and growing body of research data indicate that the preparation and ongoing professional development of teachers in Mathematics and Science needs rethinking and improvement on a large scale (Holmes Group, 1995; Hwang, 2003; National Research Council [NRC], 2001; National Science Foundation, 1996; Rodriguez, 1998; Sanders and Rivers, 1996; Wright et al., 1997; Wu, 2004). They found out that teacher preparation programs are characterized by a lack of coherence and articulation across the general education, science education and professional education curriculum strand (NRC, 1997,p. 9). Even though most programs require prospective elementary school teachers to have a major in a discipline other than education, few of them choose majors in mathematics and science. Within this trend of program designing, prospective teachers received inadequate preparation in certain subject areas, for instance, mathematics and

science education. It led to the insufficiency of in-depth content knowledge and conceptual understanding and efficacy of mathematics and science needed for teaching these subjects effectively at all grade levels (Wu and Chang, 2005). Hence, this is the object of the study.

This study aimed to examine the mathematics teachers' self-efficacy beliefs in Bukidnon. Specifically, this study sought to: describe the mathematics teachers' self-efficacy beliefs; identify the constructs to describe the mathematics teachers' self-efficacy beliefs; and ascertain the factors used to describe the mathematics teachers' self-efficacy beliefs.

## METHODOLOGY

The study employed a quantitative research methodology. It applied both the constructivist and behaviorist theories of learning and teaching. The study was conducted in Bukidnon from both private and public elementary, secondary, tertiary and graduate levels of education. There are three (3) divisions of the Department of Education understudied: the Division of Bukidnon, Malaybalay City, and Valencia City.

Mathematics teachers from elementary and secondary schools were sampled using the multi-stage sampling technique while those from College and Graduate Schools used the purposive sampling. Based on the samples chosen, they were taken as respondents of the study for S.Y. 2010-2011.

In gathering the necessary data, permission was asked from the Regional Director of DepEd and CHED through a letter-request. Respondents were informed through a letter that they were chosen to take part in this undertaking, before giving them the questionnaires. They were given enough time to answer in order to obtain reliable results. The researchers personally distributed and retrieved the questionnaires from the respondents with the help of the DepEd supervisors and Presidents of each Institution.

After the data were gathered, they were scored and classified based on the problems of the study. Survey questionnaires were used to gather pertinent data. It covered the respondents' self-efficacy beliefs on teaching and learning of mathematics based on a 5-point Likert scale adopted from Benjamin (2003) and Bandura (1986). However, the scores were tried out to Mathematics Teachers not included in the study. The respondents were asked to respond to the list of items of importance in the teaching-learning process.

The following scoring procedure was used:

| Score | Range | Qualitative Description |
|---|---|---|
| 5 | 4.50-5.00 | Strongly Agree |
| 4 | 3.50- 4.49 | Agree |
| 3 | 2.50-3.49 | Uncertain |
| 2 | 1.50-2.49 | Disagree |
| 1 | 1.00- 1.49 | Strongly Disagree |

Descriptive Statistics such as mean and standard deviation were used to establish the parameters of the study such as the respondent's self-efficacy beliefs. Factor Analysis was used to identify the constructs of mathematics teachers' self-efficacy beliefs. To ascertain the description of the teachers' beliefs and efficacy, the cluster of factors was described based on the review of related studies and literature conducted.

## RESULTS AND DISCUSSION

Teaching is an extremely complex process. Research indicates the important role of teachers' self- efficacy beliefs about the teaching and learning of mathematics and how these connect with the practice of teaching mathematics. Table 1 shows the Mathematics Teachers' Self- Efficacy Beliefs. Of the forty-four (44) indicators, two (2) mathematics teachers strongly believed that "it is important to establish classroom control before one becomes too friendly with students" and "rewarding students for being good citizens is a good way to teach students to care about one another" with means of 4.60 and 4.54 respectively. These findings imply that mathematics teachers' self- efficacy beliefs conform with Ashton (1985) and Henson (2001) that teachers, with higher teaching efficacy, find teaching meaningful and rewarding, expect students to be successful, have positive attitudes about themselves and students, have a feeling of being in control and share their goals with students; and teacher efficacy is related to positive teaching behavior and student outcomes.

Table 1
*Mathematics Teachers Self- Efficacy Beliefs*

| Indicators | Mean | Standard Deviation | Qualitative Description |
|---|---|---|---|
| 1. It is important that I establish classroom control before I become too friendly with students. | 4.60 | 0.7286 | Strongly Agree |
| 2. I believe that expanding on students' ideas is an effective way to build my curriculum. | 4.10 | 0.7111 | Agree |
| 3. I like to make curriculum choices for students because they can't know what they need to learn. | 2.39 | 0.8759 | Disagree |
| 4. I base student grades primarily on homework, quizzes, and tests. | 3.58 | 0.8943 | Agree |
| 5. An essential part of my teacher role is supporting a student's family when problems are interfering with a student's learning. | 3.39 | 0.9911 | Uncertain |
| 6. To be sure that I teach students all necessary content and skills, I follow a textbook or workbook. | 3.70 | 0.8745 | Agree |
| 7. I teach subjects separately, although I am aware of the overlap of content and skills. | 3.30 | 0.8226 | Uncertain |
| 8. I wait for students to approach me before offering extra help. | 2.85 | 0.7692 | Uncertain |
| 9. When there is a dispute between students in my classroom, I try to intervene immediately to resolve the problem. | 2.23 | 0.9626 | Disagree |
| 10. I believe students learn best when there is fixed schedule. | 3.84 | 0.8799 | Agree |
| 11. I adjust my lesson plan based on results of homework assignments. | 4.04 | 0.8419 | Agree |
| 12. I make it a priority in my classroom to give students time to work together when I am not directing them. | 3.64 | 0.1242 | Agree |
| 13. I encourage students to solve internal problems independently when doing group work. | 3.71 | 0.3028 | Agree |
| 14. I encourage students to discuss conflicts in group meetings. | 3.72 | 0.6670 | Agree |
| 15. I immediately tell students the correct answers when they cannot figure them out by themselves. | 3.05 | 0.9774 | Uncertain |
| 16. For assessment purposes, I am interested in what students can do independently. | 4.18 | 0.7229 | Agree |
| 17. I encourage students to resolve conflicts independently. | 3.94 | 0.7689 | Agree |
| 18. I invite parents to volunteer in or visit my classroom almost any time. | 3.55 | 0.7140 | Agree |
| 19. I prefer to assess students informally through observations and conferences. | 3.64 | 0.8429 | Agree |
| 20. I function in my classroom as a learner and partner in learning with my students. | 4.15 | 0.8103 | Agree |
| 21. I find that textbooks and other published materials are the best sources for creating my curriculum. | 3.80 | 0.8527 | Agree |
| 22. I encourage parents to follow up on classroom activities with students at home. | 4.39 | 0.7267 | Agree |

| Indicators | Mean | Standard Deviation | Qualitative Description |
|---|---|---|---|
| 23. I encourage students to suggest ideas for arranging our classroom. | 4.09 | 0.7914 | Agree |
| 24. It is more important for students to learn to obey rules than to make their own decisions. | 4.01 | 0.9417 | Agree |
| 25. When rules don't work, I change the rules based on my professional judgment. | 2.23 | 0.8538 | Disagree |
| 26. I often create thematic units based on the student's interests and ideas. | 3.80 | 0.7423 | Agree |
| 27. Rewarding students for being good citizens is a good way to teach students to care about one another. | 4.54 | 0.7460 | Strongly Agree |
| 28. I encourage discussions of different opinions and reasons. | 4.33 | 0.7229 | Agree |
| 29. I believe students learn most effectively when learning tasks are broken down into small sequential steps. | 4.19 | 0.7785 | Agree |
| 30. When children request my assistance, I turn the decision-making responsibility back to the child. | 3.16 | 0.7166 | Uncertain |
| 31. It is more effective to provide students with the information they need to know, rather than encouraging them to experiment. | 2.93 | 0.7647 | Uncertain |
| 32. I view conflicts between students as opportunities to foster their social and moral development. | 3.81 | 0.7647 | Agree |
| 33. It is very important that teachers enforce classroom rules once they are established. | 4.40 | 0.6462 | Agree |
| 34. I believe that encouraging competition among students motivates them to learn more. | 4.13 | 0.8146 | Agree |
| 35. I encourage students to monitor their own behaviors rather than comply with my authority. | 3.79 | 0.8325 | Agree |
| 36. When the mathematics grades of students improve, it is most often due to their teacher having found a more effective teaching approach. | 3.80 | 0.8745 | Agree |
| 37. I know the steps necessary to teach mathematics concepts effectively. | 4.03 | 0.7685 | Agree |
| 38. I am not very effective in monitoring mathematics experiments. | 3.49 | 0.8687 | Agree |
| 39. If students are underachieving in mathematics, it is most likely due to ineffective teaching. | 3.33 | 0.7374 | Uncertain |
| 40. I generally teach mathematics ineffectively. | 3.99 | 0.9179 | Agree |
| 41. The inadequacy of a student's mathematics background can be overcome by good teaching. | 2.04 | 0.8927 | Disagree |
| 42. I wonder if I have the necessary skills to teach mathematics. | 3.59 | 0.7078 | Agree |
| 43. Effectiveness in mathematics teaching has little influence on the achievement of students with low motivation. | 3.11 | 0.7360 | Uncertain |
| 44. When teaching mathematics, I usually welcome student questions. | 1.78 | 0.8684 | Disagree |
| **TOTAL MEAN** | **3.60** | | **Agree** |

Legend:

| | |
|---|---|
| 4.51- 5.0 | = Strongly Agree (SA) |
| 3.51- 4.50 | = Agree (A) |
| 2.51- 3.5 | = Uncertain (U) |
| 1.51- 2.5 | = Disagree (D) |
| 1.0 - 1.5 | = Strongly Disagree (SD) |

The other indicators for mathematics teacher efficacy beliefs are as follows: "It is very important that teachers enforce classroom rules once they are established";" I encourage parents to follow-up on classroom activities with students at home"; "I encourage discussions of different opinions and reasons";" I believe students learn most effectively when learning tasks are broken down into small sequential steps"; "For assessment purposes, I am interested in what students can do independently"; "I function in my classroom as a learner and partner in learning with my students"; and "I believe that encouraging competition among students motivates them to learn more." This implies that teachers were agreeable with the statements in the questionnaire. This means that the Mathematics teacher self-efficacy beliefs survey is a good instrument in evaluating the constructs on Mathematics teacher's self-efficacy beliefs as shown in Table 1.

However, there were three (3) indicators where the Mathematics teachers disagree. These are: "When rules don't work, I change the rules based on my own professional judgment"; "Where there is a dispute between students in my classroom, I try to intervene immediately to solve the problem"; "I like to make curriculum choices for students because they can't know what they need to learn"; "The inadequacy of a student's mathematics background can be overcome by good teaching"; and " When teaching mathematics, I usually welcome student questions". These findings indicate that mathematics teachers are adhering to the constructivist management since they always involve others in their activities especially in solving problems. This finds support on Benjamin (2003). On the other hand, there were indicators where the mathematics teachers were not certain. These are: "An essential part of my teacher role is supporting a students' family when problems are interfering with students learning"; "I teach subjects separately, although I am aware of the overlap of content and skills"; I immediately tell students the correct answer when they cannot figure them out by themselves"; "When children request my assistance, I turn the decision-making responsibility back to the child"; "It is more effective to provide students with the information they need to know, rather than encouraging them to experiment"; "If students are underachieving in mathematics, it is most likely due to ineffective teaching, and lastly, "Effectiveness in mathematics teaching has little influence on the achievement of students with low motivation".

On the whole, the mathematics teachers were agreeable with the statements in the questionnaire. These findings imply that the Mathematics teachers' self-efficacy beliefs survey is a good instrument for assessing teachers' self-efficacy beliefs.

Table 2 shows the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. As can be gleaned from the table, the KMO value of 0.690 shows the sampling is adequate since it is greater than the standard value of 0.600. This further indicates that the questionnaire is a sufficient tool in measuring the Mathematics teachers' self-efficacy beliefs.

Table 2
*Kaiser-Meyer-Olkin Measure of Sampling Adequacy*

| | | |
|---|---|---|
| KMO Measure of Sampling Adequacy | | 0.676 |
| Barlett's Test of Sphericity | Approximated Chi-Square | 2111.04 |
| | Degrees of Freedom | 946 |
| | Significance Level | .000 |

Table 3 reflects the principal component analysis which yielded five (5) factors with eigenvalues ranging from 1.808 to 6.251. The factors were rotated to a final solution using varimax method. These are extracted in a mechanical manner, and thus, not all of the factors are necessarily relevant since only factors with eigenvalues greater than or equal to 1.0 are significantly relevant and dimensional factors. Guilford, as cited by Amaza (1999), recommends factor analysis as the valid test for unidimensionality were it could cluster generated data by many statements into five or more groups.

Table 3
*Eigenvalues and Percent of Variance Explained*

| Factor Extracted | Eigenvalue | Percentage of Variance | Cumulative Percent of Variance |
|---|---|---|---|
| 1 | 6.251 | 14.207 | 14.207 |
| 2 | 3.224 | 7.327 | 21.534 |
| 3 | 2.238 | 5.087 | 26.621 |
| 4 | 2.107 | 4.788 | 31.409 |
| 5 | 1.808 | 4.109 | 35.517 |

Results of the study revealed that out of seventy-three (73) items subjected to reliability analysis, only forty-four (44) items were left and included for the scale in Table 4. The overall scale recorded a reliability alpha coefficient of 0.75. These findings imply that the scale is reliable for assessing Mathematics Teachers' Self-Efficacy Beliefs.

Therefore, the Mathematics Teachers' Self-Efficacy Beliefs Survey Scale used in this study is a good measure since all the items measure in the same direction with high item-total-correlation coefficient. This is in consonance with Amaza (1999).

The forty-four (44) items that were left with correlation coefficients 0.30 and above were grouped according to their construct. Table 4 shows the different constructs of the Mathematics Teachers' Self-Efficacy Beliefs. Data shows five (5) constructs with significant factor loadings. This confirms the study of Talisayon (1994) which revealed that all factors with values of 0.40 and above could be employed for evaluating the Mathematics Teachers Self-Efficacy Beliefs.

The rotated factors that were clustered as the self-efficacy beliefs of Mathematics Teachers namely: Behaviorist Teaching, Constructivist Teaching, Behaviorist Management, Constructivist Management and Professional Abilities. The four (4) factors were in agreement with Benjamin (2003) with an addition of one construct on Professional Abilities/ Teaching Effectiveness.

Table 4
*Factor Analysis of the Mathematics Teachers Beliefs and Efficacy Scale*

| Construct 1- Behaviorist Teaching | Significant Factor Loading | Qualitative Description |
|---|---|---|
| 28. I encourage discussions of different opinions and reasons. | 0.824 | Excellent |
| 29. I believe students learn most effectively when learning tasks are broken down into small sequential steps. | 0.701 | Very Good |
| 26. I often create thematic units based on the student's interests and ideas. | 0.519 | Fair |
| 45. When teaching science, I usually welcome student questions. | 0.478 | Fair |
| 16. For assessment purposes, I am interested in what students can do independently. | 0.393 | Poor |

| Construct 2- Constructivist Teaching | Significant Factor Loading | Qualitative Description |
|---|---|---|
| 11. I adjust my lesson plan based on results of homework assignments. | 0.775 | Excellent |
| 14. I encourage students to discuss conflicts in group meetings. | 0.605 | Good |
| 12. I make it a priority in my classroom to give students time to work together when I am not directing them. | 0.495 | Fair |
| 13. I encourage students to solve internal problems independently when doing group work. | 0.486 | Fair |
| 25. When rules don't work, I change the rules based on my professional judgment. | 0.416 | Poor |
| **Construct 3- Behaviorist Management** | **Significant Factor Loading** | **Qualitative Description** |
| 24. It is more important for students to learn to obey rules than to make their own decisions. | 0.651 | Very Good |
| 31. It is more effective to provide students with the information they need to know, rather than encouraging them to experiment. | 0.588 | Good |
| 42. I wonder if I have the necessary skills to teach mathematics. | 0.579 | Good |
| 10. I believe students learn best when there is fixed schedule | 0.548 | Fair |
| **Construct 4- Constructivist Management** | **Significant Factor Loading** | **Qualitative Description** |
| 18. I invite parents to volunteer in or visit my classroom almost any time. | 0.788 | Excellent |
| 19. I prefer to assess students informally through observations and conferences. | 0.619 | Good |
| 22. I encourage parents to follow up on classroom activities with students at home. | 0.446 | Poor |

| Construct 5- Professional Abilities/ Teaching Effectiveness | Significant Factor Loading | Qualitative Description |
|---|---|---|
| 38. I am not very effective in monitoring mathematics experiments. | 0.781 | Excellent |
| 39. If students are underachieving in mathematics, it is most likely due to ineffective teaching. | 0.608 | Good |
| 43. Effectiveness in mathematics teaching has little influence on the achievement of students with low motivation. | 0.564 | Good |
| 40. I generally teach mathematics ineffectively. | 0.502 | Fair |

Legend:

| Factor Loading | Qualitative Description | Factor Loading | Qualitative Description |
|---|---|---|---|
| 0.71 Above | Excellent | 0.45- 0.54 | Fair |
| 0.63- 0.70 | Very Good | 0.32- 0.44 | Poor |
| 0.55- 0.62 | Good | | |

This would be the basis for construct labeling. Based on the findings, the factor loadings are reliable, uni-dimensional and relevant to determine the Mathematics Teachers' self-efficacy beliefs because all the factors that emerged from the analysis were going in the same direction.

From the factor analysis of the teachers' response to self-efficacy beliefs, teachers were able to rate themselves on how they perceived their levels of professional effectiveness and were able to distinguish between the various aspects of their professional duties/work in which they felt more or less effective. The teachers in this study perceived that they were able to practice behaviorist teaching, constructivist teaching, behaviorist management, constructivist management and professional abilities/teaching effectiveness. Furthermore, the study shows that teachers have a high self-efficacy competence and professional qualities. However, the teacher had a weak sense of their effectiveness in the area of getting the most difficult students, motivating students who show low interest in school work and getting students to obey rules. Govell and Capron in Adedoyin (2010) suggested that "it is important to instill a sense of efficacy in those who are being prepared to ensure that they have the confidence to attempt to apply their knowledge when the appropriate time comes." This was also supported by Dembo and Gibson in Adedoyin (2010) that teacher's belief could affect student's learning and may influence teacher/student interactions and teachers' success in facilitating gains in student achievement.

## CONCLUSION

In the light of the findings, mathematics teachers strongly believed on the following: the importance of establishing classroom control, good effects of reward system, implementation of classroom discipline, high parents' involvement, open communication, sequential learning, independent learning and that teachers are learners and partners of students. On the other hand, they do not espouse the following ideas on their roles: make curricular choices for students, intervene to immediately solve students' disputes, make changes of rules based on their professional judgment support students' family, teach unconscientiously, help only when asked by students, answer problems directly even if they cannot figure it our themselves, give students the responsibility to decide on their own, and the reason of the students' underachievement.

Moreover, they do not believe that effective instruction has little influence in the achievement of students with low motivation. There were five (5) constructs that emerged from the factor analysis with given values greater than one and with significant factor loadings. These were: behaviorist teaching, constructivist teaching, behaviorist management, constructivist management, and professional activities/teaching effectiveness.

## RECOMMENDATION

Based on the conclusions, the study recommended that school administrators in all levels of education: elementary, secondary, tertiary and graduate levels use the Mathematics Teachers Self-Efficacy Beliefs Survey instrument since it is found to be valid and reliable. Furthermore, it is recommended that continuous evaluation be done among Mathematics Teachers to improve their performance.

A new perspective on teacher educational quality should be provided to improve the teaching effectiveness of the teachers. From the results of this study, it was observed that there were areas that the teacher's perceptions were very weak due to low factor loadings, these areas should be investigated and looked into because they have implications for student learning.

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