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Diagnosis of Maths Teaching Efficacy Beliefs Using Expert System

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ABSTRACT

Research on the design of an expert system to diagnose Mathematics Teaching Efficacy Beliefs (MTEB) using the Certainty Factor method was the first to be developed. The MTEB instrument was first initiated by Enoch and transformed into an expert system application using the paradigm of modified waterfall software development to sequential or sequential testing steps, ranging from analysis, design, coding, and testing. Data calculation and analysis using the certainty factor method assumes the user's choice is not exact and is at a certain interval. The weighting of expert values from MTEB items is carried out by two experts in the field of mathematics education. Meanwhile, the weight of user consultation uses five approval options, namely strongly agree, agree, simply agree, disagree, and disagree, successively represented by -0.2, -0.1, 0, 0.1, and 0.2. The results of the study gave success to each page of the diagnosis application, and the accuracy rate of the MTEB diagnosis was about 98%. The implication of this research is recommendations for related stakeholders to be followed up so that the MTEB of mathematics teachers becomes even better.

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1. INTRODUCTION

One important aspect of teacher professional development is self-education. Self-education is necessary for developing communicative, motivational, characterological, reflexive, educational, intellectual, and psychophysiological aspects of human beings (Bessarab, 2021). For self-education to effectively improve the quality of the educational process, teachers need support and assistance (Pasternatskyi et al., 2022). This situation indicates the need for the design and implementation of special technologies to develop experiences through *self-study* that can improve the quality of teacher training in the future in professional activities depending on students' understanding of the role of self-study in the modern educational environment and the educational process (Sebalo & Teslenko, 2020).

The results of the literature review provide information that mathematics learning using technology involves components that play an important role, such as skill sets, time, knowledge and *belief* about mathematics and technology (Soebagyo, 2016). Personalized teacher knowledge of mathematics related to everyday life is very necessary (Septiani & Purwanto, 2020), and mathematical problem-solving ability is indispensable for solving real problems (Hidayat, Rohaya, Nadine, & Ramadhan, 2020). On the other hand, mathematics is claimed to be absent as an instrument for describing and solving real problems (Maarif, Setiarini, & Nurafni, 2020). In addition, mathematics learning also initiates affective aspects (Dockendorff & Solar, 2018) and psychomotor aspects and psychological factors (Maesya Firdaus, Purwanto, & Nuriadin, 2021).

Teacher expectations related to *the outcome* of mathematics learning are an important aspect by seeing that mathematics is the foundation in various fields by considering the basic aspects of mathematics (Septiani & Purwanto, 2020). This expectation also reflects in several ways, namely mathematical ability, learning methods, and evaluation of mathematics learning (Soebagyo, 2016). Expectations of mathematics learning *outcomes* are claimed to be built from the experience of teaching mathematics (Segarra & Julià, 2020). Personal teacher assessment of mathematics teaching, needs to be carried out because it has an impact on the process and results of mathematics learning, where an important part lies in improving the quality of learning and promoting student learning (Kaiser & König, 2019). Likewise, teacher expectations related to the *outcome* of mathematics learning need to be measured because they are able to believe teachers in carrying out the learning process (Han, Kelley, & Knowles, 2021; Perkins Coppola, 2019). In the future, a system that is able to accommodate the situation is needed to anticipate assessment and diagnosis independently (Laela Mubarokah & Muhammad Abdul Aziz, 2021). The expert system is one of the solutions that can accommodate the situation. The expert system is a solution for teachers of students and those who are interested. In the expert system, an expert's knowledge is incorporated into the program so that it is like a teacher's assistant, where the system is able to help diagnose a person's learning independence problem and provide solutions and recommendations that should be done (Rosiani, Permatasari, & Yunhasnawa, 2018).

Hodges & Jong stated that Mathematics Teaching Efficacy Beliefs (MTEB) has two dimensions, namely Personal Mathematics Teaching *Efficacy* (PMTE) and *Mathematics Teaching Outcome Expectancy* (MTOE) where each has the meaning of belief to carry out effective learning and belief that effective learning has a positive influence on student learning (Thomson, Walkowiak, Whitehead, & Huggins, 2020). Mathematics Teaching Efficacy Beliefs are an extension of Bandura's self-efficacy applied to the study of teachers predicting that teachers who have confidence in student learning have an effect on effective learning (Enochs et al., 2000). Mathematics Teaching Efficacy Beliefs come from a combination of two components, namely teaching efficacy belief and mathematics teaching efficacy, where each means the concept of motivation used in describing the ability to achieve certain tasks and the teacher's belief about effectiveness in mathematics learning (Thomson et al., 2020).

The *Mathematics Teaching Efficacy Beliefs* (MTEB) indicator used in this study refers to Enoch et al. with two aspects, namely the aspect of self-efficacy and outcome expectancy, where each aspect contains 13 indicators, namely items 2, 3, 5, 6, 11, 15, 16, 17, 8, 18, 19, 20, 21 and 8 indicators, namely items 1, 4, 7, 9, 10, 12, 13, 14. The following are presented items of indicators of its capabilities namely 1) When a student performs better than usual in math, it is often because the teacher gives a little extra effort; 2) i will continue to look for better ways to teach math; 3) even if I try very hard, I won't teach math as well as I do on most subjects; 4) as students' math scores improve, it is often because their teachers find a more effective approach to teaching; 5) i know how to teach math concepts effectively; 6) i will not be very effective in monitoring mathematical activities; 7) if students are underachieving in mathematics, it is most likely due to effective mathematics teaching; 8) i would normally teach math ineffectively; 9) the insufficiency of a student's mathematical background can be overcome by good teaching; 10) when a child performs low in mathematics, it is usually due to the extra attention given by the teacher; 11) i understand the concepts of mathematics well enough that they are effective in teaching basic mathematics; 12) teachers are generally responsible for students' learning achievement

in mathematics; 13) students' mathematics learning achievement is directly related to the effectiveness of teachers in teaching mathematics; 14) if parents comment that their child is more interested in mathematics at school, it may be due to the performance of the child's teacher; 15) i would have a hard time using manipulatives to explain to students why math works; 16) i will usually be able to answer students' questions; 17) i wonder if I will have the necessary skills to teach mathematics; 18) given a choice, I will not invite the principal to evaluate my mathematics teaching; 19) when a student has difficulty in understanding a mathematical concept, I will usually be confused about how to help the student understand it better; 20) when teaching math, I will usually welcome students' questions; and 21) i don't know what to do to turn students into math (Enochs, Smith, & Huinler, 2000).

Expert system is the ability of human expertise to make decisions (Chandra, Yunus, & Sumijan, 2020) implemented in computer programs (O'Leary, 2021). Where are computer programs capable of manipulating reasoning and learning to solve problems (Sayed, 2021). An expert knows something deeply in a field (Syahputri, Yetri, & Sari, 2022), and has experience in the field (Nurholis, Fauziah, & Natashia, 2021). Requirements needed in building an expert system based on knowledge *acquisition*, *knowledge representation* and *decision support* include heuristics as a source of designing knowledge, expert heuristics as a source of validation in creating designs, the structure of knowledge as a source that describes the dimension as a frame of content as a model, implementation of knowledge as a source to avoid potential and constant bias, agent-based systems and optimization, and create design alternatives (Choi & Kim, 2021).

The benefits of expert systems, according to several sources, include: always being available (Shishehchi & Banihashem, 2021), Capable prediction accuracy (Hossain et al., 2019), sharing knowledge and self-checking (Othman, Arbaiy, & Rahman, 2018), able to uncover the causes, prevention and results of diagnosis (Konyeha & Imouokhome, 2018), able to analyze diagnostic results (Rachman & Napitupulu, 2018), reduction of costs and sources (Nazari, Fallah, Kazemipoor, & Salehipour, 2018), and improve performance and value (Fendji et al., 2020). The Certainty Factor (CF) method is a method used to accommodate the inaccuracy of an expert's reasoning (Yuwono, Fadlil, & Sunardi, 2019). The certainty Factor can describe experts' level of trust in the problem at hand. This method is able to diagnose symptoms with a high degree of confidence (Chandra et al., 2020). *The Certainty Factor* method is claimed to be able to analyze conditions based on experience or experts and is able to provide solutions to problems that occur (Widians, Puspitasari, & Ameilia, 2018). The steps in using the Certainty Factor method to diagnose a disease or symptom are: make a list of each symptom (Safira, Irawan, & Setiningsih, 2019), create a disease and symptom code (Sembiring et al., 2019), build the weight of the CF rule of each symptom (Pakpahan et al., 2019), Building a table of interactions between diseases and symptoms (Pakpahan et al., 2019; Sembiring et al., 2019), build a CF user (Safira et al., 2019), dan calculating the CF value based on the Certainty Factor formula (Pakpahan et al., 2019; Safira et al., 2019; Sembiring et al., 2019). The results of the study will provide easy self-diagnosis of Mathematics teaching efficacy beliefs of mathematics teachers.

This study aims to design an expert system for diagnosing mathematics teaching efficacy beliefs (MTEB) for mathematics teachers using Android Studio and the certainty factor method. Research on teacher effectiveness in the learning process shows that teacher experience in teaching is directly proportional to effective and optimal learning (Irvine, 2019). In addition, research on teacher self-efficacy provides an estimate of attitudes predicting attitudes in learning, especially the teacher's attention in carrying out learning in the classroom. Strong efficacy beliefs and attitudes that are claimed to be positive can improve the teacher's ability to carry out learning (Savolainen, Malinen, & Schwab, 2022). The relationship between teacher efficacy and preparation in teaching shows a moderate value with multiple regression values ($F(2.46) = 54.66$, $p = 0.038$), and about 13% affects performance in learning (Brown, Myers, & Collins, 2021). The level of self-efficacy beliefs of teachers in a study is claimed to have no significant differences according to gender, but the self-efficacy beliefs of teachers who choose the profession voluntarily are higher in learning mathematics. In addition, it was revealed that there was a moderate positive relationship between self-efficacy beliefs and teachers' ability to

teach (Yılmaz, 2020). The use of the certainty factor method in the field of education has been carried out by several researchers, including diagnosing student anxiety levels in preparing thesis with 100% accurate results being able to measure student anxiety levels when their study period exceeds the desired target (Muku et al., 2022). Other studies that specifically measure student learning styles using the certainty factor method show an accuracy of 94.52% where these results provide recommendations for appropriate learning methods for students. (Fawwas, Setianingsih, & Dirgantara, 2022).

The results of the research above do not show that there is research specifically on mathematics teaching efficacy beliefs. The knowledge above shows that the teacher's belief in learning mathematics has an influence on the performance and effectiveness of learning. Furthermore, the use of the certainty factor method in diagnosing student anxiety and learning styles accurately. Therefore, a diagnosis of mathematics teaching efficacy beliefs of mathematics teachers using the certainty factor method is needed to improve performance and effectiveness in learning. This research needs to be carried out as a first step in monitoring and evaluating both the teacher himself and related parties in the hope of providing improvement and follow-up in the learning process.

2. METHODS

The application development paradigm in the form of android-based applications, websites or applets can be carried out based on 3 general models, namely the waterfall approach, iterative development, and component-based software engineering (Sommerville, 2017). The waterfall model is the development method used to make the MTEB diagnostic application. The waterfall model is a classical model that is systematic, and sequential in building software, where the process is done in stages and you have to wait for the previous stage to finish and then start the next stage. Waterfall is a software model development that is carried out sequentially, as for the stages of the software development model: 1) *Analysis*, 2) *Design*, 3) *construction*, 4) *Testing*, *5) Deployment*, and *6) Maintenance* (Soebagyo & Kurniawan, 2020). For more details, the stages of the waterfall model can be seen in Figure 1.

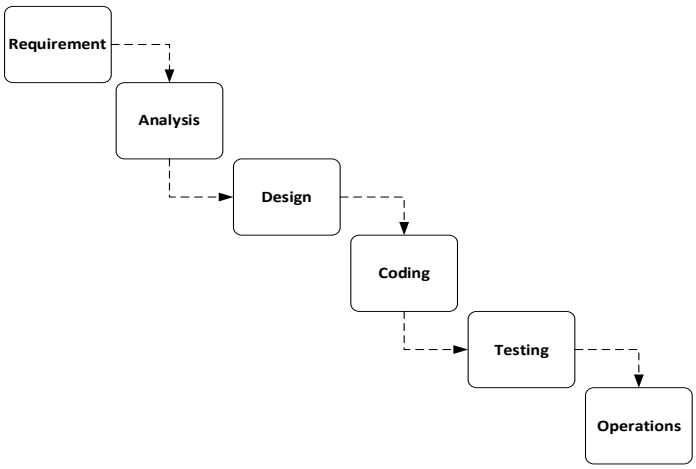

Figure 1. Application Development Stages is designed with Waterfall Methods

The developed application is expected to be able to diagnose math teacher's MTEB and provide mirrors and anticipatory recommendations needed. The MTEB indicator used in diagnosing was declared reliable with an alpha value of Personal Mathematics Teaching Efficacy (PMTE) of 0.88 and Mathematics Teaching Outcome Expectancy (MTOE) of 0.77. While the validity of the MTEB was stated to be valid based on the confirmatory factor analysis with a comparative fit index (CFI) value of 0.919 (Enochs et al., 2000). The MTEB indicator will then be weighted by experts in the field of mathematics education to be used as a weight for calculations using the certainty factor, and indicators are symbolized by the letter G.

The Use Case Diagram in Figure 2 is created with unified modeling language to determine the system's behaviour that will be used starting from the user registering, logging in, and so on to the admin role as an application manager. Users can access *news*, instructions, accounts, about, consultation, and diagnosis pages, while admins can enter information and data in the form of expert weights, statement items, user consultations, diagnostic results and suggestions, and so on.

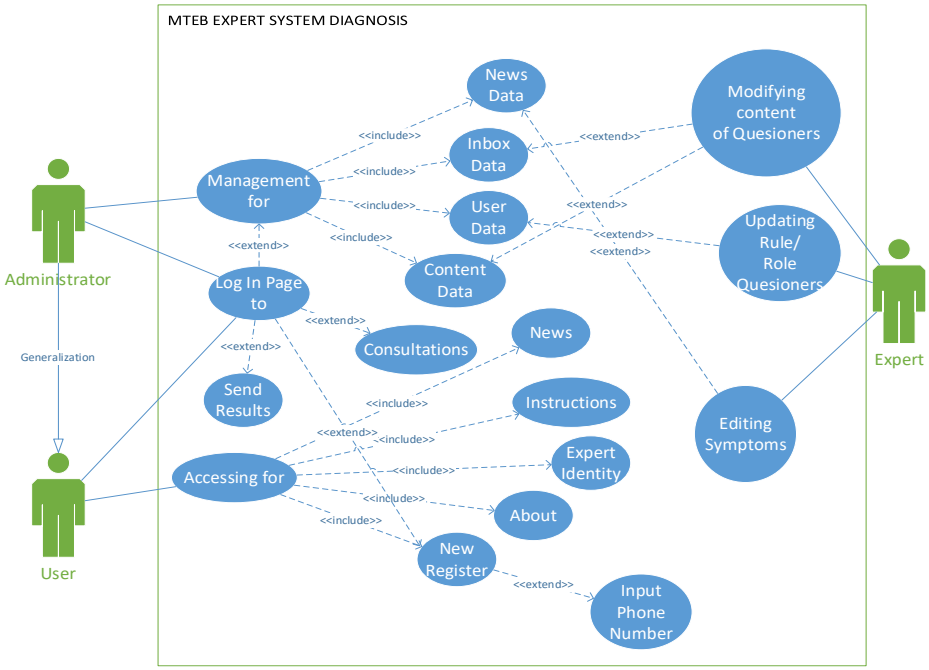

Figure 2. Use Case Diagram for Expert System Diagnosis

The expert system process to be built follows the Figure 3 flow, where the user starts filling in data from the registration form and then logging in. Next, the user selects the symptom and fills in five approval options from 21 statement items and submits the completed diagnosis. Then the certainty factor algorithm calculates the user's answer and displays the result.

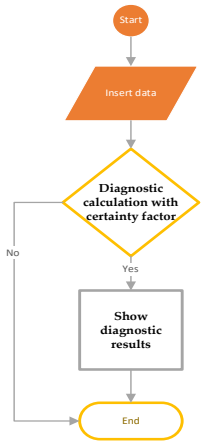

Figure 3. Flowchart to Processing in Insert Registration Data

The data of the user's answer results is calculated using the certainty factor formula with the following steps (Safira et al., 2019; Sembiring et al., 2019):

1. Calculate value $CF[H,E] = CF[H] * CF[E]$ (1)
2. Calculate value $CF_{combine}\ CF[H,E]_{i,j} = CF[H,E]_i + CF[H,E]_j * (1 - CF[H,E]_i)$ (2)

The $CF[H]$ value is taken from the expert weight value, while the value $CF[E]$ uses five modified user consent options (Fahmi et al., 2020) as needed in the range of values -0.2 to 0.2 which successively represent disagree, disagree, simply agree, agree, and strongly agree. Negative values are included because there are negative items in MTEB, and the range of user consultation weight values is chosen five to provide room for interpretation of uncertainty from the user.

3. FINDINGS AND DISCUSSION

3.1. MTEB Aspect Weighting Results

The first stage of the waterfall is an important stage because we have to define and arrange MTEB items which are first converted into Indonesian and determine the appropriate sentence points. The results of the transformation of the item items were validated by two experts in the field of mathematics education and were given weights. Weighting is done by giving MTEB item sheets to experts and we have discussions regarding how to fill in weights with a range of values between 0 to 1, and then they fill in according to their scientific capacity. In the discussion, the experts provided input and suggestions regarding the translation of the statement items and their views on the weighting given. The results of the weighting of two experts in the field of mathematics education related to MTEB statement items were averaged and validated through group discussion forums and data as shown in Table 1.

Table 1. MTEB Item Weight by Expert

Item Code	Item	Weight
G1	When a student performs better than usual in math, the teacher often gives a little extra effort.	0.80
G2	I will continue to look for better ways to teach math.	0.95
G3	Even if I try very hard, I won't teach math as well as I do most subjects.	-0.80
G4	As students' math scores improve, it is often because their teachers find a more effective approach to teaching.	0.90
G5	I know how to teach math concepts effectively.	0.90
G6	I will not be very effective in monitoring mathematical activities.	-0.90
G7	If students are underachieving in mathematics, it is most likely due to effective mathematics teaching.	0.50
G8	I would normally teach math ineffectively.	-0.95
G9	The insufficiency of a student's mathematical background can be overcome by good teaching.	0.95
G10	When a child performs low in mathematics, it is usually due to the extra attention given by the teacher.	0.35
G11	I understand the concepts of mathematics well enough that they are effective in teaching basic mathematics.	0.95
G12	Teachers are generally responsible for students' learning achievement in mathematics.	0.90
G13	Students' mathematics learning achievement is directly related to the effectiveness of teachers in teaching mathematics.	0.90
G14	If parents comment that their child is more interested in mathematics at school, it may be due to the performance of the child's teacher.	0.80
G15	I would have a hard time using manipulatives to explain to students why math works.	-0.95
G16	I will usually be able to answer students' questions.	0.90
G17	I wonder if I will have the necessary skills to teach mathematics.	-0.95

Item Code	Item	Weight
G18	Given a choice, I will not invite the principal to evaluate my mathematics teaching.	-0.95
G19	When a student has difficulty in understanding a mathematical concept, I will usually be confused about how to help the student understand it better.	-0.90
G20	When teaching math, I will usually welcome students' questions.	0.80
G21	I don't know what to do to turn students into math.	-0.95

MTEB item weighting is the first time it has been carried out because we have not found relevant literature in the field of mathematics education doing the same thing. This MTEB weighting will be a certainty factor or CF rule that needs to be done because MTEB diagnostic calculations with a certainty factor (CF) algorithm require CF rule values and CF users to produce a final value along with recommendations. This calculation is not the same as calculations on a Likert scale, where the user selects one of several options and then calculates the value of each item.

The MTEB or CF, rule weighting values, have limitations because they are assessed based on the judgments of two experts in the field of mathematics education, and it is possible that the results will differ from the judgments of other experts. Even so, the MTEB item weighting can be the basis for further research and development. In the future, measuring the ability of mathematics teachers independently and periodically can be a consideration for decision-makers and related parties.

3.2. User Consultation Weight

User consultation weights were obtained by analyzing negative items on the MTEB, where five variations of approval options were selected, as in Table 2.

Table 2. User Consultation Weight

No	User Responses	User Weight
1	Very Agree	0,2
2	Agree	0,1
3	Simply Agree	0
4	Less Agree	-0,1
5	Disagree	-0,2

User consultation weighting does not have a good package in general on measurements using certainty factors, especially in the field of mathematics education. Commonly used ranges from -1 to 1 (Fahmi et al., 2020). The weighting of user consultations in Table 2 was first created to accommodate the user's confidence in trusting MTEB items. Weighting does not use the yes and no option because one's beliefs are not exact and are at a certain range.

3.3. Interface Display

The second step is to conceptualize the system of calculations using certainty factors embedded in the application. In addition, designed systems that are relevant to the needs and display design of the diagnostic application. The initial design of the diagnosis application tried to adapt the Halo Doctor application, but it was modified according to the purpose of use of the diagnosis application.

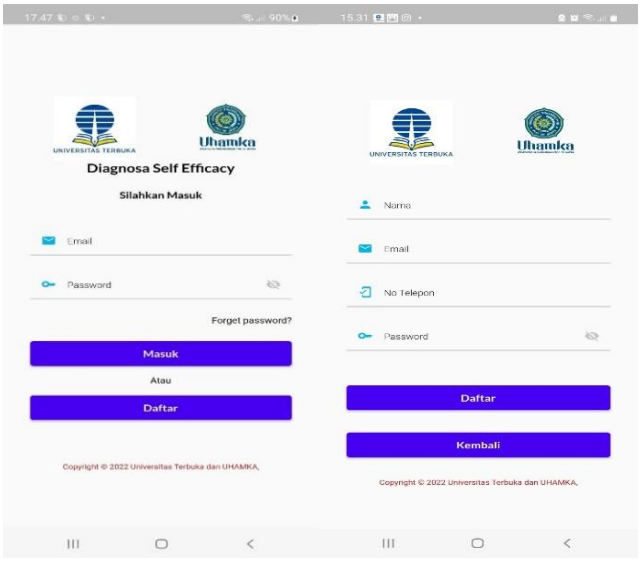

Figure 4. Initial View and Registration Page

Dashboard pages and user accounts as shown in Figure 5 were successfully implemented where it can provide information related to MTEB as an enhancer of teacher insights and personal data. The MTEB diagnostic application provides an opportunity for users to improve their understanding of effective and efficient mathematics learning, as well as provide access to monitoring and evaluation for parties who are in conflict with the field of mathematics education. Consideration of using the registrant page has two sides for users, namely positive and negative. On the plus side, admins or interested parties can browse and manage databases for various useful interests. On the other hand, users are worried about the security of their data. Nevertheless, the app is designed for good purposes and uses security in its application.

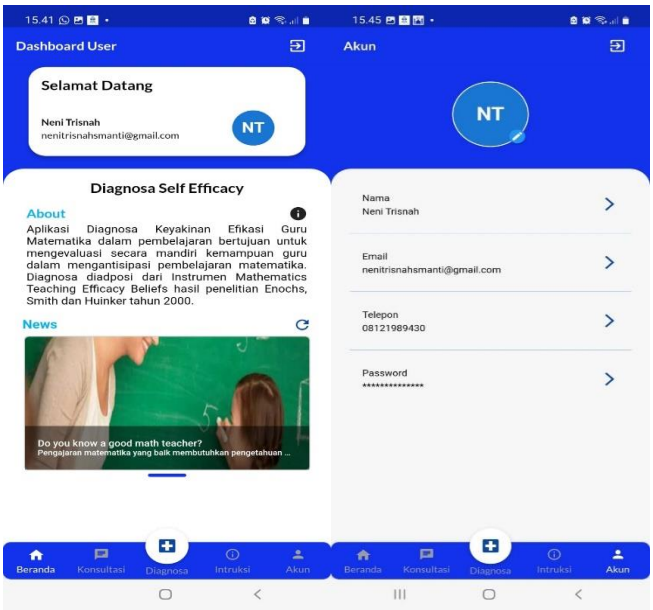

Figure 5. Dashboard and User Account Page

Consultation and conversation pages such as in Figure 6 are successfully carried out where it can provide space for users to ask questions and discuss in real time about the obstacles and problems encountered in mathematics learning, both preparation, process, and assessment of mathematics learning.

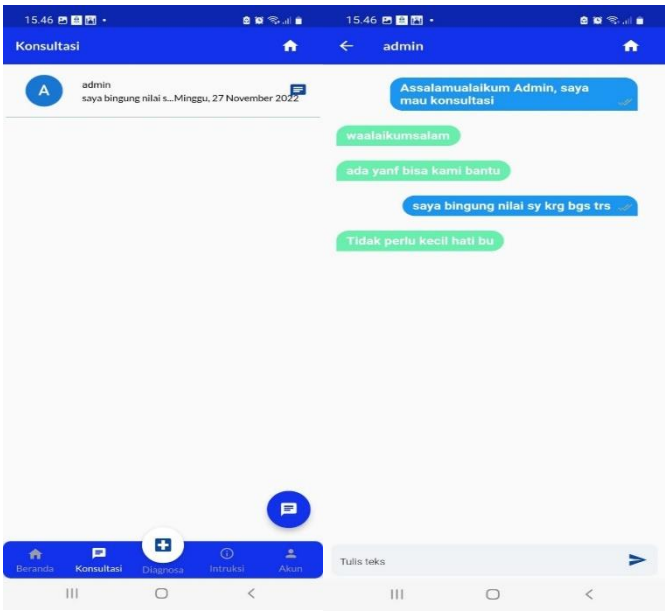

Figure 6. User Consultation and Conversation Page

The diagnostics page and the display of results as shown in Figure 7 were successfully applied using expert weights and user consultation using certainty factors. The MTEB diagnosis application is able to describe the diagnosis results and provide appropriate suggestions and represent user fields. Follow-up of these results can be consulted through consultation and conversation pages to question the results or discuss other problems related to the mathematics learning process.

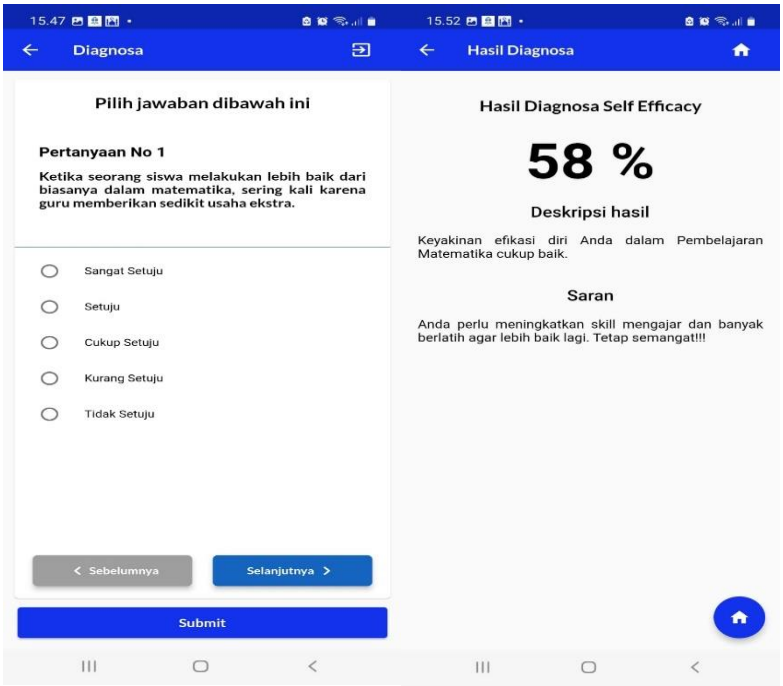

Figure 7. User Diagnostic and Results Page

3.4. Test result

The implementation and unit testing stages are carried out after the weighting of MTEB items and the weight of user consultations are completed. This stage identifies each module whether it is working

according to the algorithm or not and corrects the less accurate results. The system and integration testing phase accumulates the entire unit or module as a whole and retests the calculation results. The application of the diagnosis of efficacy beliefs of mathematics teachers in independent learning is expected to be able to motivate and improve MTEB. The registration and login process in Figure 4 was successfully carried out and allowed database browsing for parties in need.

An example of calculating the diagnosis of MTEB using the certainty factor with several MTEB items and combinations of user choices is shown in Table 3. User diagnostics on MTEB items number 1 through 6 successively voted to agree, strongly agree, simply agree, strongly agree, and disagree. The results showed that 49% of users' efficacy confidence in mathematics learning was at a low level in terms of MTEB, and it was recommended to improve skills in teaching and practice a lot.

Table 3. Example of User Diagnostics

No	Item MTEB	CF R	CF U	CF [H, E]	CF (i,j)	Results
1	When a student performs better than usual in math, it is often because the teacher gives a little extra effort.	0.80	0.10	0.08	1,2	0.25
2	I will continue to look for better ways to teach math.	0.95	0.20	0.19	Old 1, 3	0.25
3	Even if I try very hard, I won't teach math as well as I do on most subjects.	-0.80	0.00	0.00	Old 2, 4	0.39
4	As students' math scores improve, it is often because their teachers find a more effective approach to teaching.	0.90	0.20	0.18	Old 3, 5	0.44
5	I know how to teach math concepts effectively.	0.90	0.10	0.09	Old 4, 6	0.49
6	I will not be very effective in monitoring mathematical activities.	-0.90	-0.10	0.09		

The test results of the MTEB diagnostic application showed an accuracy rate of 98% by combining all user consultation weights, as shown in Table 4. Manual calculations with a combination of choices strongly agree all give a result of 53%, meaning that users are at a level of lack of confidence in efficacy in learning mathematics. The diagnostic application still has limitations, especially in expert weighting and user consultation. The choice of MTEB item diagnosis depends on the honesty of the user in choosing the weight of the user's consultation. If the user fills in without real consideration according to the conditions, it is certain that the results will not represent his efficacy beliefs in teaching mathematics.

Table 4. Accuracy of The System

Item Code	The Accuracy of The System	Expert Observation
G1, G2, G3, G4, G5, G6, G7, G8, G9, G10, G11, G12, G13, G14, G15, G16, G17, G18, G10, G20, G21	98% Results are obtained from manual calculations using the appropriate options and compared with the results from the application.	Accepted

The accuracy level of the MTEB diagnostic system in Table 4 is strongly influenced by the weighting of MTEB items by experts and the weight of user consultations. Accuracy has limitations in measuring MTEB. This research is in line with research on mathematics teaching self-efficacy (PMTE), and mathematics teaching outcome expectancy (MTOE), which shows the importance of experience in teaching mathematics (Segarra & Julià, 2020). In addition, the results of this study confirmed that teacher self-efficacy contributes 22% of the teacher's stress level in teaching (Fathi, 2019). The results of

this study are in line with expert system research using certainty factors which show optimal results in diagnosing diseases and pests on bonsai trees (Michael & Sulindawaty, 2022). Other research using the certainty factor method shows accuracy in diagnosing disease based on the weight of the symptoms selected by the user (Maulina & Wulanningsih, 2020). Furthermore, other studies on the certainty factor method show high accuracy in diagnosing aesthetic skin diseases (Chandra et al., 2020). The certainty factor method in diagnosing red chilli disease shows significant accuracy based on evidence and expert judgment (Agus, Wulandari, & Astuti, 2018). The results of the research on the comparison of the use of the certainty factor method and the Bayes theorem show that the certainty factor is about 67% better than Bayes regarding open decision-making (Dwiparaswati, 2017). Research on learning style diagnostics using certainty factors has succeeded in providing significant decisions and recommendations to users (Yulianti, Liza Trisnawati, & Theresia Manullang, 2019). Other research related to the use of the certainty factor method is also able to provide the ability to diagnose photocopier damage (Pakpahan et al., 2019). The expert system for diagnosing black orchids uses an even more extreme certainty factor where the accuracy level shows up to 100% (Widians et al., 2018). These results are similar to cirrhosis diagnostic studies using a certainty factor with an accuracy rate of 100% (Safira et al., 2019). Other research related to the use of the certainty factor method also shows the ability to diagnose computer damage so that users can anticipate when to repair it (Sembiring et al., 2019).

Research on self-education related to self-assessment shows that teacher abilities increase by around 80% compared to teachers who do not carry out self-assessment of themselves (Sebalo & Teslenko, 2020). Today society needs mobile teachers who continue to learn and improve their personal and professional qualities where teachers learn independently and self-assess because the knowledge and skills acquired at the university are insufficient to solve dynamic school problems (Pasternatskyi et al., 2022). The results of this study also confirmed that learning and self-assessment are transitions in education that cannot be avoided (Groen, Bijsmans, & Adriaensen, 2020). Currently, the application has not distinguished the aspects of self-efficacy and outcome expectancy due to limitations in calculating using certainty factors. Future research is very likely to distinguish two aspects of the MTEB. As the first research in designing an MTEB diagnosis to independently measure the confidence of mathematics teachers in teaching, this research can be the foundation for further research.

4. CONCLUSION

Design and build the Mathematics Teaching Efficacy Believe diagnostic application for the first time with the aim that users can independently measure their beliefs in teaching mathematics. Small-scale trials of multiple users yielded significant results and were relevant to actual conditions. The calculation results of the MTEB diagnostic system using the certainty factor show a 98% accuracy rate with expert weighting and user consultation used and still, combine all aspects of MTEB. The level of accuracy obtained is expected to contribute in the form of recommendations for users and related stakeholders so that they can anticipate and improve MTEB math teachers. The math teacher's MTEB diagnostic expert system is expected to be able to provide independent assessments so that mathematics learning is carried out more optimally and with quality. This study has limitations related to the weighting of the MTEB, where the scores are given by two experts in the field of mathematics education. Therefore, it will be very beneficial if it is carried out by more than two experts in the field of mathematics education.

Further research is expected to compile the weighting of MTEB items by other experts in the field of mathematics education and compile a more precise user consultation weight. Future research is recommended using other calculation methods and comparing the accuracy rate of systems using the certainty factor method. Given the need for independent measurement by the user (teacher), further research is recommended to develop other diagnostic applications that are beneficial for everyone.

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