

Implementation of Case-Based E-Consultation to Handle Student's Stress Levels

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Abstract: Despite the declaration of the COVID-19 pandemic's end, the effects of some cases persist in the new normal era of 2023. Several cases indicate a decline in the learning motivation of students and university students, which significantly affects aspects of understanding, creativity, productivity, and learning outcomes. University students transition from learners who, during their high school years, spent more time studying online without directly interacting with peers or teachers. Internal issues, stemming from students' inability to adapt to the university environment, are a contributing factor to university student dropout rates. The purpose of this research is to compile cases frequently experienced by university students that cause stress and lead to the decision to discontinue their studies. We do this to identify solutions and stop similar incidents from happening again. The implementation of e-counseling helps provide solutions in the form of action recommendations on how to address student issues. We conducted the research in several stages, including data collection, literature review, modeling, model evaluation, and prototype building and testing. We obtained the solution for the collected cases from the counselor through a focus group discussion (FGD). This research employs case-based reasoning, utilizing four reasoning processes: retrieve, reuse, revise, and retain. We chose the modified weighted average similarity function to measure the case's similarity value with the cases in the case base. Through the case-based e-counseling system, the calculation results reveal the similarity between the new cases and the old ones, recommending actions that counselors have validated as valid solutions.

Keywords: e-counseling; case-based reasoning; stress; students

INTRODUCTION

In May 2023, the WHO lifted the global emergency status of the COVID-19 pandemic. However, even after the pandemic officially ended, there remain numerous cases in the field that indicate a decline in learning motivation among students and university students. This condition has significantly impacted other aspects, such as comprehension levels, creativity, productivity, and, ultimately, learning achievement. (Patricia, 2023) Additionally, other influencing factors include limited learning materials, less varied teaching resources, economic constraints, and adjustments in learning evaluations for graduation standards.

The transition from student to university student also demands adaptation in socializing and developing a more mature mindset (Mansyur, 2020)(Sucia & Kusuma, 2022). Prior online learning in high school, which limited direct social interaction with peers and educators, often triggers the stress students experience in adjusting to the university environment (Laili et al., 2023)(Syah, 2020).

This study analyzes the effects of the COVID-19 pandemic on university students in the learning environment, with a focus on topics commonly discussed in student counseling services, such as the causes of student stress and dropout rates. Counselors then discussed these cases to compile a case base. We used this case base to develop a prototype model for an e-counseling (electronic counseling) information system, which can recommend actions based on similar cases that have occurred previously.

Various countries, including Indonesia (Suyadi & Selvi, 2022)(Sitohang, 2023), Brazil (T.D.Oliveira, D.S Costa, A Alvin-Soares, D.M Miranda, 2020), the United States (Loades et al., 2020)(Hails et al., 2020), China (Niland et al., 2020), Canada (Niland et al., 2020), Italy (Muller et al., 2020), and France (Chambonniere et al., 2020), as well as cross-country comparisons (Paterson et al., 2021), have conducted studies on the impact of the COVID-19 pandemic on children's behavior and adolescent mental health. Findings indicate changes in behavior among children and adolescents with moderate-to-severe levels of severity. This highlights the need for greater attention to parenting styles, especially for adolescents approaching adulthood who are now university students.

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Behavioral changes among students due to the pandemic require the role of counselors in providing support to academic advisors or even to students' parents. Therefore, e-counseling serves as a potential medium to assist academic advisors and parents in addressing students' behavioral issues.

E-counseling provides solutions in the form of recommended actions derived from similar cases stored in a case base, validated by counselors. Currently, universities are using e-counseling as a solution to provide advice and guidance services. We hope that the implementation of e-counseling will address issues leading to student dropout, thereby reducing dropout rates among students.

In the post-pandemic era, many universities are increasingly recognizing the importance of accessible psychological support systems to help students face new challenges. The COVID-19 pandemic significantly impacted the mental well-being of students, who experienced limited social interaction and prolonged online learning. In response, the e-counseling system presents an innovative solution by providing technology-based counseling services accessible anytime and anywhere.

We expect the presence of e-counseling to enhance students' motivation, mental resilience, and adaptability in the new and challenging academic environment. Rich in case studies, e-counseling not only facilitates the provision of pertinent recommendations but also aids universities in tracking student issue trends, allowing for continuous improvement of support services to meet student needs (Rasyid & Muhid, 2020)(Jalil, 2021).

LITERATURE REVIEW

We conduct a literature study to ensure a clear and structured design for the research methodology. The literature study will be focused on studies related to the case-based reasoning method to find new cases from old cases that are already stored in the database.

Case Based Reasoning

Case Based Reasoning (CBR) is a method used to implement a computer diagnostic system into real-world applications. CBR can be used to analyze a problem according to the case at hand and then classify the case based on previous classification experience. The advantage of CBR is that it allows the use of past case examples to gain knowledge and ultimately find out what happened to the case. According to (Putri, 2023)

CBR Structure

CBR Structure: According to Aamont & Plaza, a detailed explanation of the CBR structure, along with the CBR cycle, can offer a deeper understanding of the CBR process. These four processes, which can be broken down into different parts of the work, include choosing which case information to store, how to organize cases to make it easy to find similar problems, retrieve, reuse, revise, and retain are four categories of arguments based on cases. The scheme that describes the four types of case-based reasoning is as shown in Fig. 1 below (Minarni et al., 2021).

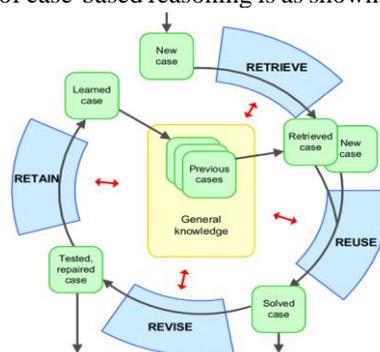


Fig. 1 Case Based Reasoning Cycle (Putri, 2023)

When a new problem occurs, the system first performs the Retrieve process, which involves two processing steps: problem recognition and searching for problem similarities in the database. After the Retrieve process is complete, the system will perform the Reuse process, which uses previous problem information that has similarities to solve the new problem. The system will solve similar problems.

METHOD

The structured Case-Based Reasoning (CBR) system development process starts with data collection and literature review to comprehend the fundamental concepts of the system under construction. System modeling, which involves creating a case base and determining key functions like retrieve, reuse, revise, and hold, follows this stage. Following the modeling phase, we conduct an evaluation to confirm the validity of the developed model. Prototype development can proceed if the model satisfies the criteria. If the model lacks validity, we will repeat

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the modeling stage. The CBR-based system development process follows a comprehensive flow that outlines these steps as shown in Fig. 1

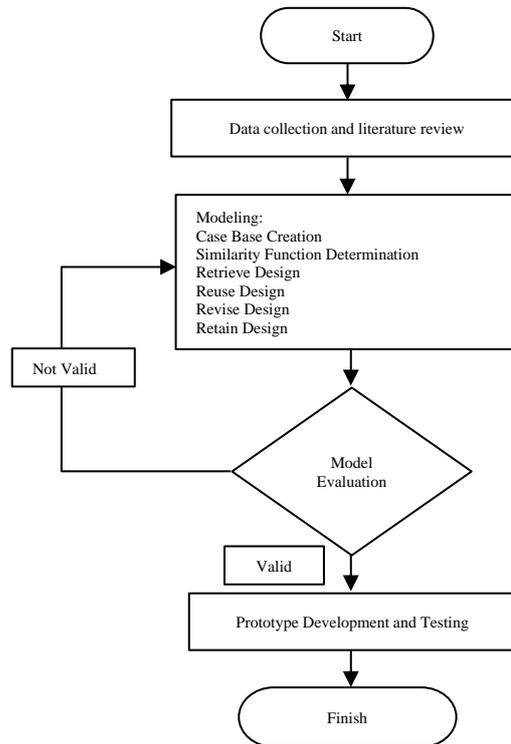


Fig. 2 Research Flow Chart

Data Collection and Literature Review

At this stage, data in the form of cases commonly experienced by students is collected from various online sources (such as news, social media, and health applications), questionnaires, and interviews with lecturers and counselors. We gather a minimum of 150 cases to establish the case base. We obtain solutions for these cases through FGDs and direct interviews with counselors, documenting them in a spreadsheet. In addition, we conduct a literature review to identify common components of problems faced by students in the post-pandemic period and examine previous studies to find solutions for the collected cases.

Modeling

Counselors begin the system modeling process by creating a case base, which contains knowledge in the form of resolved cases. This case base serves as a guideline for problem-solving. This study introduces a new method for calculating similarity values in case-based reasoning (CBR) using a modified weighted average similarity function. This function measures the similarity between a new case and cases in the case base by comparing the weights of matching components.

Modification of the similarity function with weights can be done by dividing the sum of the weights of the same components between the new case to be solved (C) and the i-th case in the case base (K_i) by the maximum of the number of components in C (e.g., m) and components in K_i (e.g., n), so that the similarity value T_i is obtained as follows(Li et al., 2024):

$$T_i = \begin{cases} \frac{\sum_{j=1}^n \text{the same component weight between } C \text{ and } K_i}{\sum_{j=1}^n \text{component weight } K_i}, & m \leq n \\ n \frac{\sum_{j=1}^n \text{the same component weight between } C \text{ and } K_i}{\sum_{j=1}^n \text{component weight } K_i + \alpha (m - n)}, & m > n \end{cases} \quad (1)$$

This process will try several threshold values (θ) to determine the minimum similarity value and discuss this value with the counselor to ensure optimal results.

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Model Evaluation

At this stage, we test the CBR model using new cases not included in the case base and evaluate the results. We measure the model's performance by comparing its recommendations with counselors' solutions using precision (P), recall (R), F1-score, and ROC parameters. This stage aims to generate a tested model, ready for further development into a prototype. Four counselors conduct the evaluation through a Focus Group Discussion (FGD) with students, lecturers, and counselors.

Building and Evaluating Prototypes

We build the prototype based on a proven model. The prototype is built based on a website, then tested with users, namely lecturers, students, and counselors. We conduct usability testing to assess the prototype's ease of use and alignment with user needs.

RESULT

Data collection and literature review

We collected data by distributing an online Google Form questionnaire to students to understand their problems. We first discussed the questionnaire instrument with a psychology expert to ensure it met the research needs. We distributed the questionnaire for approximately a week to gather a minimum of 150 cases. We collected a total of 153 cases using Google Form, and then conducted a Focus Group Discussion (FGD) with counselors to select 30 cases for model testing, based on important issues or topics frequently mentioned by respondents.

Counselors provided solutions for a total of 153 cases, which they then collected into an e-counseling database. The results of the analysis show that the author identified 54 symptoms out of a total of 153 cases collected. The three most frequently found symptoms in those cases, each reaching more than 20 cases, are economic/financial problems/lack of funds/financial issues, academic pressure, and heavy task workload. These three issues are the most commonly encountered by students during their studies, often leading to their decision to drop out.

Modelling

Case-Based Reasoning (CBR) modeling is an approach that uses past experience to solve new problems. **Retrieve**, the first process in CBR, involves identifying and selecting relevant cases from the database to compare with the problem under analysis. In this retrieval step, we use the Modified Weight Average (MWA) method to determine and select the most relevant cases.

Table 1. Case Study 1

Case	Symptom	Score
1. I'm concerned about not finishing the final project.	No vision related to future work	1
2. As I study more, I find that it falls short of my expectations, many classes are meaningless, which causes me to doubt my final project.	Far from family/migrating	1
	Students feel unmotivated/lazy	1
3. I'm concerned that they may not be able to apply the knowledge they have gained from lectures in the future.	Students feel insecure, inferior, or lack self-confidence	1
4. Growing up far from parents, I became a Rantau child who needed to be self-sufficient in every way.	Issues with thesis/final project	1
5. It can be challenging to overcome laziness and become more interested in understanding subjects not taught in college when creating a proposal.	No future plans/not according to plan	1
I apologize, but there aren't many things I can mention.		

Next, Table 2 present a calculation method that combines similarity calculations to analyze and determine the level of similarity between cases collected in the database. This method aims to provide more precise and relevant solutions based on the similarity of symptoms or characteristics found in each case. By using similarity calculations, the system can identify patterns that emerge from existing data and utilize the knowledge gained to provide appropriate recommendations or diagnoses. The use of this method allows for the implementation of a more accurate and efficient system in the context of case-based diagnosis and decision-making.

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Table 2. Case Similarity Calculation 1

No.	Case	Symptom	Similarity (Total Matching Weight / Total Weight)	Solution
K21	As a child from a distant family, I face financial challenges and must rely on my own resources. I often feel down and consider quitting, wanting to end my life here, but I feel pity for those who are still waiting, knowing that all my struggles would be in vain otherwise.	Having economic/financial problems/lack of funds/financial issues	2/8 = 0.25	<ol style="list-style-type: none"> 1. Acknowledge Your Strengths. You successfully faced financial difficulties and continued your studies despite the challenges. That's proof that you are resilient. 2. Manage Negative Thoughts. When you feel useless or want to give up, change the narrative in your mind. Focus on the struggles you have already faced and the people who support you. 3. Look for additional income. Utilize skills such as selling or flexible freelance work to help with finances without disrupting your studies. 4. Maintain mental health. Give yourself time: meditate, do light exercise, or take a break to recharge your energy.
		Students living away from home are far from their family		
		Students have mental health issues or feel anxious/depressed		
		Students feel unmotivated/lazy		
		Expectations that are too high		
K22	I am currently focused on my thesis, missing my family, lacking motivation, and struggling with time management.	Students living away from home are far from their family	2/10 = 0,20	You can try learning to prioritize the most important tasks to complete first and need to break down your work time into smaller parts to avoid burnout (time management issue).
		Academic pressure		
		Having trouble managing time		
		Students feel unmotivated/lazy		

The reuse process is the act of reusing old cases that have been stored in the case base as information or knowledge to solve problems. The number of similar cases depends on the previously set threshold value (θ). The similarity results between the new case and the stored one usually fall within the range of 0 to 1.

A value of 0 means the two cases are absolutely not similar, while a value of 1 means they are absolutely similar. Therefore, we choose the midpoint value of 0.5 as the minimum similarity requirement to determine the recommended solution. Following the receipt of a new case, the counselor will receive several relevant cases that approach a minimum similarity value of 0.5 as recommendations for solutions. The system does not recommend these results because the highest similarity scores in case 1 were 0.20 and 0.25, which are below 0.5 and less relevant to the new case.

Table 3. Case Study 2

Case	Symptom	Score
I am a final semester master's student who is currently still working on my thesis. Sometimes, I feel exhausted and confused, but I understand the importance of completing my studies on time to lighten the burden, especially	Thesis supervision issues	1
	Burnout	1

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considering my thesis advisor travels from Semarang to Solo.		
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Table 4. Case Similarity Calculation 2

No.	Case	Symptom	Similarity (Total Matching Weight / Total Weight)	Solution
K60	Lack of motivation and burnout during college	Lack of motivation	$\frac{1}{2} = 0,5$	Burnout occurs when someone exceeds their physical and mental stress tolerance. Taking a 'break' is a very wise thing to do; you need to reorganize what is truly important to work on or complete. Don't push yourself too hard; rekindle your motivation by remembering why you are doing this.
		Burnout		

In the second test, the tested case yielded a single similar case, identified as case 60, with a similarity of 0.5. Figure 3 displays the results of the manual calculations using Excel.

Case	Case Component	Solution	Const MAX (Case Component, New Case)	Same = 1; Not the same = 0	The Same Amount	Similarity (T)
K56	G14	S56	2	0	0	0,00
K57	G2	S57	2	0	0	0,00
K58	G14 G10	S58	2	0	0	0,00
K59	G32	S59	2	0	0	0,00
K60	G31 G41	S60	2	0 1 0 0 0 0 0	1	0,50
K61	G17 G2 G39	S61	3	0 0 0 0 0 0 0	0	0,00
K62	G27	S62	2	0 0 0 0 0 0 0	0	0,00
K63	G21 G19	S63	2	0 0 0 0 0 0 0	0	0,00
K64	G2	S64	2	0 0 0 0 0 0 0	0	0,00
K65	G10 G21	S65	2	0 0 0 0 0 0 0	0	0,00
K66	G14 G8 G10 G11	S66	4	0 0 0 0 0 0 0	0	0,00

Fig. 3 Manual Excel Calculation

The results indicate that counselors have the freedom to choose the solution that best suits the context and conditions faced by the individual or group concerned. Additionally, counselors possess the liberty to modify or alter the selected solution, ensuring it effectively tackles the problem at hand while considering specific factors that might shift due to the solution's implementation. Counselors can use existing solutions, add more suitable options, or create new ones that fit the actual situation.

Revise is intended to improve the proposed solution. The counselor carries out the revision in this case, verifying the solution recommendations provided by the case-based system (e-counseling). If a case requires revision because it no longer aligns with current conditions, the counselor undertakes the revision.

Retain process involves storing new solutions from counselors to address previous problems. Counselors provide solutions based on recommendations generated by the case-based system, which are based on the similarity value of previous cases. The case base will store the new solutions, transforming them into knowledge for solving future case problems.

Model Evaluation

The researchers' statistical testing involves students and counselors. To evaluate the model, case testing used 30 real cases most frequently experienced by students. During the Focus Group Discussion (FGD), the counselors agree that the cases examined reflect significant issues that often arise.

On the other hand, we tested the e-counseling system using a questionnaire through Google Forms. Alignment with actual conditions is a factor in testing the system on these users. Tables 3 show the results of the

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instruments used for the assessment. A total of 4 counselors and 30 students utilized Google Forms to provide their evaluations on the use of e-counseling.

Table 3. A User Satisfaction Questionnaire about the E-Counseling System

No	Question	Strongly Agree	Agree	Quite Agree	Disagree	Strongly Disagree
1	The e-counseling system helps solve problems for students.	82,35%	17,65%	0%	0%	0%
2	The e-counseling system provides solutions that align with the actual situation.	79,41%	20,59%	0%	0%	0%
3	The e-counseling system significantly impacts changes in managing students' stress levels.	73,53%	17,65%	8,82%	0%	0%
4	The e-counseling system is simple to use, user-friendly, and flexible.	94,12%	5,88%	0%	0%	0%
5	I am satisfied with using the e-counseling system and would recommend it to others.	88,24%	11,76%	0%	0%	0%

The results of the instrument, which posed five questions about the experience of using the e-counseling system, showed that the majority of respondents provided very positive feedback. More than 80% agree that the e-counseling system helps solve problems for students. This shows that the e-counseling system will be very beneficial in addressing the challenges faced by students today.

Moreover, more than 90% of respondents said they were very satisfied with using the e-counseling system and would recommend it to others. This shows that e-counseling can meet all user needs in terms of providing the solutions and services they desire. The database stores the best solutions recommended by counselors to solve problems based on real-world experience.

Building and Testing Prototypes

Figure 3 displays the interface of the e-counseling application, which assists in analyzing counseling cases. On the screen, users can enter the case description in the text box. In one example case, student are grappling with a number of issues related to her concerns during their final year. After filling out the case column, users can press the " Process of Searching for Symptoms" button to start looking for symptoms relevant to the case. We designed this e-counseling to simplify the analysis of client issues.

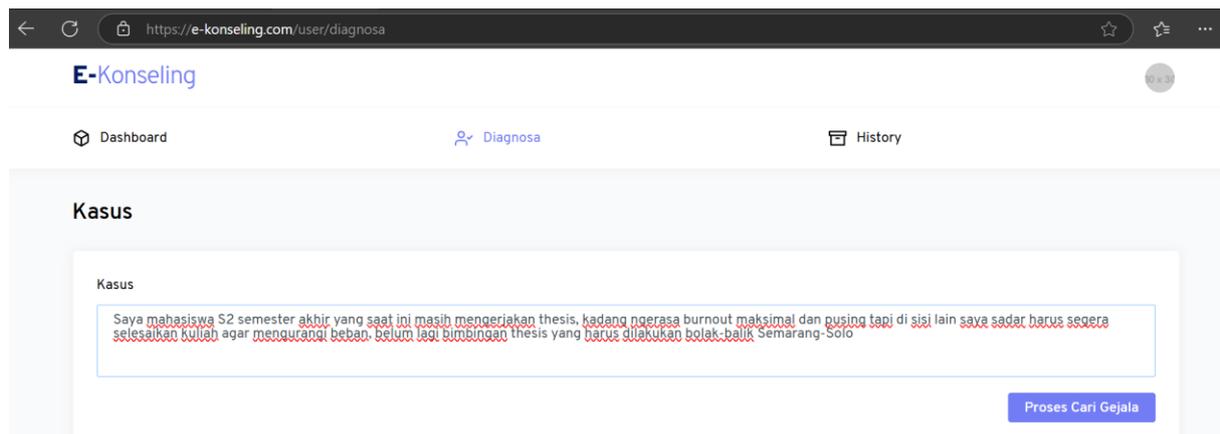


Fig. 3 Case Input Interface

Fig. 4 displays the E-Counseling application interface within the symptom selection section, which corresponds to the counseling case in question. At the top, there is a navigation menu with the options Dashboard, Diagnosis, and History. On the main screen, users are given a list of symptoms in the form of checkboxes, with each symptom given a code (e.g., G036, G041) and a brief description.

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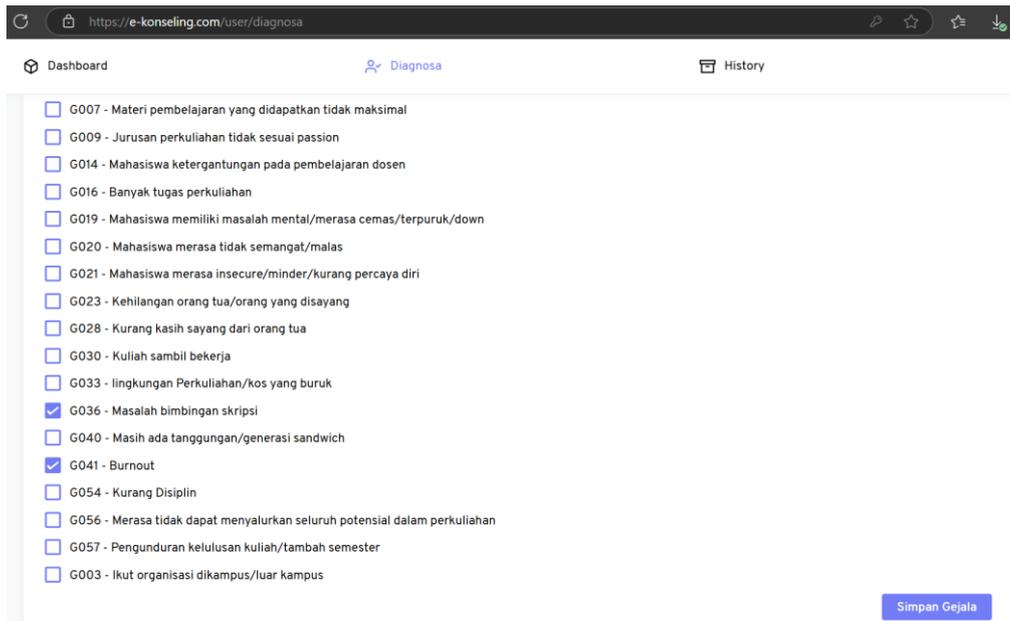


Fig. 4 Select Symptoms Interface

Users can select symptoms such as “thesis supervision issues”, “burnout”, and so on. Users select symptoms relevant to the current case to assist in the analysis process. After selecting the symptoms, users can press the "Save Symptoms" button to save their choices. This e-counseling is very helpful for counselors or users in identifying symptoms related to their counseling issues.

Fig. 5 shows the Case Verification page in the E-Counseling application, which is used to review and verify previously selected symptoms in a counseling case. At the top, there is a navigation menu with several options, such as Dashboard, Master, Solution Verification, and Report. In the main area, there is a Case Review section that displays a description of the case. Six symptom lists have been selected from the input case. Users can click the "Find Solution" button to continue the process of searching for a solution that matches the symptoms. This feature makes it easier for counselors or users to review the case and related symptoms before searching for the appropriate solution.

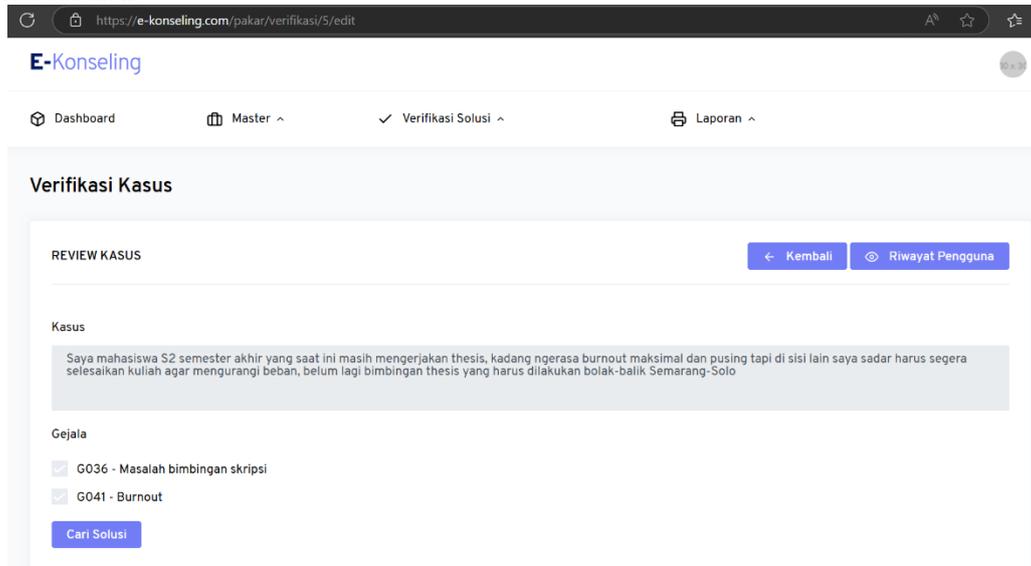


Fig. 5 Solution Output Interface

Figure 6 shows the application interface that provides solutions for various student issues. The counselor will automatically send a notification to the user's email upon receiving a relevant solution. In the main section, there is a table displaying several cases and solutions from previously saved cases.

Each case has a code (such as K25, K20, K40, and K3) with a specific solution to address the issue. Additionally, each solution has a "Use" button next to it, enabling users to choose which solution to apply to the

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specific case. At the bottom, there is a text input area where users can add new solutions or adjust existing solutions and then save them by clicking the "Save Solution" button.

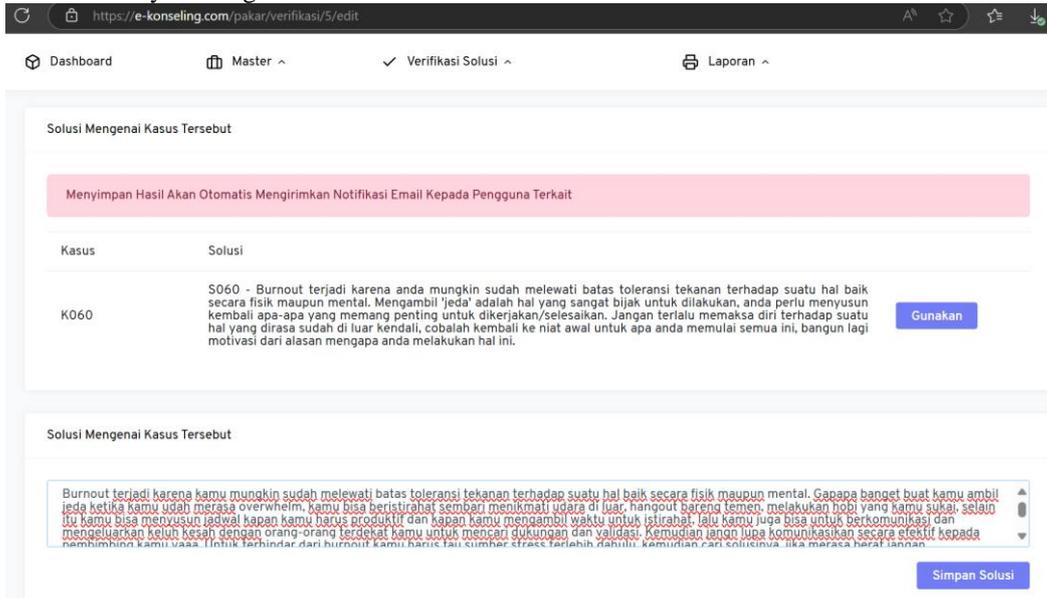


Fig. 6 Counselor Verification Interface

Figure 7 displays the case diagnosis results sent via email. The email explains how the system calculated and matched cases using the Case-Based Reasoning (CBR) method to determine the appropriate solution. The counselor has conducted a rematch to verify that the provided solution aligns with the case the user previously inputted. The case section explains the problem as follows: *“Burnout occurs when you exceed your physical and mental stress tolerance. It’s totally okay for you to take a break when you start feeling overwhelmed. You can rest while enjoying the fresh air outside, hang out with friends, or engage in hobbies you love. Additionally, you can schedule productivity and rest. You can also communicate and vent your frustrations to your close ones to seek support and validation. Then don’t forget to communicate effectively with your supervisor, okay? To avoid burnout, you must first identify the source of your stress, then find a solution. If it feels too heavy, don’t force yourself to stay in this difficulty. You can ask for help from a friend in the same program or a psychologist. Remember to celebrate your progress, no matter how small.”* Below it, it is written that the solution chosen by the counselor to overcome this problem will be explained further.

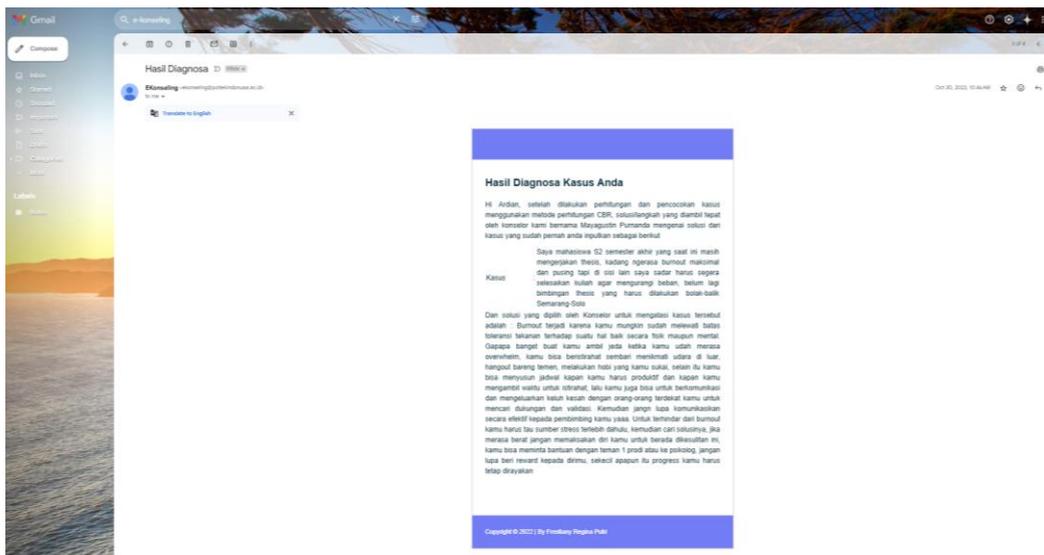


Fig. 7 Diagnosis Results

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DISCUSSIONS

Previous research has developed a website-based stress level monitoring system using the waterfall method. We used the white box method for unit testing and integration, and the black box method for test validation. This test resulted in 100% validity in 85 test cases. The Sortsite tool tested the non-functional requirements of the system, demonstrating the website's operation across several search engines (Fardiana Risa et al., 2020). The study did not include counselors to assist in overcoming student stress problems.

The system testing in this study, which aimed to identify student problems based on the website, yielded positive results. The similarity function used in this study is a weighted average. This method is very susceptible to false similarity levels because it only involves case components on a case basis to calculate the similarity value and also involves validators with a background in psychology. The results obtained from both manual calculations using the Case-Based Reasoning (CBR) method with a modified weighted product approach and calculations carried out through the system are exactly the same, showing an accuracy level of 100%.

This shows that the system has successfully implemented the CBR algorithm and modified the product weights correctly, resulting in results that are identical to manual calculations. This 100% accuracy shows that the system is quite reliable and accurate in running the case matching process and calculating the suitability value, providing relevant solutions. This is important in the context of e-counseling, where the accuracy of case matching will affect the quality of solution recommendations given to users.

Thus, the similarity of these results is also evidence of the validity of the application of the CBR system on the e-counseling platform used and ensures that the system can be relied on to help counselors determine the best solution to the problems faced by users. This research shows the increasingly important role of AI in predictive analysis to address student issues, with CBR being the primary method to enhance the accuracy and relevance of predictions in this field. Although there are alternative methods for developing AI for counseling systems, not all of them produce solutions based on real-world case studies, such as using CBR.(Putri, Sukmaningsih and Mukaromah, 2024)

CONCLUSION

The developed e-counseling system has successfully implemented the Case-Based Reasoning (CBR) method with the modified weight product approach, as evidenced by the similarity of results between manual calculations and system calculations at an accuracy level of 100%. This demonstrates the system's reliability in matching cases and accurately calculating suitability values, enabling it to offer users relevant solution recommendations.

The use of e-counseling in universities is very important, especially in the post-pandemic era where students still experience various challenges in terms of learning motivation, social adaptation, and mental health due to prolonged online learning. With e-counseling, universities can provide more easily accessible psychological support, help students face new challenges, and reduce the potential for dropout.

In addition to serving as a tool for providing solutions, this system assists universities in tracking trends in student problems, enabling them to continuously improve their support services as necessary. The success of the implementation of CBR in e-counseling also proves that a technology-based approach can make a significant contribution to supporting the counseling process and helping students achieve their academic and personal success. In future research, it is hoped that the counseling system can be developed to the stage of problem resolution, not just to the stage of providing solution recommendations.

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