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Learning in Higher Education Based on Artificial Intelligence (AI) with Case Based Reasoning (CBR)

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Abstract

Learning in Higher Education Based on Artificial Intelligence (AI) with Case Based Reasoning (CBR) is a teaching and learning process as part of artificial intelligence providing a problem solving learning model Learning is a process of transferring knowledge from teaching staff to students. Artificial Intelligence (AI) is present as a tool that can facilitate the teaching and learning process in tertiary institutions. This research aims to produce a learning model in higher education by utilizing AI as a learning tool. The method used is Case Based Reasoning (CBR). CBR is a computer reasoning way of thinking by utilizing past knowledge to handle new cases. Research subjects in universities. The implementation of this learning process can be carried out in various study programs, including: Accounting, Civil Engineering, Teaching and Education Faculty and all existing study programs in tertiary institutions. The results achieved by teachers and students will be easy to use technology in the teaching and learning process. The implication is that universities produce quality students in the application of information technology by implementing AI with CBR.

Keywords Artificial Intelligence, Case Based Reasoning, College Learning.

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1. Introduction

Artificial Intelligence or artificial intelligence is the development of robotic technology in a process that models human thinking and designs a machine so that it can behave like humans, known as cognitive tasks, namely how machines can learn automatically from programmed data and information. Artificial intelligence can also be interpreted as Artificial intelligence or AI is one part of computer science that makes machines (computers) able to do work as and as well as humans do. CBR resolves new cases by observing the old cases that are closest to the new cases so that students have a history of the learning processes that have been carried out so that educators can also have a basis for providing subject matter delivered. All of that will be embodied in CBR as a learning aid tool.

AI-based learning in individual learning systems shows that it can improve learner focus. Because AI has the ability to teach students individually and identify the areas needed to find the right way of learning for students through artificial intelligence, this is very supportive of independent learning at universities launched by the Indonesian Ministry of Education. AI can play a role in many aspects that can facilitate the work of teaching staff, both in administrative matters and making it easier to carry out teaching and learning activities in universities in independent learning, the problem in universities is the completeness of existing facilities in universities, both infrastructure and human resources. in AI application design.

Why is that a problem the application of AI in education requires a set of tools that are integrated with each other in processing all information so that basic knowledge is needed to use it? The problem to be solved is the need for knowledge of the application of AI from both teachers and students. To solve this problem, the Ministry of Education of the Republic of Indonesia routinely and continuously conducts training for ToT trainers. The private sector also continues to carry out related activities to accelerate the implementation of AI in education. This is important to discuss in order to follow the times in the application of information technology in universities to the teaching and learning process because Education is UNESCO's top priority because it is a basic human right and the foundation on which to build peace and drive sustainable development. UNESCO is the United Nations specialized agency for education and the Education Sector that provides global and regional leadership in education, strengthens national education systems and responds to contemporary global challenges through education with a special focus on gender. [1] equality and Africa. The application of information technology can improve the quality of higher education and facilitate

the process of teaching and learning activities. The way to solve the problem is to improve the existing facilities in universities in the application of information technology in the learning process. Teaching staff are required to continue to innovate for the application of AI in improving the quality of human resources so that students can follow the development of existing knowledge. Artificial intelligence (AI) will change the world and higher education is no exception. AI will change the way we work, the way we learn, and the way we live. As pioneering research in this field, this study will provide insightful information for educators and detailed knowledge for academic theory building. [2]

The reason for this research is that AI-based learning innovations in universities can be applied in daily activities and digital communication can be established between teachers, students, parents, government and industry which will have a positive impact on universities. Research can contribute to filling the existing gap by producing digital learning concepts that support the development of information technology and its application in teaching and learning activities at universities The future of higher education is intrinsically linked with developments on new technologies and computing capacities of the new intelligent machines. In this field, advances in artificial intelligence open to new possibilities and challenges for teaching and learning in higher education, with the potential to fundamentally change governance and the internal architecture of institutions of higher education. [3]

The innovation proposed by the university is a place for a group of students to acquire new knowledge through the teaching and learning process, in the digital era that utilizes technology as a tool, the presence of this AI-based learning model is very much needed to improve the quality of students, universities themselves, society and industry. All lecture activities are gradually transformed into learning models that utilize AI technology. The goal is that the application of knowledge in the classroom can be directly applied with AI in order to increase students' understanding to get new findings in each course. Educational innovation in the era of Society 5.0 is directed to resolve various social challenges, issues, and problems relating to educators, students, the dynamics of the education system, and social dynamics. Era Society 5.0 is an answer to the challenges that arose due to problems resulting from the Industrial Revolution 4.0 era by utilizing innovations in technology that integrate cyberspace and the physical world. This is expected to balance economic development and solve social problems.[4]

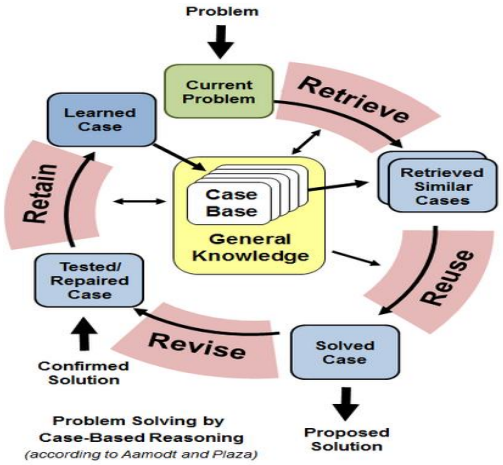
The method used is the CBR method with a feature-based technique that is proposed as a methodology for a decision support system, which is specifically designed for the selection of study programs in the

academic community in universities. And digitally documentation of all activities of the academic community will be carried out to facilitate the CBR process in order to obtain the best results as expected, by adapting solutions that have been used to solve old problems and reusing these solutions for new, similar problems. Assistive technologies—such as text-to-speech, speech-to-text, zoom capacity, predictive text, spell checkers, and search engines—are just some examples of technologies initially designed to assist people with a disability. The use of these technological solutions was later expanded, and we find them now as generic features in all personal computers, handheld devices or wearable devices. These technologies now augment the learning interactions of all students globally, enhancing possibilities opened for teaching and the design of educational experiences. Moreover, artificial intelligence (AI) is now enhancing tools and instruments used day by day in cities and campuses around the world. From Internet search engines, smartphone features and apps, to public transport and household appliances. For example, the complex set of algorithms and software that power the iPhone's Siri is a typical example of artificial intelligence solutions that became part of everyday experiences [5].

2. Research Methods

Case-based reasoning (CBR) is a family of artificial intelligence techniques, based on human problem solving, in which new problems are solved by recalling and adapting the solutions of similar past problems. CBR is an active area of research and has also been adopted by many companies such as AT&T, British Airways, Cisco, Daimler, Benz, Dell, GE, Intel, Lockheed, Nokia, Siemens, and Visa, to name but a few.[6]

Figure 1. Cycle CBR [7]



Case-based reasoning (CBR) is an established problem-solving paradigm from Artificial Intelligence (AI). It is built upon a rule of thumb suggesting that similar problems tend to have similar solutions. More specifically, the idea of CBR is to exploit the experience of similar problems in the past and to adapt their successful solutions to the current situation. Thus CBR implements experience-based problem-solving.

The core of every case-based problem solver is the case base, which is a collection of memorized chunks of experience, called cases. The case base is usually stored in a database and constitutes the core knowledge of the problem solver. New problems are solved by retrieving cases from the case base which are similar to the current problem. The experience stored in such similar cases is then reused, for example, solution pieces are adapted towards the new problem and possibly combined. CBR research has developed a considerable set of methods to realize similarity-based retrieval and adaptation of cases. CBR systems are also adaptive systems as they continuously update their case base: new problem-solving experience is retained and outdated experience is removed.

1. RETRIEVES: obtain/retrieve the most similar or the same cases. This task begins with a description of one/some problems and ends when the most suitable previous case has been found. Its sub-tasks refer to feature identification, initial matching, searching, and selection.

2. REUSE: reuse information and knowledge from the case to solve new problems. The reuse process of case solutions that have been obtained in the context of new cases is focused on two aspects, namely:

a) The difference between the previous and current cases.

b) What part of the acquired case can be transferred into a new case

3. REVIEW: review or improve the proposed solution. This phase consists of two tasks, namely, (a) Evaluating case solutions generated by the reuse process. If successful, then proceed with the retain process, (b) If not then fix the case solution using specific domain knowledge.

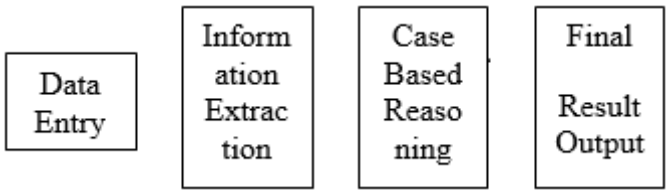
4. RETAIN: save or explore parts of previous experience that may be useful for solving problems in the future. This process consists of choosing what information from the case to store, in what form, how to structure the case to make it easy to find similar problems, and how to integrate new cases into the memory structure.

Explanation:

When a new problem occurs in the higher education environment, the system will first carry out the Retrieve process by retrieving similar problems, for example delays with various causes. The Retrieve process will perform two processing steps, namely the introduction of the type of delay problem and the search for problem equations in the database. After the Retrieve process is complete, the system will then perform the Reuse process by reusing the existing information. In the Reuse process, the system will use the information on previous problems that have similarities to solve new problems. In the Reuse process, it will copy, select, and complete the information that will be used. Furthermore, in the Revise process which reviews and improves existing knowledge, the information will be calculated, evaluated, and corrected again to overcome errors that occur in new problems.

In the last process, the system will carry out the Retain process. The Retain process indexes integrates and extracts new solutions. Then new solutions will be obtained which will be stored in the knowledge base to solve future problems. Of course, the problem to be solved is a problem that has something in common with it.

Figure 2. Conceptual Flowchart



In general, the system consists of two main processes, namely the extraction of information obtained from the academic community database and case-based reasoning (assessment of similarity) on all activities of the academic community. This process flow is intentionally designed to handle documents such as academic community reports or digital documentation, which have a similar documentation structure. More importantly, the document must have a standard format for the system to work optimally. The use of information and communication technology to provide educational services has great potential to improve learning outcomes. Healing of technological infrastructure for internet-based distance education every day, eliminating of barriers of time and place for education, having the opportunity to reach a wide audience and data are being continually updated has made internet-based education attractive. Especially in this Covid-19 pandemic era, ICT usage for effective education using technology is an increasingly urgent need [8]. This situation forces a rapid and widespread increase in the use of education technology. While artificial intelligence (AI) has received increased attention, discursive circulation, and practical application [9]. This is because the

approach is the most similar to the human judgment of similarity; the features are compared side-by-side to determine the similarity of both cases. In this study, we have adopted an equation paper to measure the similarity of all past cases in a case base. The presented equation is the simplest and easiest for an extension, as required in our research work. The equation is given as below: [10].

$$Similiarity\,A, B = \sum_{i=0}^{n} f(A_i, B_i)\, x\, W_i \quad [10]$$

Where A is the new case; B is the existing case; n is the number of attributes/features in each case; i is the individual feature/attribute of each case from 0 to n; f is the similarity function for feature i in cases of A and B, and w is the weightage of each individual feature i.The similarity function, f calculates the similarity of individual features based on the number of matches. It is supported by [11] With the increasing use of Artificial Intelligence (AI) technologies in education, the number of published studies in the field has increased. The results of the review reveal an increasing interest in using AI for educational purposes from the academic community. The main research topics include intelligent tutoring systems for special education; natural language processing for language education; educational robots for AI education; educational data mining for performance prediction; discourse analysis in computer-supported collaborative learning; neural networks for teaching evaluation; affective computing for learner emotion detection; and recommender systems for personalized learning.

Figure 3 How Artificial Intelligence Works? [12]

Artificial intelligence covers Expert systems, Fuzzy logic and the Early principle of AI. In an expert system, the computer is given a problem, and a few practices were carried out to check its logical problem-solving skills. They have been given a set of rules, and they will strictly follow the best in a constrained environment. In fuzzy logic, it is a

mostly true or false method and is applied in control systems. In Data-driven machine learning, Neural networks and deep learning algorithms are applied to process the pool of data in education making a worthy contribution to human beings. Here a complex problem is solved by dividing the problem into subunits and finding the solution to each subunit. The subunit may be a system or a human trying to find a solution to the problem. The proposed theory shows that cognitive science in education developed a tutor by programming a computer, and that tutor would watch the student's problem-solving skills. The tutor will guide the student and advise them in each step of his solution by preventing them before they fell into a trap. This method makes the student learns a lesson about the problem and be cognitive in the future.

3. Results and Discussions

Innovative college methods are what every college wants to achieve. Before discussing intelligent instruction systems, it is important to discuss computer-assisted education, which might be considered the first step in the evolution from AI. AI technologies for education: Recent research & future directions.[13] In a CBR system, case similarity is the most important criterion in determining a probable solution. While there are many methods to evaluate the case similarity, we have adopted the nearest neighbour method to evaluate the new case. This is because the approach is the most similar to the human judgment of similarity; the features are compared side-by-side to determine the similarity of both cases.

The description of Figure 2. shows the observations entered through the system data entry interface, the data obtained is sourced from the academic community database. Descriptions must be provided in free text, but must adhere to certain guidelines and formats. The system will validate all inputs to ensure that the data entered into the system can be processed accurately. For example, the description must follow a certain order of text structure as shown below: a. Overview of the academic community [14] b. Report inspection results [15] c. Description of academic achievement obtained [16] d. Additional academic findings (if available). Different report formats and levels of detail, which vary depending on the standards used at the college. The above items are based on the availability of information in the college data set, which was obtained from the main database. Will explain the dataset further in the experiments section.

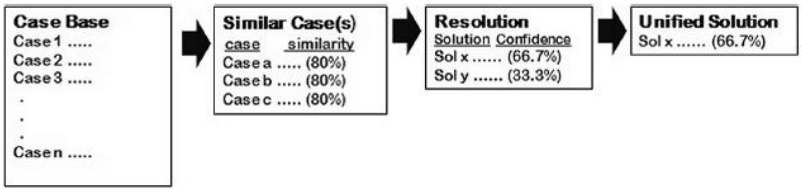
In this rapidly evolving period, notably the digital era, technology is critical. The globes presently living in the technological era, sometimes known as the "Industrial Revolution 4.0." This state is characterized by the widespread use of digital machines and the internet, which has

resulted in quick and substantial changes in many aspects of human existence, making it simpler for humans to perform numerous tasks. The digital transformation age is part of a more robust technology, which is a shift in how digital technology is applied to many elements of life in society. Artificial intelligence is a field of study that looks at ways to make computers behave like humans. In order to advance science, technology, and art in Indonesia, an artificial intelligence system framework is required. The goal of this research is to explain the Case-Based Reasoning (CBR) paradigm in the context of artificial intelligence development. This framework is intended to serve as a model for implementing intelligence systems in Indonesia. [17].

Within the CBR cycle, the synthesized information is the gist of each new case in an autopsy report. The gist, upon extraction, is transformed into a set of features and values, which are required by the system to perform a similarity analysis. The gist is compared with the past cases by computing the similarity of each individual feature. Each feature is also given a default weightage, which is learned or configured automatically via the Naïve Bayes learner. The assignment of weightage is based on the implied significance of each of the features that contributes to the overall outcome of the similarity analysis. Similarity analysis is done using the nearest neighbor approach, by computing the similarity scores for all the past cases in the case base. The most similar top-n cases are selected after the system sorts the similarity scores and displays the top-n cases to the user for reference. An outcome is recommended based on the case(s) that score the highest similarity value. Once the solution is justified and accepted by the user, the new case will be stored in the case base. The gist will also be stored in the case base as an index to speed up the comparison for future cases.of each case from 0 to n; f is the similarity function for a feature I in cases of A and B, and w is the weightage of each individual feature i. The similarity function, f calculates the similarity of individual features based on the number of matches. In this work, the weightage value will be modified by the feature-weight learner after each case is evaluated. The feature weight learner assigns an optimal weightage to each feature that contributes to the highest accuracy of the outcome. For the feature similarities, the attribute values of the current case are matched vs. the attribute values of past cases, which must be within the system vocabulary. After the similarity measures, similarity(A,B) for all cases are computed; the system ranks similar cases based on the similarity scores. The k-nearest neighbor case(s) can also be obtained for purposes of comparison. Case(s) which scores the highest value of similarity(A,B) will be used by the system as the most probable solution and will be analyzed further to suit the new solution.

The advantages include: solving problems easily, the more experience, the system will become smarter so that it can solve problems easily The drawback is that it does not guarantee the best or optimum solution because this reasoning is based on the past case, if the past solution is wrong then the revision stage is needed to reduce the error rate and the more experience, the longer the search process because you have to compare with the most similar cases.

Figure 4. Outcome recommendation using confidence factor method.[18]

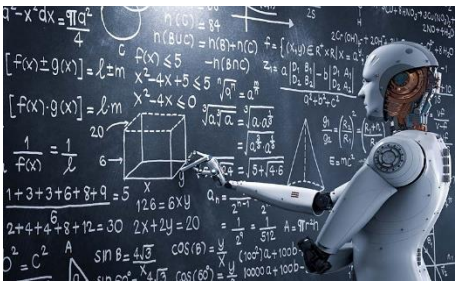


A CBR system is not complete without an outcome recommender. We experimented with two approaches for the outcome recommendation of this system. The first method is the direct recommendation method, where the best outcome of past cases that records the highest similarity score is selected as the best-fit outcome. In the instance of multiple cases with similar scores, the confidence

The method of implementing AI in tertiary institutions is by carrying out the entire process of digitizing existing learning documents and integrating with smart devices, so that the entire teaching and learning process can be carried out.. Some schools use AI to help target students in need of support. By gathering data about what makes a student successful, Ivy Tech Community College in Indiana used machine learning to identify students at risk of failing. Faculty and staff then reached out to those students with individualized advice that could help those students find help. The next level of AI

Much like artificial intelligence is used in hiring, many schools are examining how it could be used in admissions. Schools can use AI to personalize the admissions process for students, as well as identify which applicants are most likely to succeed in their programs.

Figure 5 Artificial Intelligence Is Being Used in Higher Education [19]

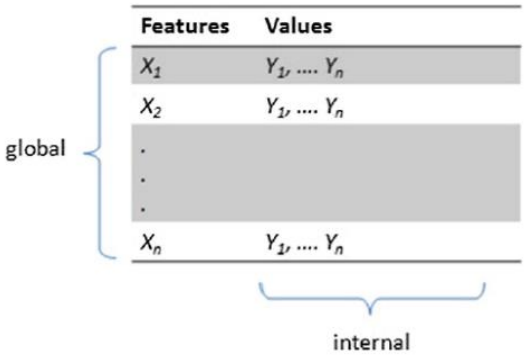


The quality of learning, we can use Intelligent Tutoring Systems (ITS) and online learning Intelligent Tutoring Systems (ITS) are based on automatic tutors for teaching science, mathematics, languages and other disciplines. In many cases, they are based on interactive technologies. Natural human language processing systems, especially with automated learning and crowdsourcing, have boosted online learning. This has had a positive impact on teaching work, significantly expanding the size of conventional classrooms and, at the same time, responding to the different needs and learning styles of students. The large data sets of online learning systems have downloadable programs and online teaching systems such as Carnegie Speech or Duolingoprovide training in foreign languages using Automatic Speech Recognition(ASR) and Neurolinguistic Programming (NLP) techniques to detect language errors and help users correct them, like the picture below:

Figure 6 Artificial Intelligence in Higher Education[20]

Factor is calculated to select the best-fit outcome. The confidence factor is obtained by calculating the frequency of the similar outcomes based on the similar cases. This method, which only relies on the nearest neighbor technique for outcome prediction is used as the baseline for the purpose of comparison. The second method we tested is the proposed method of this paper. The proposed method involves implementing the Naïve Bayes learner as a technique for the feature-weight learner in order to achieve multiple outcome resolution. On top of the normal CBR mechanism, the feature weight is learned after the recommended outcome of every case is verified. The verified outcome is used to update the learner's model for the subsequent prediction. The similarity measure of this method uses a global measure and an internal measure for the similarity analysis [21]. The global measure is tomodify the feature weight based on the actual outcome, whereas the internal measure is to learn the significance of an individual value within a feature. Fig. 4 shows the scopes for both measures, represented in a tabular form.

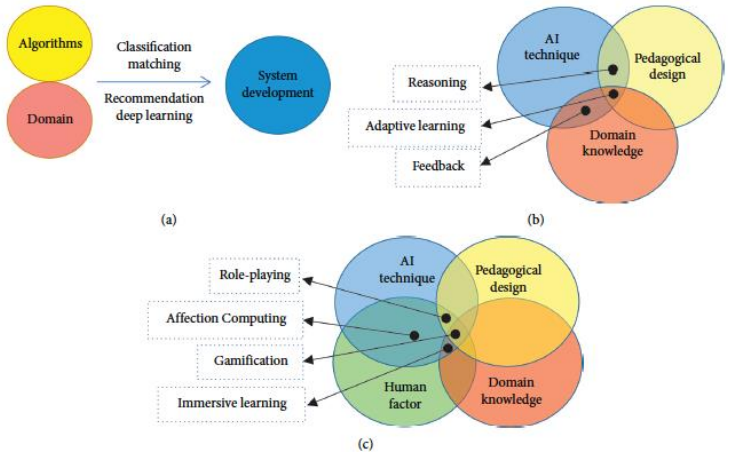
Figure 7. The scopes of global and internal measures.[10]



In the actual implementation, the tabular representation is equivalent to the model for the machine-learning parameters (Marais, 2019). Each parameter represents the conditional probability of the respective features. The overall mechanism of the CBR coupled with the Naïve Bayes learner is illustrated in Fig. 1 Through the Naïve Bayes learner, each feature is treated as an independent instance, and is evaluated independently based on both global and internal measures, respectively. Subsequently, the model (storage of the parameters) is updated by the learner after each successful decision-making process that includes the feedback from the user, if any. The feature weightages are concurrently learned to improve the similarity analysis result. Our experiments show significant improvements by using the Naïve Bayes learner as compared with the first method. The experiments and the results obtained are reported in the next section.

We obtained our data from academic quite structured [22]. Document storage area. These reports are categorized by different sites, representing cases from various location. After all reports are assessed, we obtain data, which consists of a well-structured collection of problems report. The criterion for filtering our data is completeness report. We make sure that all reports have the right section and that they are actually filled by responsible campus administration staff perform data analysis of the academic community. Each report should have a summary section and the results section. With the extraction module, the point is summary sections are translated into features and values automatically; meanwhile, the result part that represents the actual result will also be extracted and translated into a similar form the format to be used for system evaluation.

Figure 8. The hierarchy of artificial intelligence in educational implementation. (a) The dimension of system development, (b) The dimension of extraction, and (c) The dimension of application [23]



The dimension of system development [24], is a combination of algorithms and domains in conducting an in-depth document classification process into a system development so that it becomes a database for the next CBR The dimension of extraction [25] combines 3 components, namely AI techniques used in the data processing process, pedagogic design as the basis for learning used in higher education and domain knowledge as part of CBR that will be used to provide information that users want. Thinking, active learning and feedback are the results of The dimension of extraction and at the end the components are a combination of The dimension of extraction plus Human Factors [26] it is based on a source of existing knowledge to produce Role-playing, Affection Computing, Gamification and Immersive learning so that The hierarchy of artificial intelligence in educational implementation [27] applicable to universities.

According to various international reports, Artificial Intelligence in Education (AIEd) is one of the currently emerging fields in educational technology [28]. Whilst it has been around for about 30 years, it is still unclear for educators how to make pedagogical advantage of it on a broader scale, and how it can actually impact meaningful on teaching and learning in higher education. we are providing an overview of research on AI applications in higher education through a systematic review. Out of 2656 initially identified publications for the period between 2007 and 2018, 146 arti les were included for final synthesis, according to explicit inclusion and exclusion criteria and show that most of the disciplines involved in AIEd papers come from Computer Science and STEM, and that quantitative methods were the most frequently used in empirical studies. The next results present four areas of AIEd applications in academic support services, and

institutional and administrative services: 1. profiling and prediction, 2. assessment and evaluation, 3. adaptive systems and personalisation, and 4. intelligent tutoring systems. risks of AIEd, the weak connection to theoretical pedagogical perspectives, and the need for further exploration of ethical and educational approaches in the application of AIEd in higher education. In similar settings, the three techniques were tested with incomplete data; the purpose is to observe their ability to cope with incomplete data and the effects produced. We decided to retain the same baseline for the second experiment although it performed badly in the first experiment. However, the accuracy scheme for this baseline was changed; an additional rule was added to detect incomplete information. The features for both the internal and global + internal measures remained untouched, incomplete data were supposed to have slight effects on the learner's model [29]

We also evaluated the system results based on the number of features. Here, we only choose to evaluate our system with a feature-weight learner (global + internal measures). The reason of this experiment is to study the effects of increasing (and decreasing) the number of features. This is done to ensure features to support the teaching and learning process in an independent campus.

4. Conclusion

The use of Artificial Intelligence (AI) is now observed in almost all fields of data processing especially education Artificial intelligence is a technology that is evolving to change all aspects of our social interactions. In education, AI will now develop new teaching and learning solutions that will be tested in different situations. The use of Artificial Intelligence (AI) is now observed in almost all fields of data processing, especially education. Artificial intelligence is a technology that is developing to change all aspects of our social interaction. In education, AI will now develop new teaching and learning solutions that will be tested in a variety of situations. The CBR learning model is an assisted learning model of artificial intelligence technology that provides a problem-solving learning model and is heavily influenced by cognitive science, in order to improve the quality of learning in tertiary institutions.

Bibliography

[1] UNESCO., "Artificial intelligence in education: challenges and opportunities for sustainable development," unesdoc Digital Librray, 2023. [Online]. Available:

https://unesdoc.unesco.org/ark:/48223/pf0000366994. [Accessed: 01-Jan-2023].

[2] Z. Ge and Y. Hu, “Innovative Application of Artificial Intelligence (AI) in the Management of Higher Education and Teaching,” J. Phys. Conf. Ser., vol. 1533, no. 3, 2020.

[3] S. A. D. Popenici and S. Kerr, “Exploring the impact of artificial intelligence on teaching and learning in higher education,” Res. Pract. Technol. Enhanc. Learn., vol. 12, no. 1, 2017.

[4] L. Ellitan, “Competing in the Era of Industrial Revolution 4.0 and Society 5.0,” J. Maksipreneur Manajemen, Koperasi, dan Entrep., vol. 10, no. 1, p. 1, 2020.

[5] U. Ajuzieogu, “The Role of Artificial Intelligence in Modern Computing and Education,” Technol. Educ., no. July, 2019.

[6] A. K. Çınar and E. Serim, “Integrating Case Based Reasoning and Geographic Information Systems in a Planing Support System: Çeşme Peninsula Study,” no. 28476221, p. 155, 2009.

[7] U. Trier and C. Reasoning, “Our competences,” Universitat Trier, 2023. [Online]. Available: https://www.uni-trier.de/en/universitaet/fachbereiche-faecher/fachbereich-iv/faecher/informatikwissenschaften/professuren/wirtschaftsinformatik-2/research/case-based-reasoning. [Accessed: 01-Jan-2023].

[8] M. D. H. Rahiem, “Technological barriers and challenges in the use of ICT during the COVID-19 emergency remote learning,” Univers. J. Educ. Res., vol. 8, no. 11B, pp. 6124–6133, 2020.

[9] D. Indriyani and K. D. Solihati, “An Overview of Indonesian ’ s Challenging Future : Management of Artificial Intelligence in Education,” Proc. 2nd Int. Conf. Adm. Sci. 2020 (ICAS 2020), vol. 564, no. Icas 2020, pp. 279–284, 2021.

[10] W. L. Yeow, R. Mahmud, and R. G. Raj, “An application of case-based reasoning with machine learning for forensic autopsy,” Expert Syst. Appl., vol. 41, no. 7, pp. 3497–3505, 2014.

[11] G. C. and C. L. Xieling Chen, Di Zou, Haoran Xie, “Two Decades of Artificial Intelligence in Education: Contributors, Collaborations, Research Topics, Challenges, and Future Directions.,” : International Forum of Educational Technology & Society, 2022. [Online]. Available: https://go.gale.com/ps/i.do?id=GALE%7CA695154664&sid=googleScholar&v=2.1&it=r&linkaccess=abs&issn=14364522&p=AONE&sw=w&userGroupName=anon~675f245. [Accessed: 01-Jan-2023].

[12] Eduba.cpm, “How Arti cial Intelligence Works ?,” EDUCBA, 2023. [Online]. Available: https://www.educba.com/how-artificial-intelligence-works/. [Accessed: 16-Jan-2023].

[13] K. Zhang and A. B. Aslan, “AI technologies for education: Recent research & future directions,” Comput. Educ. Artif. Intell., vol. 2, p. 100025, 2021.

[14] S. Lukersmith, M. Millington, and L. Salvador-Carulla, “What is case management? A scoping and mapping review,” Int. J. Integr. Care, vol. 16, no. 4, 2016.

[15] K. Cox1, A. Aurum, and R. Jeffery, “A Use Case Description Inspection Experiment,” vol. UNSW-CSE-T, no. June 2014, p. UNSW-CSE-TR-0414, 2004.

[16] S. K. F. Briones, R. J. R. Dagamac, J. D. David, and C. A. B. Landerio, “Factors Affecting the Students’ Scholastic Performance: A Survey Study,” Indones. J. Educ. Res. Technol., vol. 2, no. 2, pp. 97–102, 2022.

[17] N. Lutfiani, S. Wijono, U. Rahardja, and A. Iriani, “A Bibliometric Study : Recommendation based on Artificial Intelligence for iLearning Education,” Aptisi Trans. Technopreneursh., vol. 5, no. 2, pp. 112–120, 2023.

[18] W. L. Yeow, R. Mahmud, and R. G. Raj, “An application of case-based reasoning with machine learning for forensic autopsy,” Expert Syst. Appl., vol. 41, no. 7, pp. 3497–3505, 2014.

[19] J. Sucich, “How artificial intelligence is being used in Higher Education,” Dimension Insight, 2019. [Online]. Available: https://www.dimins.com/blog/2019/06/05/artificial-intelligence-higher-ed/.

[20] R. Aghemo, “Artificial Intelligence in Higher Education,” DataDrivenInvestor, pp. 1–29, 2020.

[21] J. Ahn et al., “Covariance effect analysis of similarity measurement methods for early construction cost estimation using case-based reasoning,” Autom. Constr., vol. 81, Apr. 2017.

[22] Z. Zhou, D. Chen, and S. (Shengquan) Xie, Springer Series in Advanced Manufacturing. 2007.

[23] X. Zhai et al., “A Review of Artificial Intelligence (AI) in Education from 2010 to 2020,” Complexity, vol. 2021, no. April, 2021.

[24] M. Felderer and R. Ramler, “Quality Assurance for AI-Based Systems: Overview and Challenges (Introduction to Interactive Session),” Lect. Notes Bus. Inf. Process., vol. 404, no. January, pp. 33–42, 2021.

[25] S. K. Biswas, N. Sinha, and B. Purkayastha, “A review on fundamentals of case-based reasoning and its recent application in different domains,” Int. J. Adv. Intell. Paradig., vol. 6, no. 3, pp. 235–254, 2014.

[26] K. Tremblay, Assessment of Higher Education Learning Outcomes, vol. 1. 2012.

[27] X. Zhai et al., “A Review of Artificial Intelligence (AI) in Education from 2010 to 2020,” Complexity, vol. 2021, 2021.