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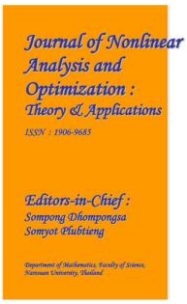

EXPLORING TEACHING APPROACHES AND CURRICULUM CONTENT: AN ASSOCIATION RULE MINING

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Abstract
Using association rule mining as an eyepiece, this study explores the complex interactions that exist between instructional strategies, syllabus covering, and overall quality of instruction. This study uses the Apriori method to find hidden patterns in a dataset that represents students' opinions of educational factors. It is critical to comprehend the nuanced links between instructional strategies and curriculum comprehensiveness as educational institutions develop. To make it easier to apply the Apriori method, the dataset—which includes student comments on syllabus covering, teaching strategies, and overall teaching quality—undergoes careful preprocessing. The investigation of association rules is improved by adjusting the algorithm's parameters, particularly the support and confidence levels. Factors are created from closed-ended parameters to provide a solid analysis.
The results indicate complex association rules that provide important insights into trends in syllabus delivery and teaching methodologies. The study offers insights into effective pedagogical approaches and their effect on overall teaching quality through a thorough interpretation. In the discussion part, practical implications for teaching approaches are outlined, and findings are contextualized within the larger educational landscape through comparisons with previous studies. Recognizing the limitations of the study, suggestions are made for further lines of inquiry. To sum up, this study uses association rule mining to find hidden connections in teaching dynamics, which adds a fresh viewpoint to the field of educational research. These findings provide insightful information for educators, administrators, and researchers who aim to improve the caliber and efficacy of pedagogy in modern educational environments as teaching practices continue to change.

1. Introduction:

Background & Motivation:

In the ever-changing field of education, new developments in curriculum design and teaching approaches demand a sophisticated comprehension of the complex interrelationships among different educational components. Many things affect students' learning experiences, such as the methods used in the classroom, the scope of the curriculum, and the general standard of education. The dynamic character of educational practices highlights the significance of conducting research that can reveal latent patterns and correlations among these components, offering educators and policymakers invaluable perspectives.

Problem Statement:

Despite the quantity of data accessible in educational settings, discovering the latent linkages between teaching tactics and student experiences remains a complicated challenge. Conventional analyses frequently fail to capture the complex interdependencies between various educational components. To sort through these complexities and extract useful information for enhancing instructional strategies and learning objectives, a more sophisticated methodology is needed.

Objectives of the Study:

By using association rule mining techniques to examine a large dataset that includes student input on syllabus covering, instructional tactics, and overall teaching quality, this study seeks to fill in the gaps in the current body of research on education. Finding hidden patterns, investigating the connections between educational characteristics, and offering a strong basis for evidence-based decision-making in educational contexts are the main goals.

Significance of Association Rule Mining in Education Research:

One effective analytical technique for revealing latent relationships and patterns in intricate datasets is association rule mining. Its use in education research is extremely important since it provides a data-driven strategy for comprehending the complex connections between student experiences and instructional strategies. This work aims to improve the quality of education in modern contexts by using association rule mining to provide insightful information that can guide curriculum creation, educational policies, and pedagogical practices.

2. Literature Review:

A comprehensive assessment of teaching quality takes into account a number of factors, such as communication clarity, student needs responsiveness, and flexibility to accommodate different learning styles. Research (Kumar J.A. 2021, Gracia B et al., 2018) emphasizes how important general teaching quality is to creating a productive and happy learning environment. The importance of a well-structured curriculum and efficient teaching methods in raising student involvement and comprehension in the classroom has been emphasized by Kahn, P., Everington, L., Kelm, K. et al.((2017), Faiz Tuma(2021) ,. The study of R Kaur(2019) uses an ARM-based approach to understand information exposure in CS1 courses, generating strong rules for instructors to structure topics and improve learning. Initial results show few anomalies with traditional pedagogy. The application of data mining techniques(Huang Shazan 2018) in Moodle curriculum administration is examined in this article, which shows how it can improve course management, learning promotion, and overall course quality for teachers of distant education.

Dol Sunita M., Jawandhiya Pradip M. (2023) explained the scope for future study is to enhance the teaching-learning process. With an emphasis on Naïve Bays, Random Forest, Support Vector Machine, J48, K-means clustering, and best classification algorithms, this review study examines 142 EDM techniques from 2010 to 2020. M. M. Rahman(2022) explained that using real-world problem-solving data from the AOJ system for programming education, the study introduces an EDM framework for data clustering, patterns, and rules mining. It also suggests that future experiments can integrate EDM results to visualize different LA for programming platforms, fuzzy estimation, and polynomial approximation.

The proposed study integrates elements including syllabus coverage, teaching strategies, and overall teaching quality—a distinctive trait in educational contexts—to find hidden patterns in a large dataset using association rule mining.

3. Methodology:

An extensive log of student interactions with an ASSISTments tutor served as the dataset for this investigation. It includes demographic and statistical data as well as action, problem, and assignment logs. Careful preparation is done on the dataset to fix missing values, harmonize formats, and guarantee consistency. Techniques for imputation can be used to deal with missing data. To enable the Apriori technique to be applied smoothly, the dataset is modified.

The educational dataset's significant patterns and relationships are extracted using the Apriori technique. It uncovers hidden relationships between different elements by identifying frequently occurring itemsets and producing association rules. Understanding the dynamics of student relationships, academic achievement, and the effectiveness of educational interventions is made possible by the information gained from this process. In order to improve the interpretability of association rules and refine the outcomes, parameters like support and confidence are adjusted.

Initial data collection for closed-ended parameters includes things like syllabus covering, instructional methodology, and overall teaching quality. To enable the implementation of the Apriori algorithm, these are transformed into factors, guaranteeing a thorough investigation of their influence on student performance and engagement. By carefully and intelligently examining the dataset, association rule mining can be used to extract insightful information.

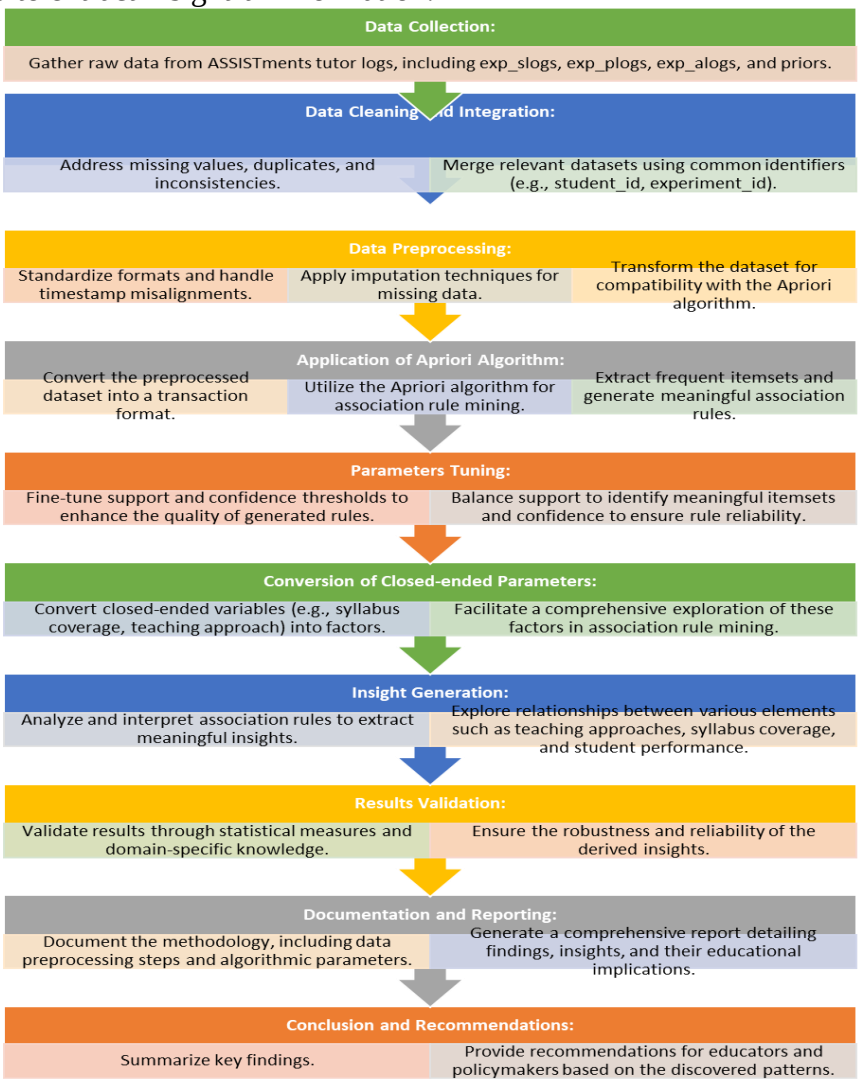

Figure 1: Research Methodology Association Rule Mining

4. Results:

The information's association rules investigation delivers insight into the associations between numerous variables. The results indicate a strong association between a practical teaching approach and comprehensive syllabus coverage. Excellent overall teaching quality is closely correlated with comprehensive syllabus coverage. Student IDs in the designated range are probably belonging to students who have studied the entire syllabus.

Excellent overall teaching quality is closely correlated with a practical teaching style. It is probable that students utilizing a hands-on learning technique will possess Student IDs within the authorized range.

Very good overall teaching quality is achieved by a variety of combinations of syllabus covering, instructional methodology, and overall teaching quality. A very good overall teaching quality is achieved by these elements, which also include syllabus coverage, instructional methodology, and overall teaching quality.

Excellent overall teaching quality can be achieved by a variety of combinations of syllabus covering, teaching methodology, and overall teaching quality. But these elements may also contribute to subpar instruction as a whole. Excellent overall teaching quality can result from using an interactive teaching strategy.

Apriori Algorithm

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inspect(rules)
     lhs                                          rhs                                    support confidence coverage lift count
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so, the dataset's association rules inspection offer insightful information on the connections between many elements, including the scope of the syllabus, the style of instruction, and the general caliber of instruction. Teachers can enhance their instruction and gain a better understanding of it by taking these elements into account.

5. Discussion:

The study provides a nuanced understanding of the relationships between various factors influencing the quality of teaching and learning processes. It offers novel insights into the specific combinations of factors contributing to different levels of teaching quality, which could be valuable for educators and policymakers aiming to enhance teaching practices.

The study's implications for teaching practices are substantial, as it highlights the importance of specific teaching approaches, syllabus coverage, and overall teaching quality in achieving desired educational outcomes. This information can guide the development of targeted interventions and training programs for educators, ultimately improving the quality of the teaching and learning experience.

The study has limitations too. The relationships found are based on trends that have been noticed, which may not indicate cause and effect, and the dataset may not include all pertinent variables determining the quality of instruction. Furthermore, the conclusions might only be applicable to the particular context and features of the dataset. To overcome these obstacles, future studies should take into account larger datasets and make use of sophisticated statistical methods.
Future study ideas include investigating the effects of more factors, doing longitudinal studies, utilizing machine learning methods other than association rule mining, and conducting comparison studies in a range of cultural and educational contexts. In summary, by identifying particular relationships within the teaching and learning process, this study adds to the growing body of research on education and helps educators, administrators, and politicians make well-informed decisions.

6. Conclusion:

Through association rule mining, the study finds strong relationships between variables pertaining to syllabus coverage, instructional strategies, overall quality of instruction, and student outcomes. The results demonstrate how comprehensive syllabus covering and superior teaching quality are positively correlated, and how crucial an interactive teaching strategy is to attaining high teaching quality overall. By providing a data-driven investigation of the elements influencing the quality of teaching and learning, these findings advance educational research. The relationships that have been found can operate as a starting point for further studies, directing investigators toward a more focused examination of particular factors and how they affect academic results. By demonstrating the ability of sophisticated analytics to extract valuable insights from educational information, the work adds to the expanding body of literature on educational data mining. The study's conclusions can help politicians, administrators, and educators make evidence-based decisions that will improve teaching methods and raise educational standards across the board. Prospective avenues for investigation encompass the examination of supplementary variables, conducting extended research, and utilizing sophisticated machine learning methods that surpass connection rule mining. It is also advised to do comparative studies in various educational environments.

7. References:

[1]. Dol Sunita M., Jawandhiya Pradip M. (2023), "Classification Technique and its Combination with Clustering and Association Rule Mining in Educational Data Mining — A survey",Engineering Applications of Artificial Intelligence,Volume 122, 106071, ISSN 0952-1976,
[2]. Faiz Tuma(2021), The use of educational technology for interactive teaching in lectures, Annals of Medicine and Surgery, Volume 62, Pages 231-235, ISSN 2049-0801, https://doi.org/10.1016/j.amsu.2021.01.051.
[3]. Garcia Brustenga, G., Fuertes-Alpiste, M., & Molas-Castells, N. (2018). Briefing paper: Chatbots in education. eLearn Center, Universitat Oberta de Catalunya. https://doi.org/10.7238/elc.chatbots.2018.
[4]. Huang Shaozhen (2018), “Analysis of Students' Learning Behavior Based on Association Rule Mining Algorithm in Moodle Network Platform”, 5th International Conference on Electrical & Electronics Engineering and Computer Science (ICEEECS 2018).
[5]. Kahn, P., Everington, L., Kelm, K. et al.((2017), Understanding student engagement in online learning environments: the role of reflexivity. Education Tech Research Dev 65, 203–218. https://doi.org/10.1007/s11423-016-9484-z
[6]. Kumar, J.A. Educational chatbots for project-based learning: investigating learning outcomes for a team-based design course. Int J Educ Technol High Educ 18, 65 (2021). https://doi.org/10.1186/s41239-021-00302-w

[7]. M. M. Rahman, Y. Watanobe, T. Matsumoto, R. U. Kiran and K. Nakamura(2022), "Educational Data Mining to Support Programming Learning Using Problem-Solving Data," in IEEE Access, vol. 10, pp. 26186-26202, 2022, doi: 10.1109/ACCESS.2022.3157288.
[8]. R. Kaur, T. Brown, G. Walia, M. Singh and M. Reddy(2019), "Using Association Rule Mining Algorithm to Improve the Order of Content Delivery in CS1 Course," 2019 IEEE Frontiers in Education Conference (FIE), Covington, KY, USA, pp. 1-5, doi: 10.1109/FIE43999.2019.9028452.