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Correlation Analysis of Student Activity Units on Soft Skill Development Using the Apriori Algorithm

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Abstract

This study aims to analyze the correlation between Student Activity Units (UKM) and the improvement of students' soft skills using the Apriori algorithm. Student Activity Units serve as a platform for self-development that can enhance non-technical skills such as communication, teamwork, problem solving, responsibility, and creativity. The research data were obtained from students participating in various activity units, including arts, religion, technology, sports, entrepreneurship, environment, and social organizations. By applying the Apriori algorithm through RapidMiner software, several association rules with high support and confidence values were discovered, indicating significant relationships between participation in specific activity units and the enhancement of certain soft skills. The results demonstrate that involvement in technology and innovation, arts, and social activity units contributes significantly to improving students' communication, teamwork, and creativity. These findings are expected to serve as a reference for higher education institutions in designing more strategic student activity programs to support soft skill development.

Keywords: *Apriori Algorithm; Association Rules; Data Mining; Soft Skills; Student Activity Units.*

1. Introduction

Students are part of the academic community who are expected to develop both hard skills and soft skills during their studies in higher education institutions [1][2]. One of the platforms that plays an important role in this process is the Student Activity Unit (UKM). Through UKM, students gain opportunities to collaborate, communicate, solve problems, and develop creativity, which complement their academic learning [3].

Soft skills contribute significantly to personal development, with studies showing that they account for 85% of success factors, while hard skills account for 15[4].However, in practice, many UKM activities remain focused on events without a clear strategy to foster these competencies. Previous research has shown the positive influence of student organizations on soft skill enhancement [5][6]. yet these studies mostly used statistical or qualitative approaches. Meanwhile, the Apriori algorithm has been proven effective in identifying hidden patterns in educational data [7].

Based on this background, this study applies the Apriori algorithm to analyze correlations between student participation in UKM and the development of soft skills. The findings are expected to provide insights into how UKM activities relate to the growth of specific soft skills and to contribute to a better understanding of the role of UKM in student development.

2. Literature Review

2.1. Data Mining

Data mining is widely recognized as a systematic process for extracting useful knowledge from large datasets by combining techniques from statistics, artificial intelligence, and machine learning. The process generally follows the stages of Knowledge Discovery in Databases (KDD), which include data selection, preprocessing, transformation, mining, and evaluation[8]. Its primary objective is to uncover hidden patterns, correlations, and trends that can provide meaningful insights for various domains, including education [9]. Within this field, several approaches are commonly used—such as classification, clustering, prediction, and association—where the Apriori algorithm has become one of the most applied methods for discovering association rules [10].

2.2. Apriori Algorithm

The Apriori algorithm is one of the most widely used techniques in data mining for identifying frequent patterns within large datasets. These patterns, also called frequent itemsets, are combinations of items that appear together with support values exceeding a predefined

threshold. From these itemsets, association rules are generated to describe relationships between items in the data [7]. A well-known application of Apriori is market basket analysis, where the algorithm detects correlations among purchased products based on transaction data [11]. The quality of the generated rules is commonly measured using support, which represents the proportion of transactions containing an itemset, and confidence, which reflects the strength of the relationship between items. For example, a rule such as {sugar, coffee} → milk with 60% support and 50% confidence indicates that milk appears in half of the transactions involving sugar and coffee, while 60% of all transactions contain all three items. Through this mechanism, the Apriori algorithm provides a systematic way to uncover hidden associations, making it applicable not only in retail analysis but also in other domains, including education and organizational studies.

2.3. Correlation

Correlation is a statistical technique used to measure the strength and direction of the relationship between two variables in a dataset[11]. By examining correlations, it becomes possible to identify whether an increase or decrease in one variable is associated with changes in another, which can reveal important patterns within the data. Correlations may be positive, where both variables increase or decrease together, or negative, where an increase in one variable corresponds to a decrease in the other. For example, a positive correlation can be seen between age and height in elementary school students, while a negative correlation may occur between student attendance and academic performance [12]. Understanding these relationships is essential in data analysis, as it helps to clarify the significance of variable interactions and provides a foundation for more accurate interpretation.

2.4. Student Activity Unit (UKM)

Student Activity Units (UKM) are higher education organizations established to develop students' interests, talents, and non-academic abilities. They function as platforms for participation in social, cultural, religious, technological, sports, entrepreneurial, environmental, and organizational activities, all of which contribute to the enhancement of soft skills [3]. Each university may offer different types of UKM, yet their primary goal remains the same: to support holistic student development. Various studies highlight the role of UKM in shaping student character, such as arts units fostering creativity [13], religious units strengthening moral and spiritual values [14], entrepreneurial units improving organizational and leadership competencies [15], and social organizations emphasizing leadership and motivation[16]. Participation in UKM therefore provides students with valuable opportunities to expand their perspectives, strengthen collaboration, cultivate creativity, and build responsibility within the campus community.

2.5. Softskill

Soft skills are generally defined as non-technical abilities inherent in individuals that can be developed to achieve their full potential [4]. These skills complement hard skills by focusing on personal and social aspects rather than technical or intellectual capabilities. They are commonly categorized into two dimensions: intrapersonal skills, such as time management, stress management, and self-regulation, and interpersonal skills, such as communication, teamwork, and leadership [17]. Soft skills play a crucial role in shaping students' character, as they enhance adaptability, creativity, and effective interaction within various contexts. Research also emphasizes that communication, leadership, and public speaking are among the core components of soft skills that significantly support individual development [18]. In higher education, fostering these abilities is essential to ensure holistic student growth alongside academic learning.

2.5. Rapidminer

RapidMiner is an open-source software designed to support various types of data analysis, including data mining, text mining, and predictive analytics. It provides more than 500 operators that cover data input, preprocessing, modeling, evaluation, and visualization, making it a comprehensive tool for exploring and interpreting complex datasets. With its descriptive and predictive capabilities, RapidMiner assists users in gaining deeper insights that can guide decision-making processes. The software can function independently as a data analysis platform or be integrated as a mining engine within other applications. Developed in Java, it is compatible with multiple operating systems, offering flexibility for diverse research and development environments [19].

3. Analysis And Methodology

3.1. Research Methodology

The research methodology refers to a structured approach consisting of organized steps for data collection, information analysis, and the achievement of research objectives. In this study, the methodology is divided into several key stages:

1. Preparation – Formulating research questions, defining objectives, selecting the population or sample, designing instruments, and developing a research plan.
2. Literature Review – Conducting a review of relevant theories and previous studies to establish a conceptual foundation.
3. Data Collection – Gathering the required data through appropriate methods.
4. Data Analysis – Processing and analyzing data to identify patterns, relationships, and findings relevant to the research objectives.
5. System Testing and Implementation – Evaluating the designed system, testing its performance, and analyzing its effectiveness.
6. Reporting – Compiling the research report, summarizing the entire process, results, and interpretation of findings.

This structured methodology ensures the validity of results by systematically aligning research objectives with data collection, analysis, and evaluation.

3.2. Model Implementation

In this study, the Apriori algorithm is applied as an associative method to correlate student activity unit (UKM) participation with the improvement of student soft skills. The Apriori process aims to identify frequent itemsets and generate association rules that describe the relationships between types of activities and specific soft skills. This method involves several stages, including data preprocessing, determination of minimum support and confidence, generation of candidate itemsets, and evaluation of association rules. The overall workflow of the Apriori method used in this research is illustrated in the flowchart below.

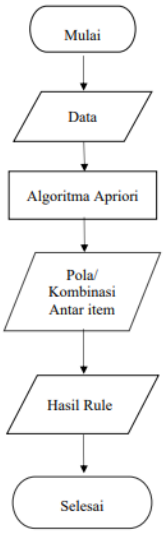

Fig. 2: Flowchart

3.3. Research Variable

To examine the impact of student activity units (UKM) on the development of student soft skills, this study identifies variables based on previous theories and research related to soft skills. A total of twelve variables were determined, consisting of seven variables representing the fields of student activity units and five variables representing soft skills. The UKM variables include: (1) arts and creativity, (2) religion and spirituality, (3) technology and innovation, (4) sports, (5) entrepreneurship, (6) environment and nature, and (7) social or executive bodies. Meanwhile, the soft skill variables include: (1) communication, (2) problem-solving, (3) teamwork, (4) responsibility, and (5) creativity. These twelve variables are considered essential indicators to evaluate the extent to which student activity units contribute to the enhancement of student soft skills.

Table 1: UKM Variables

Description	Code
Arts and Creativity	SN
Religion and Spirituality	AR
Technology and Innovation	TI
Sports	KO
Entrepreneurship	KW
Environment and Nature	LA
Social / Executive	SE

Table 2: Softskill Variables

Description	Code
Communication Skills	A
Problem-Solving Skills	B
Teamwork Skills	C
Responsibility	D
Creativity	E

3.3. Data Processing

The Apriori algorithm was applied in several stages to identify frequent itemsets and generate association rules between student activity units (UKM) and soft skills variables:

1. **Determine minimum support (σ)** – In this study, the minimum support was set at $\sigma \geq 3$. Example from the transaction dataset, the frequent 1-itemset (F1) obtained includes: SN, AR, TI, KW, SE, A, B, C, D, and E.
2. **Generate candidate itemsets** – Candidate 2-itemsets (C2) are formed from the frequent 1-itemsets, Example : {SN, TI}, {SN, SE}, {SN, A}, {SN, B}, {SN, C}, {SN, D}, {SN, E}, {TI, SE}, {TI, A}, {TI, B}, {TI, C}, {TI, D}, {TI, E}, {SE, A}, {SE, B}, {SE, C}, {SE, D}, {SE, E}, {A, B}, {A, C}, {A, D}, {A, E}, {B, C}, {B, D}, {B, E}, {C, D}, {C, E}, and {D, E}.

3. **Support calculation** – The support value represents the proportion of transactions containing both A and B, formulated as:
$$Support\ (A,B) = \frac{Number\ of\ transactions\ containing\ A\ and\ B}{Total\ transactions} \quad (1)$$
4. **Confidence calculation** – The confidence value measures the strength of the association between items A and B, formulated as:
$$Confidence\ (A,B) = \frac{Number\ of\ transactions\ containing\ A\ and\ B}{Number\ of\ transactions\ containing\ A} \quad (2)$$
5. **Rule generation** – Based on the frequent itemsets and minimum thresholds, association rules were derived. For each 1-itemset, one association rule is produced and further evaluated using support and confidence values.

4. Analysis And Implementation

4.1. Analysis of Results

At this stage, a detailed analysis was carried out using the Apriori method to identify the relationship between the types of Student Activity Units (UKM) and the development of students' soft skills. Data obtained through questionnaires were first transformed into a suitable format and then processed using RapidMiner. The initial step involved importing raw data into the software, followed by the generation of association rules that describe significant relationships between specific UKM activities and soft skills.

The results of this analysis provide a structured overview of the contribution of each type of UKM to the enhancement of students' non-technical abilities. These findings are expected to serve as a reference for designing more effective student activity programs in the future.

4.2. Implementation Using RapidMiner

In this study, the Apriori method was implemented using RapidMiner to identify the association between Student Activity Units (UKM) and the development of students' soft skills. The dataset, collected from 539 students who participated in UKM activities between 2020 and 2024, was first prepared in Microsoft Excel and then imported into RapidMiner. Prior to analysis, the data underwent preprocessing, including discretization and conversion into binominal attributes.

The main operators used in RapidMiner were:

1. Discretize by Frequency – to convert numerical variables into discrete categories.
2. Numerical to Binominal – to transform attributes into binary values (0 and 1).
3. FP-Growth – to generate frequent itemsets with a minimum support of 3%.
4. Create Association Rules – to produce association rules with a minimum confidence threshold of 30%.

Through this process, RapidMiner generated 3,459 association rules, consisting of itemsets ranging from 2-item to 7-item combinations. The results were presented both in tabular and graphical form, allowing visualization of the most frequent patterns.

4.3. Results

From the rules generated, the best rules were selected based on the multiplication of support and confidence (S*C). These rules revealed the strongest correlations between UKM categories and specific soft skills, providing a deeper understanding of how different UKM activities contribute to the development of communication, problem solving, teamwork, responsibility, and creativity. The best rules are summarized in Tables 3.

Table 3: Best Rules

Itemset	Rule	Support	Confidence	S*C
2	If students improve creativity, then teamwork skills also improve	81.1%	95.8%	77.7%
3	If students improve responsibility and creativity, then teamwork skills also improve	75.3%	96.4%	72.6%
4	If students improve communication, responsibility, and creativity, then teamwork skills also improve	70.3%	96.4%	67.8%
5	If students improve communication, responsibility, creativity, and problem-solving, then teamwork skills also improve	65.5%	97.0%	63.5%
6	If students improve communication, responsibility, creativity, problem-solving, and join Technology & Innovation UKM, then teamwork skills also improve	31.5%	96.6%	30.5%
7	If students improve communication, responsibility, creativity, problem-solving, and join Technology & Innovation as well as Social/Executive UKM, then teamwork skills also improve	4.1%	100%	4.1%

The results indicate that teamwork skill (C) consistently appears as the consequent in the strongest rules. At the lower itemset levels (2–4), creativity, responsibility, and communication emerge as dominant antecedents. At higher itemset levels (5–7), the addition of problem-solving and UKM fields such as Technology & Innovation and Social/Executive further strengthen the rules, though with reduced support values. This shows that soft skills tend to be interrelated and mutually reinforcing, with teamwork acting as the central outcome of student involvement in UKM activities.

5. Conclusion and Recommendation

5.1. Conclusion

This study examined the correlation between Student Activity Units (UKM) and the improvement of students' soft skills using the Apriori method. The findings indicate a positive relationship between student participation in UKM and the enhancement of soft skills such as communication, problem-solving, teamwork, responsibility, and creativity. Students actively engaged in UKM tend to develop stronger non-technical competencies compared to those who are less active.
The application of the Apriori algorithm successfully identified significant patterns and associations between UKM types and soft skills. One of the best rules obtained was: *{communication, responsibility, creativity, problem-solving, technology & innovation} → {teamwork}*, with support of 31.5%, confidence of 96.6%, and S*C of 30.5%. These results provide useful insights for designing more targeted and effective UKM programs to support soft skill development.

5.2. Recommendations

Based on the results, several recommendations are proposed:

1. Future studies should explore alternative analytical methods, such as Eclat, FP-Growth, or machine learning approaches (e.g., clustering, classification), to identify more complex patterns.
2. The association rules identified can be directly applied to guide the planning of UKM activities, particularly programs aimed at enhancing specific soft skills.
3. Expanding the dataset by involving students from multiple universities and adding variables such as duration, frequency, and role in UKM will improve representativeness.
4. Longitudinal analysis across different academic periods is recommended to examine consistency and track trends in soft skill development over time.

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