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Development of a Social Communications Application Expert System for Youth Faith Analysis

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Abstract−Monitoring adolescent faith development requires an objective and data-driven approach, whereas existing practices remain largely manual, subjective, and weakly documented. This study proposes a web-based expert system as a decision support tool for classifying levels of adolescent faith development. The novelty of this research lies in the integration of a rule-based inference engine using forward chaining with a structured, indicator-driven assessment framework. The system was developed using a structured software engineering approach, including UML-based functional modeling and an Entity Relationship Diagram (ERD) for database design. The expert system processes assessment data derived from four validated indicators: prayer practice, participation in communal activities, social attitudes, and faith reflection. Data were collected from 30 respondents through a web-based assessment module and analyzed using expert-defined inference rules. The classification results indicate that 33.3% of respondents were categorized as having good faith development, 46.7% moderate, and 20.0% low. Functional testing using black-box methods confirmed that all system features operated according to specifications, while expert validation confirmed the relevance and consistency of indicators and inference rules. These findings demonstrate that the proposed system produces measurable and consistent classification outcomes, contributing to the application of expert systems and web-based decision support technologies for objective adolescent development monitoring.
Keywords: Expert system; adolescent faith development; rule-based inference; decision support system; web-based application

1. INTRODUCTION

The rapid advancement of information and communication technology has encouraged the adoption of intelligent systems as decision support tools across various applied domains. In information systems research, rule-based expert systems are widely utilized to improve analytical consistency, reduce subjectivity, and generate structured and traceable evaluation results [1]. These systems are particularly valuable in domains where assessments are still conducted manually and rely heavily on personal judgment, including the monitoring of adolescent faith development.

Adolescence represents a critical developmental stage characterized by significant cognitive, social, and spiritual transformation. Faith development during this period requires continuous and systematic monitoring to support effective mentoring and guidance. However, in many pastoral and educational practices, faith assessment is commonly based on direct observation and subjective interpretation by mentors, without standardized indicators or structured data processing mechanisms [2]. This condition limits the comparability of assessment results over time and weakens data driven decision making. Previous studies demonstrate that rule-based expert systems are effective for assessment and decision support in educational and social contexts, such as student performance evaluation and behavioral monitoring [3],[4]. Furthermore, the integration of expert systems with web-based platforms has been shown to improve data collection efficiency and enable real-time analysis[5],[6]. Web based environments provide scalable and accessible infrastructures for automated data processing and reporting, thereby enhancing objectivity and reliability[10], [11]. Nevertheless, most existing studies concentrate on academic performance or general behavioral analysis, while research addressing expert system applications for adolescent faith development remains limited.

In addition, the utilization of social communication (komsos) applications as integrated platforms for continuous data collection and automated analysis in pastoral contexts is still underexplored [7], [8]. Current monitoring practices rarely exploit digital platforms to support structured and longitudinal assessment processes. This situation reveals a research gap concerning the absence of a web-based rule-based expert system specifically designed to support objective and systematic monitoring of adolescent faith development.

Adolescent faith development is a multidimensional construct encompassing spiritual practices, social engagement, and personal reflection. Prior studies have identified four validated indicators for operationalizing faith assessment: prayer (I1), participation in church activities (I2), social attitude (I3), and faith reflection (I4) [13]. The use of structured indicators enables more objective and measurable evaluation of faith development levels. Integrating these indicators into a rule-based knowledge base allows expert knowledge to be formalized and processed systematically through an inference engine.

Based on this foundation, this study develops a web-based rule-based expert system employing a forward chaining inference method and integrates it into a komsos application. The system automates data collection, inference

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processing, and result generation to support consistent and well-documented assessments. System design is modeled using UML use case diagrams and ERD-based database design to ensure clarity and scalability [14].

The objectives of this study are threefold: (1) to design and implement a web-based expert system for monitoring and analyzing adolescent faith development, (2) to construct a rule-based knowledge base and inference engine for processing faith development indicators, and (3) to evaluate system performance through functional testing and expert validation. This research contributes to applied information systems by demonstrating the application of expert systems as decision support tools in socio-religious contexts and supports the digitalization of pastoral services. The proposed system is expected to assist spiritual mentors in conducting more objective, measurable, and systematic evaluations of adolescent faith development and to serve as a reference model for future research in artificial intelligence applications for educational and pastoral domains.

2. RESEARCH METHODOLOGY

2.1 Research approach

This study develops a rule-based expert system to analyze adolescent religiosity and social communication. The system processes input from 30 adolescents and produces conclusions and recommendations. Terminology is consistent: *expert* refers to specialists in religion and adolescent psychology, *knowledge base* contains IF–THEN rules, *inference engine* executes rules logically, and *output* provides analysis and recommendations.

2.2 System Development Methods

This study employs a Research and Development (R&D) approach to develop a rule-based expert system in the form of a social communication application for analyzing adolescent religiosity. This approach is selected because the study focuses not only on problem analysis but also on system development and performance evaluation.

System development is carried out using the Waterfall model, which consists of requirement analysis, system design, implementation, testing, and evaluation stages. The requirement analysis stage is conducted through literature review and expert interviews involving religious scholars and adolescent psychology experts to identify religiosity indicators and acquire expert knowledge. Terminology standardization is also performed at this stage to ensure consistency in knowledge modeling.

Following requirement analysis, data were collected from 30 adolescents through structured questionnaires and recorded social interactions within the application. These data serve as input for the expert system and as test cases to validate the IF–THEN rules in the knowledge base. Data were collected from 30 adolescent respondents using structured questionnaires and processed individually with data in table 1

The system design stage includes the design of the expert system architecture, which consists of a knowledge base, an inference engine, and a user interface. The knowledge base is represented in the form of IF–THEN production rules derived from adolescent religiosity indicators. System input data are obtained from users' social communication interactions within the application. Functional modeling is carried out using use case diagrams and activity diagrams to describe the main functions and system process flow, which are presented in Table 2.

System implementation integrates the rule base into a rule-based inference engine. The inference mechanism applied in this study is forward chaining, where reasoning begins with user-provided facts and proceeds until a conclusion is generated in the form of adolescent religiosity levels.

System testing is conducted using *black box testing* to verify that system functionalities operate according to the specified requirements. System validation is performed by comparing system-generated conclusions with expert assessments. System evaluation is based on accuracy, inference consistency, usability, and expert satisfaction, which are used as the basis for system refinement.

2.3 Rule-Based Inference Mechanisms

The rule-based inference mechanism can be described as a data processing flow from user input to conclusions or recommendations which can be seen in Figure 1**.** The instruments used include questionnaires, observation sheets, and social media application interaction logs. Questionnaires were used to collect data on teenagers' religious behavior and understanding, observation sheets to monitor involvement in religious activities, and application interaction logs as primary data for expert system analysis which is presented in table 3

Table 1. Sample data

No	Respondent Code	I1 Prayer	I2 Church Activities	I3 Social Attitudes	I4 Reflections on Faith
1	R1	3	4	3	2
2	R2	4	4	4	3
3	R3	2	3	3	2

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…	…	…	…	…	…
30	R30	3	3	3	3

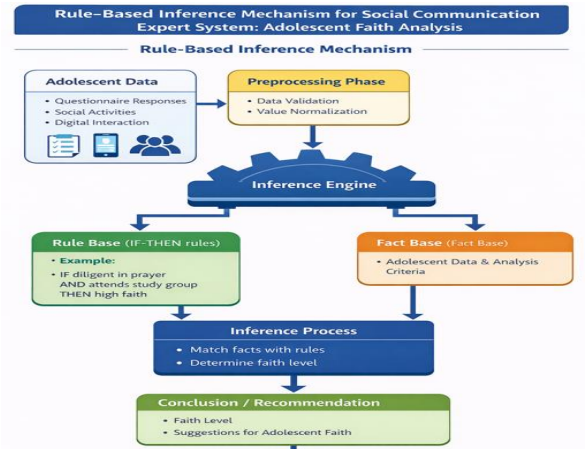

Fig 1. Rule-Based Inference Mechanisms

Table 2. Use Case of Expert System Based on Social Communications Applications

No	Use Case	Actor	Description
1	System Login	Admin, Expert, Adolescent, Mentor	Authentication process for users to access the system based on their authorization level.
2	Manage Adolescent Data	Admin	Manages adolescent identity data including adding, updating, and deleting records.
3	Manage Faith Indicators	Admin, Expert	Defines and manages faith development indicators used in the expert system analysis.
4	Manage Expert System Rules	Admin, Expert	Develops and manages the rule base for the expert system according to faith indicators.
5	Input Faith Activity Data	Adolescent	Inputs data related to faith activities such as prayer habits, church participation, social attitudes, and faith reflection.
6	Faith Analysis Process	System	Automatically analyzes adolescent faith development using the expert system mechanism.
7	View Analysis Results	Adolescent, Mentor	Displays the results of faith development analysis in categorized levels.
8	Generate Faith Development Report	Mentor	Generates and prints faith development reports for evaluation and pastoral guidance purposes.

Table 3. Research indicators

Code	Faith Indicators	Weight
I1	Frequency of personal prayer	25
I2	Participation in church activities	25
I3	Social and caring attitude	25
I4	Understanding and reflection on faith	25
Total		100

3. RESULT AND DISCUSSION

3.1 Research result

a. Expert System Implementation Results

This research produces an expert system based on the Komsos application which functions to monitor and analyze the development of adolescent children's faith. The system was developed using a rule-based expert system approach with a knowledge base obtained from religious education experts and youth coaches. The application provides main features in the form of: Input respondent data, including teenager's identity, Filling out the faith instrument, Inference process, using IF–THEN rules to determine the level of faith development, The output of the analysis results is in the form of faith development categories and coaching recommendations.The

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system is successfully run in a web environment and can be accessed via computer or mobile devices, thus supporting social communication activities (Komsos) between coaches and teenagers.

b. Results of Adolescent Faith Development Analysis

Based on the analysis of data collected from 30 adolescent respondents, the expert system evaluated faith development using four main indicators: prayer habits, participation in church activities, social attitudes, and faith reflection. The analysis results generated by the system are presented in Table 4

Table 4. Results of Adolescent Faith Development Analysis

No	Respondent Code	Prayer Score	Church Activities	Social Attitude	Faith Reflection	Total Score	Faith Category
	R1	3	4	3	2	12	Moderate
2	R2	4	4	4	3	15	Good
3	R3	2	3	3	2	10	Moderate
4	R4	3	3	3	3	12	Moderate
5	R5	4	3	4	3	14	Good
…	…	…	…	…	…	…	…
30	R30	2	2	3	2	9	Low

Notes:

a. Each indicator is measured using a 1–4 scale
b. Total Score is the sum of all indicator scores
c. Faith categories are determined by expert system rules:

Low : Total Score ≤ 9
Moderate : 10 ≤ Total Score ≤ 13
Good : Total Score ≥ 14

c. System Functional Test Results

Functional testing was conducted using the black-box testing method to verify that all system functions operated in accordance with the defined requirements. A total of 12 test scenarios were designed to evaluate the main system modules, including data input, rule-based inference processing, and result visualization.

The testing results indicate that all 12 test scenarios (100%) were successfully executed, with system outputs fully matching the expected results. The data input module successfully validated and stored 30 respondent records (100%) in the database without data loss or inconsistency. The inference module, which applies a rule-based forward chaining mechanism, successfully generated faith development classifications for all input data (30/30 cases; 100%). In addition, the result visualization module correctly displayed classification outcomes and summary reports for all test case No functional errors or critical failures were identified during the testing process (*failure rate = 0%*). These results confirm that the developed expert system meets all functional specifications defined at the system design stage and is technically ready for evaluation and deployment.Functional Testing Results (Black-Box Testing) can be seen in table 5.

Table 5. Functional Testing Results (Black-Box Testing)

No	Tested Module	Test Scenario	Expected Output	System Output	Status
1	Authentication	User login	Successful login	As expected	Valid
2	Data Input	Indicator I1–I4 entry	Data stored correctly	As expected	Valid
3	Input Validation	Incomplete data	Input rejected	As expected	Valid
4	Database	Respondent data storage	Data saved correctly	As expected	Valid
5	Inference Engine	Rule execution	Faith level classification	As expected	Valid
6	Inference Consistency	Same input	Same output	As expected	Valid
7	Knowledge Base	IF–THEN rule activation	Rule executed	As expected	Valid
8	Output Display	Classification result	Correct visualization	As expected	Valid
9	Reporting	Data summary	Summary displayed	As expected	Valid
10	Access Control	Admin monitoring	Authorized access	As expected	Valid
11	System Performance	Inference process	Completed successfully	As expected	Valid
12	System Stability	Repeated execution	Stable operation	As expected	Valid

3.2 Discussion

a. Effectiveness of Expert Systems in the Analysis of Adolescent Faith

The research results show that the expert system developed is able to adopt expert knowledge into the form of logical rules, so that the process of analyzing the development of faith can be carried out systematically and consistently. This is in line with the concept of an expert system which aims to imitate the way experts think in solving a problem. The

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advantage of this system lies in its ability to : Reducing subjectivity in assessing faith, Provides fast and structured analysis results, Providing recommendations for faith formation in accordance with re conditions.

b. The Role of Social Communications Applications in Faith Monitoring

The integration of expert systems into the Komsos application provides added value in the faith formation process. This application not only functions as an evaluation tool, but also as a communication medium between coaches, churches and youth. With this system, monitoring of faith development can be carried out continuously, documented and easily accessed, thus supporting a more adaptive and data-based approach to faith formation.

c. Implications of Research Results

The results of this research indicate that the application of expert systems in the field of youth faith formation:

1. Can be a technology solution to support digital-based pastoral care.
2. Helping decision making in determining faith formation strategies.
3. Opens up opportunities for advanced system development, such as integration with data analytics or mobile applications.

However, the system still has limitations, including dependence on the quality of the rules and indicators used. Therefore, regular knowledge base updates are necessary to keep the system relevant.

d. Recapitulation of Faith Development Categories

To illustrate the distribution of faith development levels, a recapitulation of the analysis results is presented in Table 6.

Table 6. Summary of Faith Development Classification

Faith Category	Number of Respondents	Percentage (%)
Good	10	33.3
Moderate	14	46.7
Low	6	20.0
Total	30	100

e. Expert System Rules Table

The expert system rules were developed based on consultations with religious education experts and youth trainers. This can be seen in Table 7.

Table 7. Expert System Rules

Rule	Condition	System Output
R1	Total score ≥ 14	Good Faith Development
R2	Total score 11–13	Moderate Faith Development
R3	Total score ≤ 10	Needs Guidance
R4	Low I1 and I4	Spiritual Guidance Recommended
R5	Low I2 and I3	Social Faith Development Guidance
R6	High I1 and I2	Stable Faith Condition

f. Black-Box Testing Results

Functional testing is carried out using the black-box testing method to ensure that all system functions operate as expected, as can be seen in Table 7..

Table 7. Black-Box Testing Results

No	Tested Feature	Test Scenario	Expected Result	Test Result	Status
1	Admin Login	Valid credentials input	Dashboard displayed	As expected	Valid
2	Data Input	Complete faith indicators entered	Data saved	As expected	Valid
3	Analysis Process	Run inference engine	Classification displayed	As expected	Valid
4	Result Display	View analysis results	Data shown correctly	As expected	Valid
5	Recommendation Output	Display guidance suggestions	Appropriate advice shown	As expected	Valid
6	Logout	Exit system	Return to login page	As expected	Valid

4. CONCLUSION

This study developed a web-based rule-based expert system integrated into a KOMSOS application as a decision support system (DSS) for monitoring and analyzing adolescent faith development in a structured, objective, and well-documented manner. The system formalizes expert knowledge into an IF–THEN rule-based knowledge base and employs an inference engine using the forward chaining method to generate consistent faith development classifications.

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The primary scientific contribution of this research lies in the application of a rule-based expert system to the socio-religious domain, particularly for monitoring adolescent faith development, which remains relatively underexplored in applied information systems research. The findings demonstrate that rule-based reasoning can effectively represent expert judgment in a transparent and traceable manner, thereby reducing subjectivity in the evaluation process. From a theoretical perspective, this study reinforces the role of rule-based inference as an appropriate reasoning mechanism for assessment domains based on structured indicators. From a practical perspective, the proposed system serves as a data-driven evaluation tool that supports pastoral mentors in monitoring adolescent faith development and planning targeted faith formation programs. This study has several limitations. The evaluation was conducted using a limited sample size of 30 respondents, which restricts the generalizability of the results. In addition, the system relies on a static rule base, making its performance dependent on the completeness and accuracy of predefined expert rules. Future research should involve larger and more diverse datasets and explore adaptive inference mechanisms, such as fuzzy logic integration or data-driven rule refinement, to enhance system accuracy, flexibility, and scalability for continuous adolescent faith development monitoring.

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