The Development of Career Path Recommendation Expert System (CPRES) Model in Higher Education

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Abstract: This article covers the development of a student career recommendation system, an educational innovation that assists students in planning career options or professional skills based on graduate profiles. Choosing a student's career path in higher education without the proper service information in the career recommendation route can lead to challenges in suggesting a profession by students based on their field of expertise and profiles of graduates of the study program they are interested in. In higher education, choosing a student's career path without the right service information in the career recommendation path can cause difficulties in recommending a career by students according to the field of expertise and profiles graduates of the study program they are interested in. This study aims to develop a student career path recommendation system using an expert system through an innovative Career Path Recommendation Expert System (CPRES) system that is already valid and its practicality is proven by the usability score approach, while the effectiveness of the student career model uses an expert system (CPRES) analyzed based on the level of rigor.

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Keywords: Development, CPRES model, expert system, graduate profile, study program

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1. Introduction

Universities in Indonesia provide a wide range of subjects and academic programs. Differences in study programs will define the profession and field of employment of study program graduates to fit the profile of study program graduates. Whereas the graduate profile is a function in life that graduates of study programs can perform in the future, as well as graduate outcomes. Many students have selected their career path without obtaining adequate assistance from professional services or institutions, which has the potential to result in a mismatch between students' academic achievement, personality, interests, and abilities [1]. Students typically begin to examine the career path that best matches their talents and potential after obtaining a bachelor's degree in college. Many students make poor job choices due to a lack of experience, assistance and guidance from friends and family, parents and lecturers, or career counseling. Making a professional decision is a critical stage in any student's life. Before making a professional selection, students should examine a number of things [2].

Low career maturity can lead to mistakes in career decisions; to overcome this, it is necessary to encourage and strengthen universities to conduct planning guidance and the right career selection so that students are truly experts in the field of study chosen; and one way to do this is to encourage and strengthen universities to conduct planning guidance and the right career selection. What is done is to combine existing knowledge, skills, and potential that adheres to a concept where students want to develop optimally and have the potential to direct themselves, so they need to get the opportunities they need through a sustainable education, training, and coaching system, both institutionally, communally, and personally with career counseling is a process that extends beyond action. It aims to solve three types of important problems: help in making and executing career decisions, help in job adaptation and career selection, and help in nature enables career transition and creates a balance between work and career life [3]. Graduates are expected not just to have applicable skills that are restricted to the capacity to work successfully, but also to develop a product that adds to the nation's competitiveness [4].

Planning the proper career requires career maturity in the form of information and skills regarding picking a work, as well as self-awareness to prepare for the predicted career decision. As a result, it is important to verify competence as a learning bridge and a tool to enhance the permeability of the qualification system, as well as to

broaden access to the formal qualification system by performing an inventory of student career construction [5],[6],[7],and [8]. Where competence is defined as a mix of knowledge, abilities, and attitudes based on the circumstances, career orientation must be more than just assisting students in choosing a career path; it must also be a means of developing the skills required to establish a student's career. Thus, skills and knowledge impact the profession/career in line with the profile of study program graduates. Computational frameworks can utilize competencies and knowledge bases used for career suggestions for students to estimate the amount of trust or trust-connections between members in online communities [9].

Preliminary research into the factors thought to have a dominant influence on the recommendation of a student's career path based on the profile of the study program's graduate, it is deemed important to develop an expert system for recommending student career paths based on competence in the form of attitudes, knowledge, general skills, and special skill. Research on developing student career models using an expert system is framed using the IF-THEN rule for classification with forward chaining and backward chaining tracing techniques from professions based on graduate profiles, where student careers are measured according to indicators that affect the student's career [10]. Development of a hybrid recommendation strategy for providing career path suggestions in mobile service products that combines user-based collaborative screening approaches. The trial findings demonstrate that the recommendations aid users in consulting by directing them to the best appropriate mobile service product for their needs [11].

The development model produces a new model for tracking student career trajectories using an expert system that can be used successfully by university students and teachers. The development of a student career model using indicators of graduate profiles of study programs, competencies (CPL), study program subjects, and specializations will result in a profession/career based on the profile of graduates whose construct validity has been proven to have an impact on career or profession predictions based on the profile of graduates of the student study program in the e-learning environment.

2. The purpose and objectives of the study

The purpose of this study is to develop an expert system for a career path recommendation model based on the profile of graduates in universities. A web-based career guidance information system was implemented and tested with 50 students where the test results stated that 76% of the career information system was very useful [12]. It is feasible to give career guidance to completely integrate internal and external information for students by acquiring and managing information for the career advisor model. In earlier study, Career Path Selection Recommendation System (CPRS), which investigates career consulting help, a career system model was used. This has the potential to result in a mismatch between students' academic success, personality, interests, and talents [1].

Based on observations, aspects and indicators that may be utilized as career models for students utilizing an expert system by understanding the skills and knowledge of each profession/career based on the profile of study program graduates were discovered. Information on graduate profiles and competencies, as well as relevant academic activities, serve as the foundation for developing student career models using an expert system that can be integrated into the Career Development System (CDS). Data must be collected and analyzed by administering competency items (skills, knowledge, attitudes) appropriate for students' abilities. As a result, instructors receive trustworthy information that can help them achieve their instructional objectives [13].

Artificial intelligence and information systems are continually changing, particularly in the decision-making process. Expert systems are being used as a decision-making tool in artificial intelligence, allowing for more effective use of vast amounts of data, real-time analysis, and optimization of the decision-making process. [14]. Expert systems can help students enhance their problem-solving abilities [15], assessment of abilities in a skills-based environment as well as modeling and assessment of student behavior and competence in an intelligent tutoring system [16]. The basic concept of this expert system has three main parts, namely the rule base, the search engine (inference engine) and the user interface [17].

Meanwhile, according to [18], everyone has a varied level of thinking ability (cognitive) to be able to decide that the rule-based method can determine it. Before deciding on the selection and planning of student occupations, career path tracing diagnostic can provide a solid foundation of assistance. As a result of the creation of an expert system for recommending student career paths, advice/suggestions will be provided. Career model development using an expert system and a Career Path Recommendation Expert System (CPRES) system model can interact in conducting online consultations in the form of recommendations for professional/career knowledge and skills based on the profile of Study Program graduates by linking Graduate Learning Outcomes (competence), courses that students must complete in order to work.

3. CPRES Model Development Procedure

The procedure for developing student career models using an expert system follows the sequence of activities in the Four D's (4D) model [19]. The development is carried out to solve problems related to student career path recommendations using an expert system in study programs for students and lecturers that need to be improved by

developing a Model Career Path Recommendation Expert System (CPRES), in order to create competitive new knowledge in order to improve and develop knowledge of students and lecturers about information related to career path recommendations from the point of view of Graduate Learning Outcomes (GLO) and competencies, graduate profiles, professions/fields of work and subjects that must be mastered.

The CPRES model design using an expert system focuses on four components of a program, namely, data structures, architecture of expert system-based software, interface representations and procedural details (algorithms). Product design using an expert system is illustrated in Figure 1.
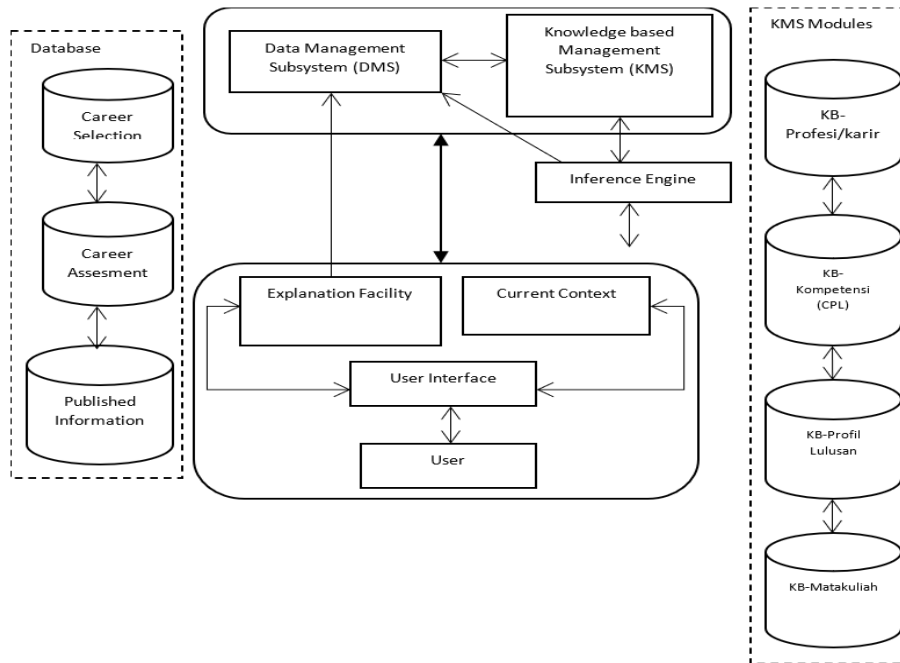

Figure 1. CPRES Model Design Architecture Using Expert System

The CPRES model design using an expert system was created using tools, namely the Unified Modeling Language (UML) modeling to describe the CPRES system model, the database where the knowledge base is stored, the Inference Engine is used to generate new information, and the user interface is designed to consult with the CPRES model. A web-based application is used to generate the CPRES model.

4. Result and Discussions

a. Framework CPRES Model

The CPRES model is a web-based information technology product that may be used by students and lecturers to enhance engagement in the search and career recommendations. This system houses all material, updates, and activities, and students may control their relationships through interactions on the online system.

CPRES is designed to discover the relevant indicators in order to generate career/professional recommendations for students based on the profile of graduates from the study program, where this recommendation is intended so that students can learn early on about planning and selecting students' professions/careers. Where students' skill competency may be recognized, so that students' career path or career/profession selection becomes more precise.

The suggested CPRES model formulation comprises identifying the model object, administering facts in the form of skills and knowledge indicators, offering career solutions using professional indicators, an expert systems method, and determining the model development technique, as shown in Figure 2.
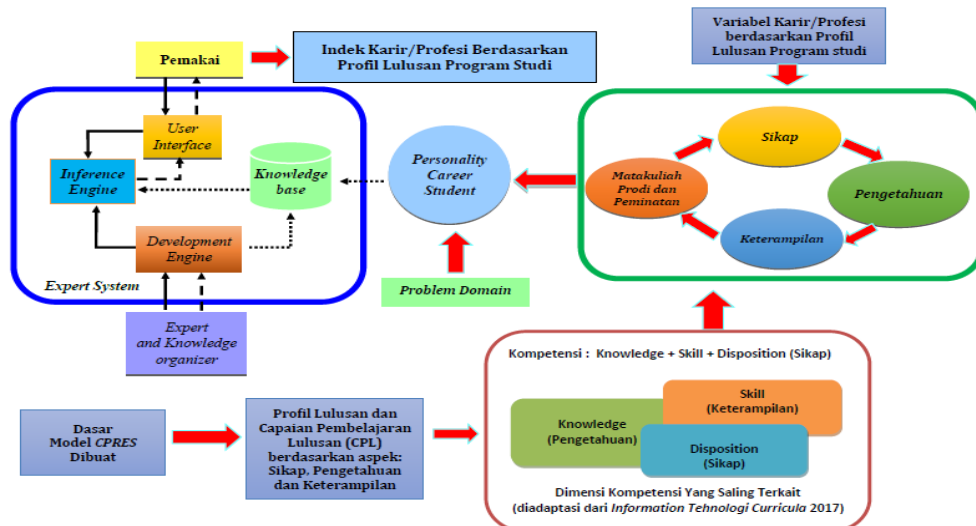
Figure 2. CPRES Model Using Expert System

From Figure 2 for the CPRES model using an expert system, the part that is researched and tested is the graduate profile indicator, Graduate Learning Outcomes (competencies) which are described in the form of skills and knowledge indicators in the form of questions on the CPRES model which produce a graduate profile, skills to be mastered, courses related to the profession taken to be able to produce a mapping of skills or careers in accordance with the level of KKNI level 6 for Bachelors (S1) which is implemented in the expert system to become the Career Path Recommendation Expert System (CPRES) model. The method for searching career mapping information or mapping expertise on the expert system uses 2 (two) searches, namely farword chaining which starts from answering specific skill indicators and produces career answers based on the profile of the study program graduates, while the backward chaining method is used to search from solutions career-supporting indicators.

Knowledge and skill questions are displayed randomly, this is intended so that they are not easily remembered by students, thus the level of truth of questions can be avoided and the continuity of questions in the data warehouse (database) can last a long time by using rule-base classification. After answering the questions given in the form of a Likert scale, namely 1 to 5 (1: not very understand, 2 = do not understand, 3 = quite understand, 4 = understand, 5 = do not understand) is to diagnose the ability of skills and knowledge that is needed owned by students. The results of the ability diagnosis from skills and knowledge are to produce career/professional solutions according to the profile of the graduate of the study program. Figure 3 is a framework for developing student career models using an expert system.

Based on Figure 3, the Career Path Recommendation Expert System (CPRES) model for student career models using an expert system is a guidance process for determining student career paths to obtain a profession based on the profile of study program graduates who are able to solve problems faced by students by collaborating through scientific stages, so that the process of securing a profession is simplified. in the Revolution 4.0 era, it must be in the recommendation of career paths from the CPRES model which contains the connectedness of graduate profiles, professions, competencies, Graduate Learning Outcomes and courses that support the student's profession/career as shown in Figure 3.
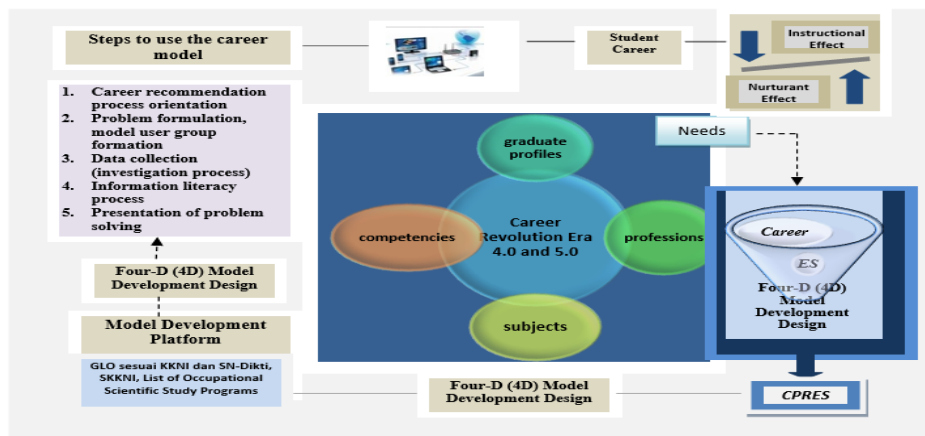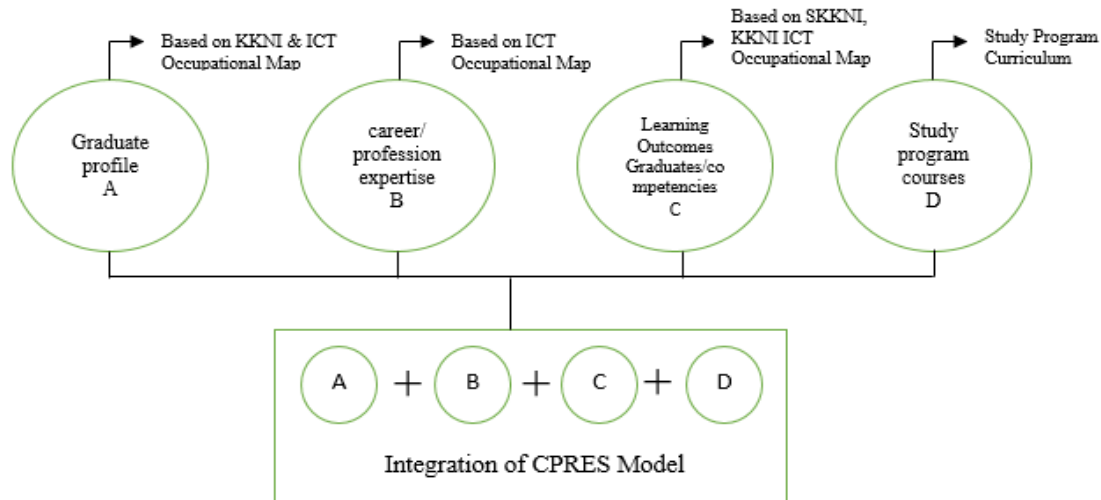

Figure 3. Career Model Development Framework Using an Expert System on the CPRES Model

Figure 4 is a depiction of the CPRES model indicators for recommendations for student career tracking. The novelty value of this research is as follows:

Figure 4. The relationship between the indicators of the Career Path Recommendation Expert System (CPRES) model

The development model produces a new model for tracing student career paths using an expert system that can effectively be used in universities. The development of student career models with indicators of graduate profiles of study programs, competencies, Graduate Learning Outcomes, study program subjects and specializations, then obtained a profession/career based on the profile of graduates whose construct validity has been proven to have an impact on career or profession predictions according to the profile of graduates of the student study program in the experimental class who were given the treatment using the CPRES model as a media for consultation effectively had differences compared to the control class who were given treatment before getting to know their career.

In the software developed in this career development includes many different aspects to existing ones. In the career development of students using an expert system, this is completed by combining the linkage of graduate profiles, Graduate Learning Outcomes/competencies that students must have to achieve careers and professions according to the profile of graduates of study programs, study program courses, specialization courses in one software package so that it is much more complex. The CPRES model was developed on a web-based basis with a simple graphical user interface for consulting career recommendations.

b. CPRES Model Support System

The support system is all means, materials and equipment or devices that are required to implement the model CPRES. The support system needed in this model is the CPRES model. CPRES Model-based expert system developed aiming for a combination of effectiveness and direct interaction with the technology opportunities that students and faculty can easily use this CPRES system in consultation regarding the selection of a career path.

Based on the output of the Support System analysis using LISREL using Confirmatory Analysis Factor (CFA) in Figure 5, the results of the Support System test state that the p-value > 0.05 is 0.60, the Root Mean Square Error Approximation (RSMEA) value is < 0.005, namely 0.00 and the Chi-Square value > 0.05, which is 40.96 so that the Support System for the CPRES model has met the goodness of fit model criteria. Reinforced by the average value of the loading factor of each component of the Supporting System > 0.5 so that it can be accepted, it means that there is a direct impact of each indicator in measuring the construct of the Support System of the CPRES model which is illustrated in Figure 5.

Chi-Square=40.96, df=44, P-value=0.60255, RMSEA=0.000
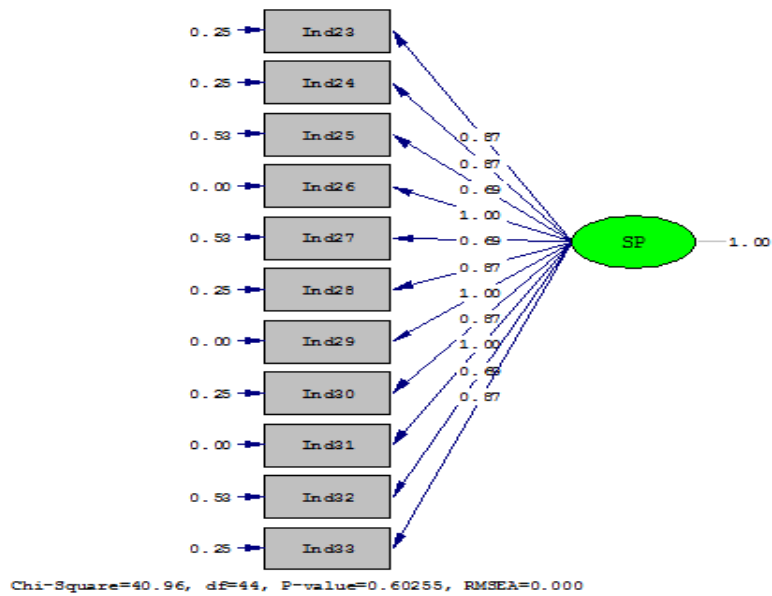
Where: SP= Support System, Ind23-Ind33 = indicator 23-indicator 33
Figure 5. Results of CPRES Model Support System Analysis

c. Result CPRES Model

Below is the CPRES Model product of student career development using an expert system. Figure 6 shows the CPRES model using the Expert System.
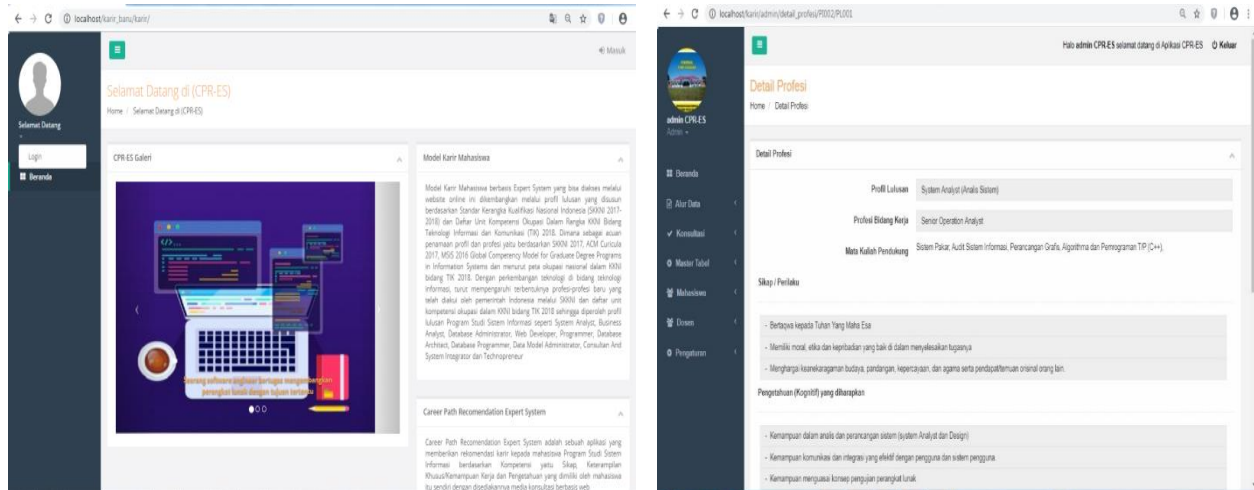
Figure 6. Display of CPRES Model

Figure 6 depicts the interface for starting a consultation, and the application of the CPRES model will automatically present the diagnosis' result (output) in the form of advice for what to do or student guidance in choosing career path recommendations.

5. Conclusion

Based on the data analysis and discussion conducted in this study, the paper offers the theoretical conclusions and product design. Based on markers of learning success, competence, knowledge, skills, and subjects, development research has created a student career model utilizing an expert system in the Career Path Recommendation Expert System (CPRES) model.

The development of consultation media based on the CPRES model, which was designed in response to user demands and allows students and lecturers to communicate without regard for space constraints throughout the consultation process on career path suggestions.

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