An Intelligent Tutoring System Proposal Based on Chatbot and Learning Styles to the Project Management Study

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Abstract*— This research full paper proposes an intelligent tutoring system (ITS) to support the study of software project management, considering the students' learning styles. The learning process is a complex and multifaceted phenomenon that varies significantly from one person to another. Everyone absorbs knowledge differently because each has learning characteristics that directly impact the learning process. Ignoring these differences can result in inefficient and demotivating teaching. Therefore, teachers must invest time in understanding each student's learning style, strengths, and weaknesses, which can be overwhelming, especially in classrooms with a high student-teacher ratio. In this scenario, AI-based technology can be a strong ally. For example, chatbot technology offers an opportunity to adapt to these individual differences and to enable a more engaging and friendly approach for students, contributing to an active and interactive learning environment when exercising the role of a study companion and, why not, a bit of study guide. In this context, this paper proposes developing and applying a chatbot-based ITS called Juh to identify each student's learning style and, based on this understanding, present study activities appropriate to their learning style. The ITS uses meaningful learning theory to personalize the learning journey, detecting five profiles: active, constructive, intentional, authentic, and cooperative. This study chose project management (PM) as its knowledge area, particularly project management methodologies, aiming to evaluate the benefits of this research proposal. In this context, this research proposes to answer the following research question: RQ) How can the study of project management be supported actively and interactively, considering the students' learning styles? As its main contribution, the solution aims to offer support in the introduction to the study of project management and improve the learning experience according to the individual characteristics of each student, maximizing the assimilation of knowledge. Therefore, the difference lies in exploring how and what to learn. The solution was developed using the Design Science Research method and the low code Blip platform. After prototyping and evaluating the ITS with PM and education experts, promising points about the approach were observed, with users highlighting improvements in productivity and ease of use of the tutoring system.

Keywords*—Intelligent tutoring system, Chatbot, Learning styles, Software Engineering Education, Project Management

I. INTRODUCTION

The learning process is a complex and multifaceted phenomenon that differs significantly from person to person. Everyone absorbs knowledge differently because each one has learning characteristics. Such characteristics directly impact the learning process [1]. Individuality in learning is an indisputable reality, highlighted by research [1]. Ignoring these differences can result in inefficient and demotivating teaching.

One of the significant challenges of software engineering education is the dynamic and constantly evolving nature of its content-intensive body of knowledge. Project management, for example, involves several aspects that are difficult to cover entirely in higher education courses and curricula. However, IT professionals interact daily with projects and their management practices and techniques. Thus, IT professionals must acquire such knowledge to coexist in the IT market [2].

Considering the diversity of human learning and the complexity of project management education, the students and professors faces a big challenge. Thus, it is necessary to offer support to students who are beginning their studies in this area. One obstacle is the extensive and conceptual content surrounding this topic, which highlights the importance of guidance for this learning [3][4]. Another obstacle lies in the relationship between the theory of project management methodologies and their applicability in concrete contexts. Often, the way these disciplines are structured does not provide students with a learning experience beyond books and bodies of knowledge. Thus, students are stuck in theory, without a sense of practical applicability and the use of techniques, methods, and tools [5].

AI-based technology can be a strong ally in this context. Chatbot-based Intelligent Tutoring Systems (IST), for example, offer an opportunity to adapt to these individual differences and deliver relevant content, meeting the unique needs of each student [6]. Furthermore, the interactive format of chatbots enables a more engaging and friendly approach for students, contributing to a more attractive learning environment [6].

From these challenges and their context, this study proposes to answer the following research question: RQ) *How can the study of project management be actively and interactively supported, considering the students' learning styles?* Considering their learning profile, we propose developing and applying a chatbot-based Intelligent Tutoring System to help students in project management study.

This paper is organized into seven sections. After this introduction, Sections II and III describe the primary references and related works, respectively. After that, Section IV presents the research methodology. The Chatbot-based ITS is presented in Section V, including the results from its evaluation. Section VI presents the discussions of this research. Finally, Section VII presents the conclusions and future perspectives of this research.

II. BACKGROUND

A. Learning Styles & Meaningful Learning Theory

The theory of meaningful learning, proposed by David Ausubel in the 1970s [7], focuses on acquiring information in the individual's mind as a complex cognitive structure. This theory emphasizes that learning should be meaningful, i.e., acquired information should be integrated with the individual's prior knowledge and experiences. Howland, Jonassen, and Marra propose a set of five aspects or dimensions that characterize meaningful learning and, together, create the student's learning profile [1]: *Active*, *Constructive*, *Intentional*, *Authentic*, and *Cooperative*.

The Active dimension emphasizes the importance of engaging students in practical tasks, which can manipulate learning objects and observe the results of their actions. Thus, students are no longer just passive recipients of information but become active participants in the study object.

In the Constructive dimension, the student internalizes knowledge through reflection, articulation, and construction of mental models. Here, the importance of introspection, critical analysis, and connection between new and prior knowledge is emphasized.

The Intentional dimension is related to self-regulation. It speaks to the student's quest to achieve their learning goal by monitoring their progress. In this profile, learning is intentionally directed towards goals established for knowledge acquisition.

The Authentic dimension emphasizes learning through direct experience and practical application in real-world tasks or simulations.

In the Collaborative dimension, learning flows from collaboration among individuals through conversations and interactions. Thus, students study and work together to solve problems and build knowledge.

In addition to understanding the characteristics of each of these dimensions, mentioning two aspects of learning styles is essential. First, each dimension acts as a spectrum, where the student can develop more or less of the main characteristic of that dimension. Second, these characteristics complement each other synergistically, meaning each dimension contributes specifically to forming the student's profile, thus requiring learning activities that develop all dimensions [1].

B. Chatbot-based Intelligent Tutoring Systems in Education

According to [8], Intelligent Tutoring Systems (ITS) are computerized learning environments that incorporate computational models from cognitive science, learning, Artificial Intelligence (AI), and computational linguistics. These systems track the student's learning state, creating a model that evaluates the level of technical and non-technical knowledge, motivations, and emotions. Generally, the interaction starts simply and flexibly to understand the student and their profile. After some interactions, the system adapts activities according to the student's needs.

In the context of interaction and communication, there is a need for conversational interfaces, such as chatbots [9], which are digital systems that can be interacted with entirely through natural language via text or voice interfaces. They are intended to automate conversations by simulating a human conversation partner and can be integrated into software. This software can be used on online platforms, as a digital assistant, or as an interface through messaging services.

Regarding objectives, chatbots can be used for Human-Computer Interaction (HCI), social, and pedagogical purposes. The main goals are improving student skills, increasing the efficiency of education, increasing students' motivation, providing learning support, and increasing knowledge availability.

Regarding roles, chatbots can play three primary roles. The first is to act as a support tool for teaching technical and non-technical knowledge using activities and traditional methods. The second works as a virtual assistant, promoting easy access to information and acting like a repository. The third acts as a mentoring platform, supporting personal development. This role's main objective is to plan, assess, and reflect on progress, developing self-regulation and lifelong learning skills.

According to [10], Chatbots differ from traditional ITS most significantly in that they are speech-based; they must be capable of interpreting the setting and proposing different solutions to problems or interpreting our communication and redirecting their response capacity.

Despite differing from a traditional ITS in some aspects, chatbots carry functions and roles that can add value to conventional ITS, such as flexibility and communication. Likewise, ITS adds the possibility of some profile modeling to chatbots, which offers greater personalization. Such personalization can occur both in the interaction and learning task and assessment formats.

III. RELATED WORK

Looking for solutions to the challenges mentioned in Section I, we found some works related to this study. The relationship between these studies and the current research occurs directly or partially regarding the use of chatbot-based ITS with student/person modeling, computing education, or the use of the Blip platform as a building tool. Table I shows the proposals' main features.

Choi et al. [11] aim to propose a chatbot to increase the adoption of assistive technology by People with Disabilities (PwD). The tool acts as a mentor, engaging with text messages. This study uses the Blip Platform as a building tool. Despite working with motivating messages, the study

does not model user profiles. Regarding learning materials, the study only uses question-and-answer methods.

TABLE I. RELATED WORKS

Characteristics				
Reference	***Proposal***	***Role***	***Student Modeling***	***Learning Materials***
(Choi et al., 2021) [11]	Chatbot to increase the adoption of assistive technology by PwD.	Mentoring, engage learner with text messages.	No evidence	Text
(Ma et al., 2023) [12]	Chatbot for acquire knowledge of Software Engineering	Assistant, act as a repository offering content based on demand.	No evidence	Text, Q&A exercises.
(Farah et al., 2022) [13]	Chatbot-based ITS to teach/train code review techniques, as well as software engineering good practices	Tutoring, monitoring content learning and offering support and interventions when necessary.	No evidence	Text, Video, Q&A exercises, Coding
(Harroun, 2022) [14]	Chatbot to support the project management learning.	Tutoring, teaching, and motivating to learn new content	Kolb, Dunn & Dunn, Honey & Mumford LSQ	No evidence
Current study	Chatbot-based ITS to teach project management.	Tutoring, teaching fundamental concepts, and motivating to learn new content.	Meaning-ful Learning Theory	Text, Q&A, practical exercises.

Ma, Liang, Wang, Huang, and You [12] aims to present a chatbot that supports students in acquiring knowledge of Software Engineering. The tool was designed according to students' needs. Regarding its role, it acts as an assistant, offering content based on demand and using different learning materials. This study does not carry out student profile modeling.

Farah et al. [13] present a chatbot-based ITS to teach/train code review techniques and good software engineering practices. The tool presents a visual interface that has good usability assessments. Regarding its role, it acts as a tutor, engaging and teaching content. This study does not conduct student profile modeling and uses different learning materials, such as text and coding.

Harroun [14] presents a proposal for a chatbot to support project management learning. The tool was designed to meet students' needs in project-based learning. Regarding the role, it acts as a tutor, engaging and teaching content. The proposal carries out student profile modeling using different learning style theories. The proposal lacks a graphical interface or conversational (UI), making usability assessments difficult. In addition, it does not use different learning materials to help students.

This current study proposes a chatbot-based ITS to help students in project management studies, recommending techniques and usages in the context of software engineering. This tool models student profiles using learning styles presented in Section II.A. Therefore, this study explores "how to learn" beyond "what to learn." Regarding its role, it acts as a tutor, teaching fundamental concepts and techniques and motivating students to study according to their profile. We also apply this tool in computing higher education experiences and performing qualitative assessments, detecting strengths and possible future improvements, which will be commented on in Section VI.

IV. RESEARCH METHOD

Looking to find alternatives to actively and interactively studying project management, considering the students' learning styles, we used Wieringa's Design Science Research (DSR) method [15], which involves comprehending the problem before conceptualizing a solution. DSR is a problem-oriented approach that guides and operationalizes research efforts to create and assess artifacts to achieve new, improved, or desirable states. Considering its problem-focused nature and iterative (cycles-based) approach to creating a concrete artifact, we select this method. Additionally, DSR recommends employing a regulatory cycle comprising four stages: (1) Problem Investigation, (2) Solution design, (3) Design evaluation, and (4) Solution proposal (including implementation and evaluation). Thus, this study describes one complete design cycle (as shown in Fig.1), the conception of chatbot-based ITS.

In the conception cycle, we understood the problem and investigated possible solutions, technologies, and architecture, considering the conception of an initial design. Initially motivated by the learning challenges posed by standardized education in a world of diverse behaviors and skills, the problem investigation stage involved conducting a literature review (non-systematic) to explore learning styles and methods. Also, we focused on teaching project management methodologies and frameworks in computing. In the solution design stage, we explored ways of personalizing learning on conversational interfaces. As a result of this stage, a chatbot-based ITS was defined as the solution, along with its architecture, technologies used, and initial interfaces.

In the proposed solution stage, a chatbot-based tutoring system was defined as being made available through messaging channels using the JavaScript programming language. The prototype was evaluated considering various factors such as its utility, ease of use, ease of learning, and satisfaction. A virtual opinion survey was developed to conduct the evaluation. The survey contained a link to the tutoring system and an explanatory video about the system.

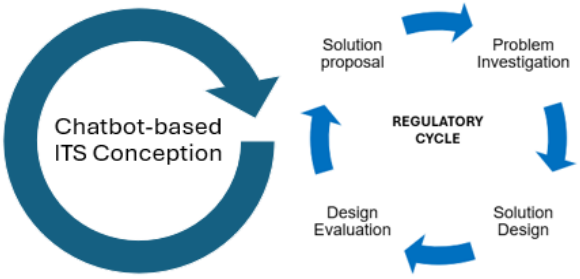

Fig. 1. DSR Cycle

The questionnaire was based on the USE (Usefulness, Satisfaction, and Ease of use) questionnaire [16] with 28 questions, divided into sections on usability, ease of use, ease

of learning to use, and satisfaction with the tool (questions 1 to 8 are related to utility, from 9 to 19 are related to ease of use, 21 to 24 are related to ease of learning to use, and from 25 to 30 are related to user satisfaction). A Likert scale-based value scale was used: 1 - *Strongly disagree*, 2 - *Disagree*, 3 - *Neutral*, 4 - *Agree*, 5 - *Strongly agree*. This evaluation will be discussed in Section VI.

As in all exploratory research, this work observed some threats and limitations. These limitations are related to the low usage of the tool by students and computing professionals and the low number of respondents to the questionnaire evaluating the tool. Another limitation is that implementing a multi-dimensional profile involves a lot of implementation complexity and evaluation time, often resulting in possible future application improvements and evaluation cycles.

V. A Proposal of Chatbot-based ITS to Project Management Study

This section describes the design and evaluation of a chatbot-based ITS called Juh. Juh aims to help students with project management by considering their profiles and learning styles. As described in Section IV, Juh was designed using the DSR method, performed in one regulatory cycle. These steps will be detailed in next subsections.

A. Solution Design

During the regulatory cycle, learning paths and ways to teach IT project management, mapping of learning styles, and the best learning resources for each profile were defined. In this same cycle architecture, the design of the chatbot-based ITS and initial evaluations with students and experts were also defined.

The first step seeks to identify ways to collect the learning profile according to the theory of meaningful learning. For this, we created a questionnaire with five statements, each accompanied by a five-point Likert scale, including the options "Strongly Agree," "Agree," "Neutral," "Disagree," and "Strongly Disagree." Each statement refers to a learning characteristic according to [1].

After collecting the form response, a simple algorithm records the student's learning profile. This algorithm selects the two characteristics with the highest adherence (highest score according to the five-point scale) to how the user likes to learn. Thus, the chatbot can direct activities they are more likely to engage with.

After this process, we define the user's interaction with the ITS and which technical knowledge would be addressed. When users interact with Juh, they can choose from three learning paths, each dedicated to introducing basic concepts of Kanban, Scrum, and the waterfall methodology (Traditional).

Regarding user interaction, all learning paths follow a standard model in overall conduct. Firstly, the object of study is introduced, explaining the basic concepts and fundamentals of the methodology. Shortly after, the user is prompted to interact with the chatbot, which serves as a trigger to send external study materials, such as videos or supplementary materials.

The next step was the definition of technologies and architecture, as shown in Fig. 2.

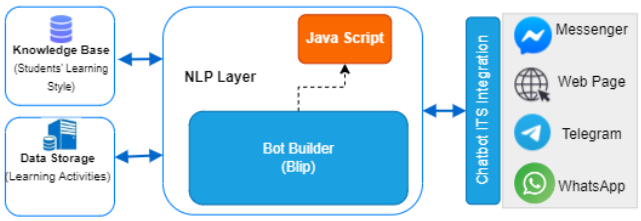

Fig. 2. Chatbot-based Architecture

According to Fig. 2, ITS is composed of four components: 1) an integration component, responsible for providing the ITS visual interactions, which can be through Web Page, Messenger, Telegram, or WhatsApp; 2) a Natural Language Processing (NLP) component, which automates the conversational flows using the Blip Technology and use JavaScript to customize the interactions when needs code intervention; 3) a Knowledge base component which collects the students learning profile at the beginning of the interaction and sends to NLP component; and 4) a Data Storage component which storage the learning activities and your relations with each learning profile.

Regarding technologies, we use a programming language and one technology. For the development of the ITS, we choose the Blip, a platform that automates conversational flows using NLP. The development environment is low code and has a graphical interface, with many possibilities for JavaScript code implementation. JavaScript, in turn, is used in the tool to adapt directions, flow processing, and user data and to control the triggering of commands arising from the use of the system. The application deployment is done through the Blip platform, which provides an embedding URL to be implemented in social media chats or on a web page. We chose these technologies due to their stability and ease of implementation, the possibility of deployment, and portability with the creation of URLs.

After defining the technologies, Juh was conceived. It consists of a chatbot-based ITS personified by a female agent named Juh, who guides the user through the knowledge-building process. As mentioned earlier, the character guides the user through a conversational flow (Fig 3), which begins with a brief introduction of herself and describing her main goal, as shown in Fig. 4.

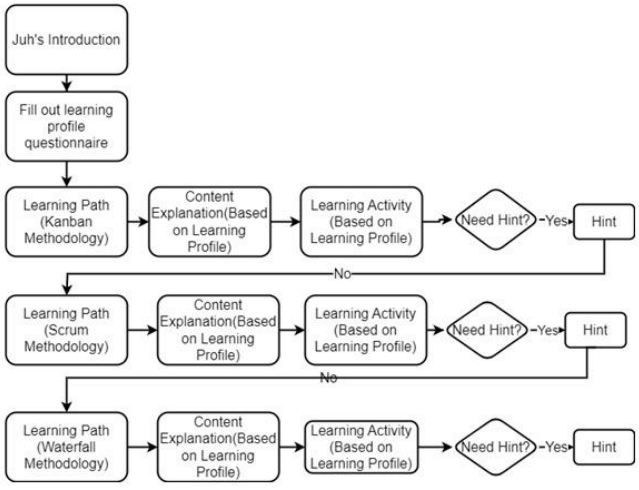

Fig. 3. ITS – Conversation Flow

Fig. 4. ITS – First Interaction

After the introduction, the character informs the user that she will ask some questions. She aims to collect the user's profile and personalize her actions and knowledge path.

As mentioned earlier, a learning profile consists of five dimensions. Each dimension varies in intensity from 1 (no adherence/incompatibility with the style) to 5 (complete adherence). In the case of the ITS presented here, the learning style guiding the user interaction will be the highest score during the collection. Each project management methodology track will use a predominant characteristic in case of a tie.

In learning paths, we considered the guide created by Yunianta et al. [17], as shown in Fig. 5. In this guide, activities are categorized according to the learning characteristics.

E-learning Activities	Meaningful Learning Characteristic				
	Active	Cons-tructive	Coo-perative	Au-thentic	Inten-tional
Course		√		√	√
Label					
Resource		√			
Role					
Upload					√
User					
Assignment	√	√			√
Feedback	√				
Blog	√				
Notes	√	√			
Quiz	√	√			√
Survey	√				√
Chat	√		√		
Lamstwo	√	√	√	√	√
Wiki	√	√	√	√	√
Journal	√	√			
Choice	√	√			√
Discussion Forum	√	√	√	√	√
Calendar					
Workshop	√	√		√	√
Book	√	√		√	
Glossary	√	√	√		

Fig. 5. Activities by Learning Profile (Source: [17])

After collecting the user's profile, the character briefly explains the methodologies that will be covered, from more traditional to agile approaches. After the theoretical part of the content, the ITS selects the learning activity the student will perform according to their learning profile.

Fig. 6 shows a learning activity related to the "active" profile. The main characteristic of the active profile is manipulating objects, models, and concrete materials. The student feels motivated to seek knowledge from other sources and absorb information. As shown in Fig. 5, the ITS recommends using Post-it notes to organize knowledge and creating a task board to organize project phases.

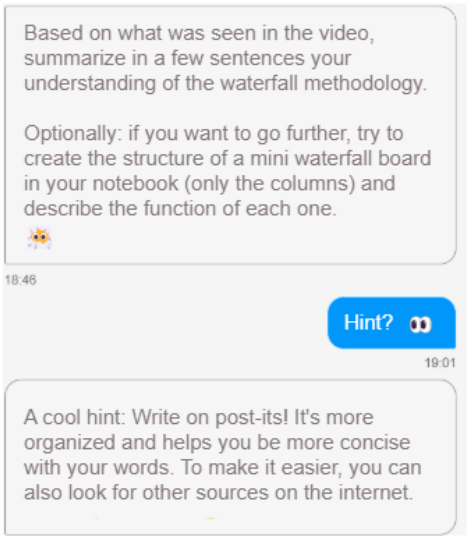

Fig. 6. ITS – Active profile Learning Activity

For the constructive profile, the activities conducted by the ITS should stimulate reflection on a previously studied subject. Fig. 7 presents an activity that connects to what was learned in a previous track about the waterfall methodology.

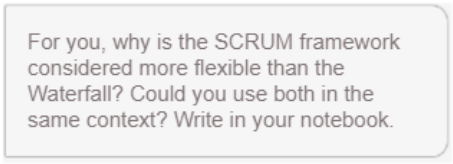

Fig. 7. ITS – Constructive profile Learning Activity

On the other hand, activities that address the intentional characteristic aim to break down the object of study into smaller topics. In this profile, the student is expected to be engaged by achieving small learning objectives at a time. Fig. 8 shows an activity focused on the intentional characteristic used in the ITS.

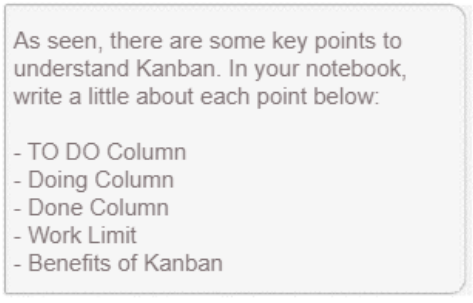

Fig. 8. ITS – Intentional profile Learning Activity

For students with authentic learning characteristics, the task assigned to them aims to bring the object of study to real life. Fig. 9 represents a learning activity for this characteristic.

When a user shows a strong inclination towards the cooperative characteristic, this skill will be stimulated through discussions and information sharing with their study peers, as shown in the second dialogue of Fig. 8. A Portuguese version of the Juh can be found at https://bit.ly/3KWsbgE.

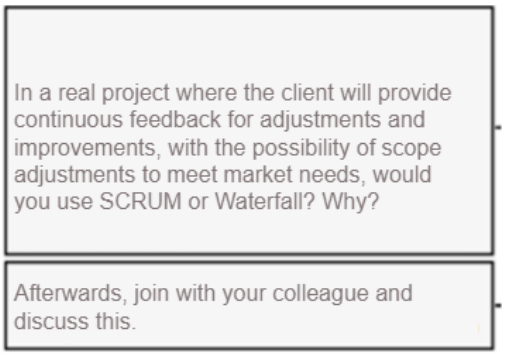

Fig. 9. ITS – Authentic profile Learning Activity

B. *Design Evaluation*

After completing the ITS implementation, we held the prototype evaluation with computer education professionals and undergraduate and graduate computing students. The participants were selected due to their affinity with project management, and they were invited to use Juh voluntarily. In this first evaluation, which focused on the dimensions of the USE model, no demographic data was collected from the participants. Table II presents the participants' profiles.

TABLE II. PARTICIPANTS' PROFILES

ID	Profile	Area
P1	Undergraduate Student	Computing
P2	Undergraduate Student	Computing
P3	Undergraduate Student	Computing
P4	Undergraduate Student	Computing
P5	Undergraduate Student	Computing
P6	Graduate Student	Computing
P7	Professor	Computing
P8	Professor	Computing
P9	Professor	Computing

Considering students and professors of project management courses, as well as the R&D project managers, an email has been sent, inviting for a virtual meeting which presented the ITS and evaluation.

In this meeting, the author presented the ITS proposal, objective and application. After that, open questions have made by the invitees about the ITS workflow. A usage link for ITS has been provided. Finally, the authors were asked to fill out the assessment questionnaire and leave you feedback.

As mentioned, the ITS was evaluated using the USE [16] questionnaire. Table III presents the questions related to the solution's usefulness (1-8). From the USE questions, we can see that most respondents accepted the tool's usefulness (Questions 1 to 8), with an agreed-upon percentage of approximately 85% and a disagreement of approximately 15%. In terms of usefulness, some participants took a neutral stance, especially when related to managing needs and expectations (Q7, Q8).

TABLE III. USE QUESTIONNAIRE (USEFULNESS - 1-8)

ID	Question
Q1	It helps me be more effective.
Q2	It helps me be more productive.
Q3	It is useful.
Q4	It gives me more control over the activities in my life.
Q5	It makes the things I want to accomplish easier to get done.
Q6	It saves me time when I use it.
Q7	It meets my needs.
Q8	It does everything I would expect it to do.

Fig. 10 shows the results of Juh's usefulness evaluation.

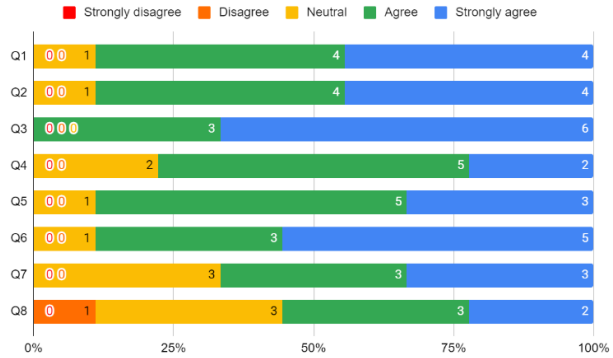

Fig. 10. USE (Usefulness evaluation of Juh)

Table IV presents the questions related to the solution's ease of use (9-18).

TABLE IV. USE QUESTIONNAIRE (EASE OF USE – 9-18)

ID	Question
Q9	It is easy to use.
Q10	It is simple to use.
Q11	It is user friendly.
Q12	It requires the fewest steps possible to accomplish what I want to do with it.
Q13	It is flexible.
Q14	Using it is effortless.
Q15	I can use it without written instructions.
Q16	I don't notice any inconsistencies as I use it.
Q17	Both occasional and regular users would like it.
Q18	I can use it successfully every time.

From the USE questions, we can see that most respondents accepted the tool's ease of use (Questions 9 to

18), with an agreed-upon percentage of approximately 90% and no disagreements. In terms of ease of use, some participants took a neutral stance, especially when related to occasional users and flexibility (Q13, Q17, and Q18). Fig. 11 shows the results of Juh's ease of use evaluation.

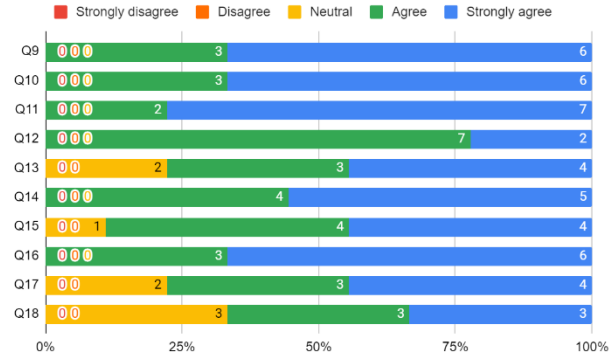

Fig. 11. USE (Juh's Ease of use evaluation)

Table V presents the questions related to the solution's ease of learning (19-22).

TABLE V. PARTICIPANTS'S PROFILES

ID	Question
Q19	I learned to use it quickly.
Q20	I easily remember how to use it.
Q21	It is easy to learn to use it.
Q22	I quickly became skillful with it.

From the USE questions, we can see that most respondents accepted the tool's ease of learning (Questions 19 to 22), with an agreed-upon percentage of approximately 95% and no disagreements. In terms of ease of learning, some participants took a neutral stance, especially when related to quickness and learning path (Q19 and Q20). Fig. 12 shows the results of Juh's ease of learning evaluation.

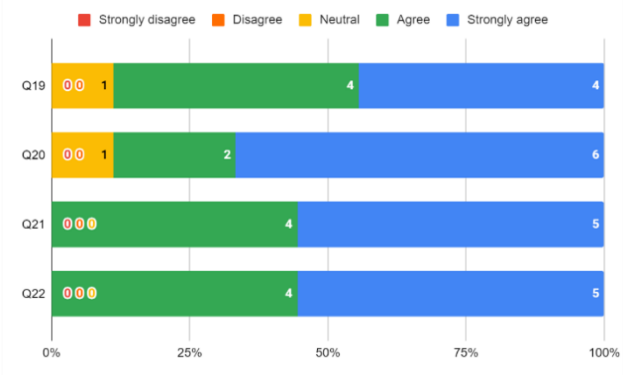

Fig. 12. USE (Juh's Ease of learning evaluation)

Table VI presents the questions related to the satisfaction of the solution (23-28).

TABLE VI. PARTICIPANTS'S PROFILES

ID	Question
Q23	I am satisfied with it.
Q24	I would recommend it to a friend.
Q25	It is fun to use.
Q26	It works the way I want it to work.
Q27	I feel I need to have it.
Q28	It is pleasant to use.

From the USE questions, we can see that most respondents accepted the tool's solution satisfaction (Questions 23 to 28), with an agreed-upon percentage of approximately 80% and 5% of disagreements. In terms of satisfaction, some participants, approximately 15%, took a neutral stance, primarily when related to the need to have the tool. Fig. 13 shows the results of Juh's satisfaction evaluation.

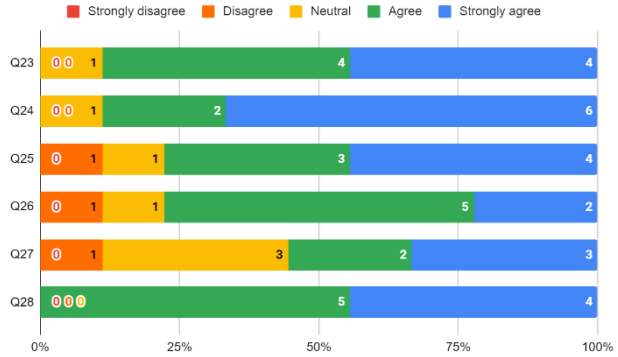

Fig. 13. USE (Juh's Satisfaction evaluation)

It is also possible to detect some observations about the ITS from open questions. Participant P1 highlights potential improvements in the inclusion of new functions related to Educational Data Mining and Decision Support Systems to help the teacher when pointed out, "*Perhaps it would be interesting to add functionalities so that the teacher could carry out analysis of student usage data, to assist in learning based on the information exchanged between the student and the bot*."

Participant P4 highlights the importance of using a learning profile in Juh's conception and conducting learning activities, emphasizing, "*It's interesting to have something like Juh. It doesn't give you the answer but guides you to do the right thing*."

As points of improvement, P9 highlights the importance of involving the final users in the conception step commenting, "*It is important to focus on teaching and learning about project management using new elements or elements that provide clarity, support, and engagement for those who will use it. Carry out a study with those who are studying disciplines related to the project*."

VI. DISCUSSIONS

The evaluation of the tool proposed the discovery of important findings, both in terms of acceptance, usefulness, and ease of use, as well as suggesting new directions.

From the usefulness evaluation, it was possible to verify that the tool is useful for what proposes and achieves the goal. However, there are some points that need to be clarified. The first is related to an alignment between user needs (especially

the student) and the functionalities. The second is a clearer explanation of the application's purpose and its intended use.

The ease-of-use evaluation showed that the tool is simple to use. The use of the avatar (Juh), along with clearer and less formal language, helped make the ITS more user-friendly. The evaluation also showed that the definition of interaction paths was well constructed.

The evaluation of ease of learning showed that the tool has a small learning curve, providing quick and memorable interaction. Additionally, the use of learning paths, along with personalized learning styles, helped students build their knowledge more effectively.

The satisfaction evaluation showed that users are satisfied with the application. A large portion of them (90%) would recommend it to other users, emphasizing its potential for project management teaching. However, there is still a need for alignment between functionalities and user needs, as mentioned earlier.

The subjective evaluations proposed three findings. The first suggests adding a functionality to help teachers track students' progress and improve their classes. The second agrees that the tool aids learning and shows that the use of learning styles for personalization was successful. The third reinforces the need for alignment and clarification between needs and functionalities.

VII. CONCLUSIONS

This work was motivated by the plurality in students' learning characteristics, which, when ignored, can make teaching demotivating for these students. Using a chatbot-based ITS promotes interactive and personalized experiences that propose improvements in individual learning when considering these learners' characteristics.

Thus, we propose a chatbot-based ITS to teach project management methodologies, using learning styles to personalize knowledge and improve student motivation. As mentioned, this work used the DSR method and presented the tool's design and evaluation cycle.

The results showed good acceptance of the tool. The usefulness evaluation showed that the tool is useful and accomplishes its purpose. The ease-of-use evaluation showed that chatbots with interaction paths helped make the interaction simpler. The use of learning styles helped students understand knowledge construction. The satisfaction evaluation showed the potential of the application to reinforce project management teaching.

Despite the positive evaluations, some improvements still need to be made to the application. One is related to adding new functionalities to help the teacher track students' performance. The other is related to aligning users and application functionalities. This latter improvement may be related to the low adoption of the application and the low number of evaluation respondents. It is essential to highlight that the decisions regarding the technological architecture, including the WhatsApp interface, showed a high potential for Juh's scalability. However, applicability in new domains requires constructing a specific knowledge base.

In future work, beyond these improvements, we also considered analyzing and including new relevant topics in software project management. Finally, we intend to explore other strategies for implementing the tutoring system, in addition to chatbots, develop functionality to assist the teacher in monitoring student use, and develop new DSR cycles, aiming to evolve and improve the system.

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