ChatGPT-based Recommendations for Personalized Content Creation and Instructional Design with a Tailored Prompt Generator

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***Abstract*— Recent advancements in Artificial Intelligence (AI) have significantly influenced educational innovations, making learning environments more sophisticated with personalized learning, tailored feedback, and learning analytics. Among these advancements, Generative AI, namely ChatGPT, has emerged as a powerful tool in education. ChatGPT's ability to generate human-like content in real-time can assist educators with course design and educational material creation, allowing for enhanced instructional strategies without starting from scratch. Moreover, integrating ChatGPT into the recommendation process offers superior understanding of user needs and delivery of context-aware recommendations. In view of the above, this paper explores the integration of ChatGPT with a tailored prompt generator within an intelligent authoring system to offer effective recommendations for personalized content creation and instructional design. The system was evaluated and compared to its conversional version where instructors manually use ChatGPT. The findings indicate significant improvements in system usability, content quality, personalization, and time and effort savings, demonstrating the effectiveness of the proposed approach.**

Keywords—Authoring tool, ChatGPT, Conversational recommender system, Generative AI, Educational content, Instructional design, Personalized learning.

I. INTRODUCTION

In recent years, educational innovations are inextricably linked to Artificial Intelligence (AI) technology [1, 2, 3]. AI technology makes the educational environments more sophisticated, enabling personalized learning, tailored feedback and learning analytics [4, 5, 6]. Among the various advancements in AI, Generative AI has rapidly evolved, getting ground in education by providing new capabilities in content creation, interactive learning experiences, and dynamic educational resources [7, 8, 9].

One of the most widely used Generative AI tool is ChatGPT, released in 2022. ChatGPT has the remarkable capability to instantly generate human-like content as users interact with it [10]. In education, this tool can significantly enhance learning and development for both educators and students [11, 12]. Many studies have demonstrated the potential of ChatGPT in assisting instructors with course design and the creation of educational material [13, 14, 15]. Using ChatGPT, educators can synergistically enhance instructional design, instead of developing courses entirely from scratch [16].

Recommender systems play a crucial role in educational environments by offering personalized content based on user profile [17, 18]. Traditional recommender systems use approaches like collaborative filtering, user-item interactions, or content-based filtering to generate suggestions [19]. Leveraging ChatGPT in recommendation process, can better understand user needs and offer context-aware recommendations [20, 21].

In view of the above, this paper investigates the use of ChatGPT in conjunction with a tailored prompt generator to provide effective recommendations for personalized content creation and instructional design in an intelligent authoring system. In particular, the system incorporates the ChatGPT API acting as a recommender system, and a prompt generator for constructing tailored prompts based on course characteristics and teachers' feedback. These prompts are used as input to the ChatGPT-based recommender system. The aim of these modules is to improve the quality of educational material proposed to instructors, and the content personalization, as well as to facilitate them by simplifying and accelerating course design and content creation. The study explores the effect of this approach on teacher engagement and curriculum development process. The results are very encouraging in terms of system usability, content quality, content personalization, and time and effort saving.

II. SYSTEM OVERVIEW

In this work, an intelligent authoring system for improving course development is presented. The system allows instructors to create courses, importing lessons and assigning to them activities, quizzes and assessments. During this process of course development, the system offers precious suggestions on course elements, namely instructional design, knowledge transfer, structure, assessment, collaborative activities etc. In particular, the system integrates ChatGPT with a tailored prompt generator based on course characteristics and instructors' feedback to provide personalized recommendations on curriculum content and instructional design (Fig. 1).

The authoring tool utilizes the ChatGPT API in recommendation procedure, in order to propose customized educational material to teachers. As such, the recommender system sends HTTP requests to the ChatGPT API endpoint, and gets the response with the generated text in JSON format. The responses are refined and delivered to users in the proper form. Using the ChatGPT-based recommender system, the authoring tool offers highly personalized content on a wide

range of topics and levels. Moreover, it supports various types of content creation, such as lesson plans, chapter text, presentations, activities, quizzes and exams. Furthermore, the proposed content is up-to-date and aligned with the latest pedagogical trends.

The prompts used in ChatGPT interaction are generated automatically by the prompt generator module. This module uses a rule-based approach to construct tailored prompts based on course characteristics and instructors' feedback on the recommended content. The course characteristics are given by the instructor when creating the course, including its title, description, target students, educational level, duration, learning outcomes etc. The system automatically proposes an instructional design based on these characteristics, which teachers adopt or not, if they wish. Moreover, the instructors can ask for recommendations while building each course element, and then the system provide them tailored content based on course characteristics. They can also customize further the recommended content giving the proper feedback depending on their needs. The system offers a variety of feedback options related to content relevance, structure, difficulty level, level of analysis, types of knowledge etc. Based on teachers' feedback, the prompt generator module refines the prompt properly to meet teachers' needs and preferences. This new tailored prompt is the input for other ChatGPT-based suggestion, aiming to be more suitable and accurate.

For better understanding of system functionality, an example of operation is described below. A high school history teacher named Mr. Pappas uses the intelligent authoring tool to develop a new course on World War II. Mr. Pappas logs into the system and starts creating a new course titled "World War II: A Comprehensive Study". He inputs the course description, target students (high school juniors), duration (one semester), and learning outcomes, such as understanding the causes and consequences of World War II. Afterwards, the system automatically proposes a lessons plan based on these characteristics. Mr. Pappas chooses to create the first lesson named "Introduction to World War II", importing basic information. Then, he asks the system for additional content. The system sends an HTTP request to the ChatGPT API endpoint with the proper prompt generated by the corresponding module based on Mr. Pappas's course characteristics and feedback. The system receives a response from the ChatGPT API in JSON format, containing a detailed introduction to World War II, This content is refined and presented to Mr. Pappas in a user-friendly format. He reviews the suggested content, and provides his feedback. Mr. Pappas uses feedback options to indicate that the proposed content should include further analysis of the political and economic causes of the war. Based on this feedback, the prompt generator module refines the prompt and a new request is sent to the ChatGPT API. The updated content recommendation is received, aligned with Mr. Pappas needs. Adding assessments: Mr. Pappas proceeds to assign an assessment to the lesson. He asks the system for recommendations on assessment items. The system suggests a set of questions. Using the feedback options, Mr. Pappas indicates that he needs 5 multiple-choice questions of higher difficulty level. The system responses the updated content. Mr. Pappas continues the same process to complete course development. Namely, he inputs initial content, requests recommendations, provides feedback, and refines content based on the system's suggestions. The system continuously adapts the prompts to his feedback, ensuring that the recommended content is highly personalized.

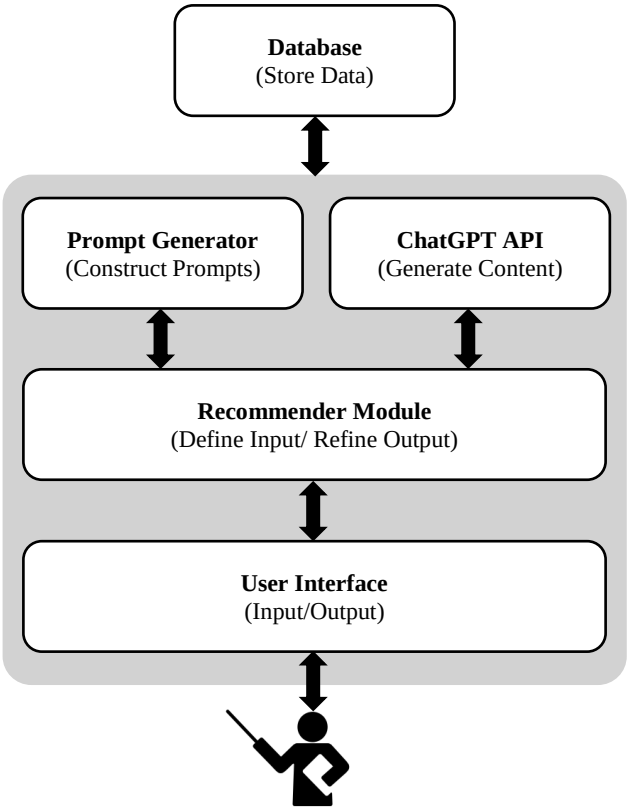

Fig. 1. ChatGPT-based recommender system with automatic tailored prompts, embedded into an authoring tool for effective course development

III. Research Methodology

In order to assess the effect of ChatGPT-based recommender system with the tailored prompt generator, a quantitative analysis was conducted based on 4 evaluation dimensions, namely system usability, content quality, feedback/personalization, and time/effort saving. Thus, a 5-point likert scale questionnaire was employed, including 3 questions for each dimension. Table I illustrates the questionnaire used in this research.

TABLE I. Questionnaire of System Evaluation

Questionnaire Items
System Usability
1. How easy was it to create a new course using the system?
2. How satisfied are you with recommender system's ability to understand and incorporate your course characteristics and feedback?
3. How responsive was the system when generating and refining content based on your feedback?
Content Quality
4. How relevant was the content recommendations to your course objectives?
5. How accurate and up-to-date was the educational material provided by the system?

6. How comprehensive were the lesson plans and instructional designs proposed by the system?
Feedback/Personalization
7. How effective was the system in incorporating your feedback into content recommendations?
8. How helpful were the feedback options provided by the system in improving the content quality?
9. How satisfied are you with the overall personalization capabilities of the system?
Time/Effort Saving
10. To what extent did you save time in creating courses by using the intelligent authoring system?
11. How effectively did the intelligent authoring system reduce the need for manual content creation?
12. To what extent did the intelligent authoring system improve the course development process?

Apart from the survey using the aforementioned questionnaire, a t-test evaluation was conducted to assess the effectiveness of the intelligent authoring system in improving course development compared to the same authoring tool without the embedded functionality of ChatGPT-based recommender system and prompt generator. Hence, the experimental group consists of educators who use the intelligent authoring system to develop their courses. On the other hand, the control group consists of educators who develop their courses using the conversional version of the authoring tool without the AI-driven recommendations. In particular, the control group uses the ChatGPT tool independently and manually, without the assistance of the tailored prompt generator.

The sample includes 30 high school teachers, which were divided in experimental and control groups, each consisting of 15 individuals, with similar demographic characteristics to ensure comparability. Table II shows the demographic characteristics of the sample. The gender distribution includes 14 male teachers and 16 female ones. In terms of age, 20% of the participants fall within 25-30 age range, 33.3% between 31 and 40 years old, and the remaining 46.7% are over 40 years old. Regarding years of teaching experience, the majority of the teachers has over 10 years (60% of the sample), while 4 teachers have between 1 and 5 years of experience and 8 teachers have 6 to 10 years of experience, representing 13.3% and 26.7% of the sample correspondingly. Finally, 33.3% of the participants state that they have low previous experience with ChatGPT tool; 40% of them have medium experience, while only 26.7% of the sample have high experience with AI tools like ChatGPT.

TABLE II. DEMOGRAPHIC CHARACTERISTICS OF THE SAMPLE

Characteristic		Frequency	Percent
Gender	Male	14	46.7%
	Female	16	53.3%
Age	25-30	6	20%
	31-40	10	33.3%
	> 40	14	46.7%
Years of experience	1-5	4	13.3%
	6-10	8	26.7%
	> 10	18	60%
Experience with ChatGPT	Low	10	33.3%
	Medium	12	40%
	High	8	26.7%

The experimental and control group used the two systems, namely the intelligent authoring tool and its conversional version respectively, for a semester, developing courses and continually updating their content. Each instructor developed 2 courses in average.

IV. EVALUATION RESULTS AND DISCUSSION

In order to evaluate the effect of the intelligent authoring tool, a survey was conducted on the experimental group. Participants were asked to answer the aforementioned questionnaire at the end of the semester after using the system. The 5-point likert scale answers of each question were converted into 3 categories, namely Low for values 1 – 2, Medium for value 3, and High for values 4 – 5. Afterwards, they were aggregated in the 4 evaluation dimensions. The survey results are shown in Fig. 2.

A significant majority of participants (80%) rated the system usability as high, indicating that the tool is user-friendly and easy to navigate. Moreover, 67% of the teachers rated the content quality as high, which demonstrates that the intelligent authoring system provides high-quality educational material. An important portion of participants, namely 60%, rated the tool highly for the dimension of feedback and personalization. This indicates that the tool effectively incorporates instructors' feedback and personalizes the content based on their needs and preferences. However, the noticeable percentage of 27% who rated it as medium, shows that there is room for improvement in this dimension. Finally, the majority of educators (73%) stated high levels of time and effort saving, indicating that the intelligent authoring tool is highly effective in reducing the time and effort required for course development.

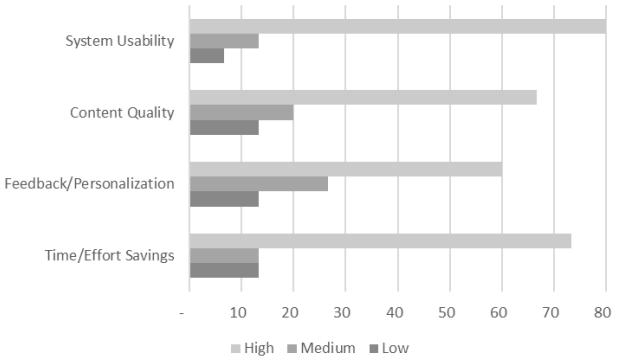

Fig. 2. Survey results on the effect of using the intelligent authoring system.

An independent-samples t-test was conducted to compare content recommendations in the intelligent authoring system and the conversional one. As such, there is a significant difference in content recommendations between using the intelligent authoring system (Mean = 4.133, Variance = 1.123) and the conventional one (Mean = 3.067, Variance = 1.638), $t(27) = 2.486$, $p<0.05$. This result suggests that the intelligent authoring tool outperforms the conventional one in terms of recommending content that meets instructors' needs. It seems that the prompt generator module effectively constructs tailored prompts based on course characteristics and educators' feedback, enabling the ChatGPT API to return educational material customized to instructors' need and preferences. In contrast, the conversional version of the authoring tool requires the teachers to manually utilize the

ChatGPT, meaning that they have to create the prompts themselves and interpret each response. The instructors may have difficulty with this task, as it requires from them to be familiar with how ChatGPT works and how to make a meaningful conversations with it.

TABLE III. T-TEST RESULTS ON TAILORED PROMPT GENERATOR

	Content Recommendations	
	Experimental Group	**Control Group**
Mean	4.133	3.067
Variance	1.123	1.638
Observations	15	15
Hypothesized Mean Difference	0	
df	27	
t Stat	2.486	
P(T<=t) two-tail	0.019	
t Critical two-tail	2.052	

The second t-test evaluation addresses the null hypothesis "There is no significant difference in the time and effort saving between using the intelligent authoring system and conventional one". The results, as shown in Table IV, illustrate that there is a statistically significant difference between the means of the two trials. In particular, the 15 participants who used the intelligent authoring system (Mean = 4.267, Variance = 0924) compared to the 15 participants in the control group (Mean 3.133, Variance = 1.838) demonstrated significantly better time and effort saving, $t(25) = 2.641$, $p < 0.05$. It seems that embedding the power of ChatGPT into the authoring tool reduces the time and effort involved in switching between different tools and moving data between different systems. Furthermore, the intelligent authoring tool through the automatic prompt generator functionality eliminates the need for instructors to manually create prompts, which can be time-consuming and require significant effort to ensure precision and relevance.

TABLE IV. T-TEST RESULTS ON TIME AND EFFORT SAVING

	Time and Effort Saving	
	Experimental Group	**Control Group**
Mean	4.267	3.133
Variance	0.924	1.838
Observations	15	15
Hypothesized Mean Difference	0	
df	25	
t Stat	2.641	
P(T<=t) two-tail	0.014	
t Critical two-tail	2.059	

To sum up, leveraging the power of ChatGPT, the developed intelligent authoring tool provides a high-quality course development, reduces the time and effort needed by teachers for instructional design, and ensures that the content is up-to-date and engaging for the students. The system's ability to provide personalized content recommendations and to adapt to instructors' feedback makes it a valuable tool for educators.

V. CONCLUSIONS

This paper introduces an intelligent authoring tool for effective course development. In particular, the tool incorporates a ChatGPT-based recommender system for providing high-quality educational content and covering a wide range of subjects. Moreover, it utilizes a prompt generator for constructing tailored prompts based on course characteristics and educators' feedback. These prompts are used as input to the ChatGPT API.

The findings of the assessment process showed that the intelligent authoring tool is highly effective in system usability, content quality, and time and effort saving. While the feedback and personalization dimension shows some potential for further enhancement, the overall positive ratings suggest that the tool is valuable for educators in course development. Moreover, the intelligent authoring tool outperforms its conversional version where instructors use the ChatGPT manually, in terms of generating the proper prompts for providing tailored content and saving time and effort in developing courses.

Part of our future plans is to improve the mechanism of prompt generator in order to enhance content personalization. Moreover, future work includes the extension of system evaluation using further methods and a larger sample.

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