Software Engineering for Educational AI Applications: Insights from Student Requirements for a VR Coaching System

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***Abstract*—This paper presents findings of a study which explored students' perspectives on a virtual reality (VR)-based AI coach designed to support preparation for oral examinations. It highlights the complex interplay between user experience, acceptance, and software development priorities. The qualitative data collected from informatics students provides important insights into their learning goals, expectations, and specific requirements for such a tool and reveals significant implications for the design and development process.**

The study shows that students are generally open to the use of AI-based VR applications in exam preparation. They express strong interest in virtual coaching — particularly to build confidence and reduce exam-related anxiety in oral settings. Students value the opportunity to engage in realistic simulations, receive authentic and useful feedback, and benefit from a personalized learning environment that adapts to their individual needs.

The students articulated high expectations regarding the realism of the virtual coaching scenarios, the accuracy and completeness of the content, and the degree of individualization provided by the system.

In summary, the student feedback underscores the critical role of user experience and perceived value in the development of educational technologies. When prospective developers are also the users, their standards become even more stringent. To succeed, a VR-based coaching system must not only be technically functional but also pedagogically credible and emotionally acceptable from its very first use. These insights challenge typical development rhythms and require a raised awareness of the experiential dimension of educational software.

Keywords-AI-based learning; virtual reality; VR; educational software engineering; oral examination; requirements.

I. INTRODUCTION

Digital transformation has become a key driver in reshaping educational practices in higher education. In recent years, the rapid advancement of Artificial Intelligence (AI) and immersive technologies such as Virtual Reality (VR) has opened new possibilities for designing personalized and interactive learning environments. Particularly large language models (LLMs) like ChatGPT have catalyzed discussions about the potential of AI to enhance teaching and learning experiences.

Despite these technological innovations, the formats of academic assessments have remained largely unchanged. Written examinations still dominate the assessment landscape, followed by oral examinations. While students are generally accustomed to preparing for written assessments, oral examinations are often associated with discomfort, anxiety, and uncertainty. Many students report feelings of nervousness or even fear when faced with the challenge of articulating knowledge in a face-to-face examination setting.

These emotional barriers can significantly affect performance and learning outcomes. To address this, AI-based learning companions – specifically, virtual coaches using VR and conversational AI – may offer a promising approach. By simulating realistic examination situations, providing feedback, and offering adaptive support, such tools could help students prepare more effectively and confidently for oral assessments.

This paper presents an exploratory study investigating students' goals, preferences, and requirements for an AI-based VR coach designed to support oral examination preparation. Through qualitative content analysis of open-ended questionnaire data, we aim to understand better how such a tool should be designed to meet learners' needs. It derives some implications for software engineering for educational AI applications.

II. RELATED WORK

The development of virtual and AI-based coaching systems for educational purposes is interlinked with numerous research approaches, including virtual reality in higher education, user-centered design in educational software engineering, and adaptive feedback mechanisms for oral communication training.

A. Virtual Reality in Higher Education

The use of VR technologies in education has gained momentum over the past decade, especially in domains that benefit from immersive, scenario-based learning environments. VR has been applied in healthcare (e.g., surgery) [1], [2], engineering (e.g., simulation of hazardous environments) [3], and language learning (e.g., simulated dialogues) [4], [5] to enhance experiential learning and motivation [6], [7]. Recent studies highlight that VR can support cognitive, affective, and behavioral learning when used in well-structured instructional designs [8], [9].

In the context of assessment preparation, however, research is still emerging. Some initial works have investigated VR as a means to reduce anxiety [10], [11] and increase speaking fluency [12], [13], [14]. Others have explored virtual exam situations [15] but often in context of healthcare [16], [17]. The integration of adaptive, AI-based elements, especially for open-ended oral interactions, is still relatively novel.

B. Coaching Systems and AI in Educational Feedback

AI-based coaching systems are increasingly used to provide personalized feedback and scaffolded learning environments. Intelligent tutoring systems have been shown to improve learning outcomes by offering adaptive support based on user input, performance history, or predefined instructional rules [18], [19]. Recent approaches leverage natural language processing and machine learning to model open-ended communication, such as in empathic pedagogical conversational agents [20].

In oral exam preparation, however, such systems are rarely used. While virtual agents have been developed for interview training or job application scenarios [21], [22], the level of pedagogical alignment and realism required in academic oral examinations presents unique challenges. The present study addresses this gap by investigating learner expectations for a VR-based AI coach in this high-stakes educational context.

III. Research question and Research Design

A. Research Questions

This study primarily aims at better understanding students' needs and expectations regarding the use of a virtual coach to prepare for oral examinations in higher education. Specifically, the research explores if students are generally open to learning with a virtual coach, and if so, what their intended learning outcomes are. Furthermore, the study aims to identify students' requirements and preferences for a virtual coach that supports the preparation for oral examinations.

The following questions guided the study:

- Would students be willing to use a virtual coach for exam preparation? (RQ1)
- What are their learning goals when using such a tool? Which purposes do students associate with using a virtual coach? (RQ2)
- Which requirements and expectations do they have with respect to the functionality and behavior of a virtual coach? (RQ3)
- Which features or behaviors would lead students to reject or avoid using such a coach? (RQ4)

B. Research Design

The study employed a qualitative design based on a paper-and-pencil questionnaire containing open-ended questions. These questions invited students to complete sentence prompts related to their expectations, goals, and concerns regarding a virtual coach for oral examination preparation. We asked the following questions:

"Imagine you had the ability to prepare for oral exams with the support of virtual reality. What should such a VR-based training system look like, what should it be able to do? Please complete the following sentences:

- The most stressful thing for me before or during an oral exam is ...

- From a VR-coach I expect ...

- I would like to train with a VR coach...

- I'd love to...

- It's not possible that ..."

Participants included a total of 44 participants from informatics (bachelor) and data science (master). The survey was conducted in the middle of the term.

Qualitative content analysis (QCA) following Mayring [23] was applied to analyze the data. This approach allows a structured, category-based, and research question–oriented evaluation of the open responses [24]. QCA was chosen because it is systematic and transparent, ensuring that results are understandable and intersubjectively verifiable.

The analysis followed the eight standard steps of QCA:

1) Definition and Selection of Material

The first step determines the type and scope of the material to be analyzed. A representative subset of the complete data corpus should be selected, ensuring relevance and alignment with the research questions. The selection criteria are informed by the aim to capture the diversity and key dimensions of the material in a manageable, yet meaningful way. In our case, no selection was necessary because we can include all 44 questionnaires received.

2) Analysis of the Context of Material Production

To understand the material in its original context, the circumstances of its creation should be examined. This includes identifying the individuals or institutions responsible for compiling the material, their motivations, and the intended purposes. Particular attention should be paid to the broader socio-institutional and thematic context in which the material was produced, which is essential for interpreting its content appropriately. This step was not relevant for us as we conducted the survey ourselves.

3) Formal Characterization of the Material

The selected material should be formally described with respect to its type and structure. This includes documentation of the transcription conventions and other formatting rules applied, ensuring transparency and reproducibility of the analytical process. The questionnaire was answered by our students in a paper-and-pencil survey.

4) Determination of the Analytical Perspective

The focus of the analysis should be defined by specifying which aspects of the material would be explored. This study primarily concentrated on students' requirements and preferences for an AI-based VR coach, in accordance with the overarching research interest.

5) Theory-Guided Differentiation of the Research Question

The main research question should be refined into several sub-questions, based on relevant theoretical considerations. This step allows for a more nuanced investigation and facilitates the development of a structured analytical

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framework. In our case, section III.A. describes the detailed research questions.

6) Selection of Analytical Techniques

Based on the nature of the material and the research aims, appropriate analytical techniques should be selected. These include elements of summarizing, explicating, and structuring content. In our study, we focus on summarizing the content [25, p. 64ff] and analyzing frequencies.

7) Definition of Units of Analysis

According to Mayring, "the focus [of CQA] is always on the development of a category system. These categories are developed in a relationship between the theory (question) and the concrete material, defined by construction and assignment rules and revised during the analysis." [25]

In principle, both an inductive and a deductive approach to category formation is possible. In deductive category formation, a coding guideline clearly defines the category system. These category definitions are formulated in advance from the theoretical background. Only then the material processing starts and searches for relevant sections of text. This approach is often used for explicating and structuring content analysis.

In contrast, we chose summarizing content analysis as analyzing technique. The summary content analysis tries to take all material into account and systematically reduce it to the essentials. If only certain components (to be determined according to a definition criterion) are taken into account in such reductive text analysis processes, this is a kind of inductive category formation [25]. Therefore, inductive category development was used in our study, allowing categories to emerge from the data in close relation to the research questions. Inductive category definition derives categories directly from the material in a generalization process, without referring to previously formulated theoretical concepts [25, p. 84].

8) Conducting the Material Analysis

The material was analyzed according to the established procedure. The category system was applied iteratively, allowing for dynamic interplay of the coding process and the refinement of categories. When the category system was adjusted substantially, previously coded material was re-examined to ensure consistency and validity.

IV. Results

Participants included bachelor students in their second or third year (Informatics) and master students in Data Science. The survey was conducted in the middle of the semester, and 22 students from each course (a total of 44 participants) completed the questionnaire.

Bachelor students attach much more importance to the goal of "gaining certainty, reducing excitement" (21), while this is only a marginal phenomenon for master students (6). The latter put more emphasis on closing knowledge gaps and achieving understanding of the content (18), while bachelor students prefer to learn answers to all possible questions (7) and thus build knowledge (2). There is a striking shift during the course of studies from the "soft" focus on gaining security and reducing examination anxiety to content-related and knowledge-related aspects.

Interaction and feedback are also becoming increasingly important for training with a VR coach during the course of studies, even though bachelor students already have high demands here. 12 bachelor students want real feedback rather than an imposed, standardized interaction. This aspect becomes even more important for the master students (17).

It is also striking that bachelor students prefer to be motivated by a VR coach (2, in the master's program only one person), while master students want the VR coach to develop an individual schedule for further learning together with them.

Overall, individualization and personalization gain relevance along with the study progress: while only one bachelor student expects personalized feedback from the VR coach, there are already 7 master students who wish to do so.

The main requirement for a VR coach is particularly striking: about 70 percent of students (15 bachelor and 16 master students) expect realistic scenes and as real situations as possible from a VR coach. 5 bachelor and 5 master students wish to have images of the real examiners and sometimes even a picture of the real examination room. In terms of proximity to reality, both groups are very similar in their statements and see this as an essential requirement and also a prerequisite for using the VR coach.

The statements of the students can be summarized into two super-categories with sub-categories:

1. One category puts a focus on learning goal-related aspects (RQ2), which in turn can be subdivided into personal and content-related learning outcomes.
2. The second category relates to aspects of the learning process (RQ3 and RQ4), including realistic scenarios and the simulation of real instructors and assessors as well as the examination room. Another sub-category is real interaction and individualized feedback. A third aspect is personalized and individualized support of the learning process including the motivation and development of learning paths.

V. Discussion of Results

The results of the QCA provide valuable insights into students' learning goals and expectations regarding the use of a virtual coach to prepare for oral examinations. Regarding RQ1, all but two students have no fundamental reservations against using a virtual coach.

Regarding learning goals (RQ2), students expressed both personal and cognitive motivations for using a virtual coach. On a personal level, many bachelor students emphasized a desire to gain confidence in their performance, reduce examination anxiety, and manage nervousness prior to the exam. This shows a strong emotional component in preparing for oral assessments, which a virtual coach might address through repeated exposure to realistic exam-like settings.

On the cognitive level, students wish to identify and close knowledge gaps and assess their own level of understanding. This indicates that learners are not only looking for emotional support but also expect the virtual coach to contribute to their academic progress by offering feedback that enhances metacognitive awareness and supports self-regulated learning.

Regarding the requirements for the VR-coach (RQ3), students highlighted several key expectations. First and foremost, authenticity and realism are essential. Students expect the simulation to closely mirror real-life examination scenarios, including realistic examiners, spaces, and question types. Furthermore, the coach must enable real interaction and provide meaningful, situation-specific feedback. Simple or generic responses were considered insufficient.

A second major requirement is personalization. Students want the virtual coach to support their individual learning processes by offering customized feedback, motivation, and structured guidance, such as helping to create a personalized preparation schedule.

Notably, although most participants were in favor of using a virtual coach, two students preferred not to engage with such a tool. One key reason cited was physical discomfort or motion sickness when using VR/AR devices, illustrating that technical accessibility and user comfort must be considered in system design.

Students were also clear on what would be unacceptable in a virtual coach (RQ4). These “no-go” criteria include predefined or incorrect answers, impolite or insensitive behavior, and above all a lack of personalization or the use of unrealistic or artificial scenarios. Such deficiencies would undermine the coach’s credibility and usefulness and might even exacerbate exam-related stress rather than reduce it.

Taken together, these findings suggest that a virtual coach can be a valuable tool for preparing oral examinations – but only under certain conditions. Technically limited or overly generic solutions are unlikely to be accepted by students. From a development perspective, this implies that the virtual coach must be technically mature, pedagogically sound, and tailored to the needs of individual learners. While iterative development methods such as agile approaches offer flexibility, they can only be applied within narrow limits if the product is to meet user expectations from the outset. In particular, iterative and agile approaches often develop solutions in short iterations that result in increments which can be rolled out to users even way before the system is complete. This does not seem to be a viable option here since a large share of students declines to learn with an incomplete or partly faulty VR tutor. Consequently, incremental development may kill user acceptance due to bad user experience.

In conclusion, the data point toward a clear user demand for realistic, interactive, and personalized virtual learning environments. If these criteria are met, a virtual coach may not only support cognitive preparation but also help students overcome emotional barriers, ultimately contributing to more confident and competent oral performance.

VI. Conclusions from the User Survey

This study investigated students’ perspectives on a VR-based AI coach developed to support preparation for oral examinations. Overall, the findings point to clear priorities for educational software engineering and challenge assumptions about early-stage development and user tolerance.

A. *High Expectations rather than Skepticism*

Students exhibit general openness and interest in the concept of a VR-based coach, especially regarding managing exam-related anxiety, building oral communication confidence, and enabling repeated, self-directed practice. They want to use the VR coach also for preparing content. The survey also revealed that students see the VR-based coach primarily as a means to an end, i.e. a tool to improve their exam performance. Yet, this openness is paired with very high expectations. From the outset, the system is expected to deliver accurate content, reflect realistic exam scenarios, and provide individualized responses. Core requirements include realism, individualization, and content accuracy. Rather than accepting early-stage imperfections, students only consider the VR coach useful if it works meaningfully from the very first interaction. This leaves little room for gradual quality improvements or tolerance of rough, minimally functional prototypes. A “wobbly” first impression, as several students implied, would result in the tool’s immediate rejection.

B. *Tension between Virtual and Real Examiners*

The potential trade-off between realism and emotional safety emerged as an implicit theme. While real examiners might represent the gold standard for authenticity, the idea of a virtual coach offers psychological advantages—especially the ability to practice without judgment, make mistakes safely, and repeat scenarios as needed. This tension between learning in a realistic environment and practicing in a protected space suggests a need for further exploration into the pedagogical positioning of virtual coaches. Students’ responses indicate that the VR coach is not expected to replace real examiners but rather to supplement preparation in a way that increases emotional readiness and perceived control.

C. *Shifting Perspectives: From Developer to User*

Nearly all surveyed students had a technical background, often engaging in software development themselves. In particular, the bachelor students were enrolled in a course that deals with requirements elicitation and analysis. Interestingly, their expectations changed when viewing the VR system not as developers, but as users. When eliciting requirements in the course, they often complained that customers did not care about a system’s technical issues but were only interested in getting a solution for their problem. Now, they were not interested in specific VR features of the tutor system but showed a marked shift toward usability and outcome orientation. Likewise, while they typically accept early-stage, technically incomplete prototypes in development contexts, they became far less tolerant when taking a user role themselves. In that mindset, the technical implementation became secondary to the learning outcome. When imagining themselves as users of the VR-based coach, students showed less concern about the underlying technology and focused instead on whether the system would provide real value in preparing them for exams.

This shift illustrates a known but often underestimated cognitive bias in software development: when students are in the user role, their tolerance for imperfection and experimentation decreases dramatically. Their focus shifted from "how the system works" to "what the system enables". This highlights a critical insight: when students are the end users, their standards for usability, reliability, and educational effectiveness rise sharply—regardless of their technical empathy for the development process. This also underlines the importance of integrating user-centered perspectives early and consistently in the software engineering process.

D. *Implications for Development: Beyond Classical Agile Approaches*

The findings raise questions about the applicability of conventional agile development practices in this context. While agile methodologies promote early user feedback and continuous improvement, the survey responses suggest that in this particular use case, this can backfire if early iterations do not meet the expected level of realism and content quality. In the case of educational technologies used in emotionally charged situations—such as oral exam preparation—careless early releases may compromise user acceptance.

This is not an argument against agile principles as such but calls for cautious and strategically staged implementation of increments. Each release must meet high quality standards in terms of usability, realism, and content correctness, even in early stages. Thus, an adapted or hybrid approach is required: agile principles may be maintained but with greater emphasis on upfront planning, anticipatory design, and thorough quality assurance in each increment to ensure that early impressions do not jeopardize the tool's acceptance.

VII. Summary and Outlook

This study presented a qualitative analysis of students' expectations for a VR-based AI coach to support oral exam preparation. The qualitative data collected from undergraduate and graduate informatics students provides important insights into students' learning goals, expectations, and specific requirements for such a tool.

The results clearly show that students appreciate the idea of a virtual coach and express a strong interest in using it, especially to manage examination anxiety and improve their confidence in oral settings.

The results underline that while students are highly receptive to the concept, they also hold clear and demanding expectations: Students are critical of systems that feel inauthentic, lack individualization, or provide overly generic responses. They value realism, personalized feedback, and content accuracy, and they require these features to be present from the very first use.

The pedagogical potential of such systems is evident. Students appreciate the chance to train in a psychologically safer space and repeat challenging scenarios without social consequences. Yet, the virtual coach's success hinges on more than functionality: it must offer a credible learning experience and be perceived as professionally valuable.

Crucially, informatics students—mostly with development experience—demonstrated a significant shift in mindset when viewing the system as users rather than as developers. While technically-minded in many academic contexts, they deprioritized implementation details in favor of usability, effectiveness, and emotional relevance. This highlights the importance of continuous, user-centered validation throughout the development process.

A further question that emerges from the data concerns the relationship between virtual and real-life exam preparation: Is a real examiner ultimately the better coach, or can a realistic virtual alternative offer distinct advantages? On the one hand, the authenticity of real-life interaction may provide the highest degree of realism and thus better prepare students for actual exams. On the other hand, a well-designed virtual coach could offer a psychologically safer and more flexible environment for iterative practice—free from fear of judgment—allowing students to practice more calmly, make mistakes without embarrassment, and build confidence over time. The real examiner may be most authentic, but a virtual system could lower emotional barriers, enabling deeper, repeated engagement with the exam format.

This tension between realism and psychological safety presents a promising area for future comparative studies. Such studies should empirically examine the relative benefits of human versus virtual coaching scenarios, particularly in terms of learner outcomes, confidence development, and long-term skill retention.

These insights have important implications for educational software engineering. First, they underline a strong pedagogical demand for immersive, user-adaptive technologies that support oral communication skills in realistic settings. Second, they point to a need for development strategies that prioritize the user experience—not only in terms of interface design, but also regarding the system's pedagogical effectiveness and credibility; otherwise, the technology may neither be accepted, nor used effectively. The findings further suggest that a purely technical focus or minimal-viable approach may fall short if it does not align with learners' expectations for realism and relevance. A VR coach that fails to simulate realistic examiner behavior or classroom dynamics may even increase insecurity rather than alleviate it.

In terms of outlook, further research and iterative development with student involvement are necessary. Future work should investigate how adaptive AI systems can dynamically tailor content and feedback to individual learners and how the realism of examiner behavior can be technically modeled in VR. Moreover, long-term studies may also provide valuable insights into the actual learning impact of such systems on learning outcomes, examination performance, and user acceptance over time.

The next step for our project is a prototype development phase, in which a minimal viable product will be co-created and evaluated with student feedback loops. Special attention will be paid to usability, immersion, content reliability, and pedagogical effectiveness from the start. By addressing users' expectations proactively, we aim to ensure that the VR-based coach is not only technically sound, but also pedagogically credible and emotionally supportive. The challenge will be to strike the right balance between technical feasibility, psychological comfort, and educational impact—ensuring that the VR-based coach becomes a credible, accepted, and effective tool in students' academic journeys.

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