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ЕЛЕКТРОННО ОБУЧЕНИЕ ЗА СТУДЕНТИ ПО ДЕНТАЛНА МЕДИЦИНА

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A MOODLE QUIZ FOR PRE-SIMULATION ENDODONTIC TRAINING FOR THIRD-YEAR DENTAL STUDENTS

Abstract: *Simulation-based training is central to contemporary conservative dentistry curricula. Embedding assessment-as-learning activities in a learning management system such as Moodle may further enhance self-regulation, metacognition, and preparedness for high-technology simulation. This study describes the design and preliminary evaluation of an interactive formative quiz on "Endodontic access cavity preparation" used as pre-simulation assessment-as-learning in third-year dental students at the Medical University of Plovdiv.*

A Moodle interactive quiz with multiple attempts on "Endodontic access cavity preparation" was developed. The quiz included different question types and allowed repeated attempts without penalty, with targeted hints for incorrect responses and explanatory feedback for correct answers. The activity was implemented in both Bulgarian- and English-taught cohorts of third-year dental students in Conservative dentistry. Students' perceptions of the quiz as an assessment-as-learning tool were collected through an anonymous electronic questionnaire administered after quiz completion. Data were analysed using IBM SPSS Statistics v.23.

Findings indicate high levels of satisfaction with the interactive quiz among both Bulgarian- and English-speaking students. Learners reported that the quiz helped them not only check and consolidate their knowledge but also monitor their progress over time by analysing their results across multiple attempts. Students indicated the detailed feedback supported error analysis, guided correction of misconceptions, and informed adjustments

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in their learning strategies. Participants perceived the quiz as a suitable tool for self-directed preparation before practice on a high-technology dental simulator.

The results suggest that an interactive Moodle quiz configured for assessment as learning is a feasible and well-received approach to support pre-simulation preparation in conservative dentistry. Further work will examine relationships between quiz engagement, changes in self-reported learning strategies, and performance in subsequent simulation sessions.

***Keywords**: Moodle, assessment as learning, simulation-based learning, conservative dentistry, formative quiz.*

Introduction

Rapid digital transformation in higher education has reshaped the design and delivery of dental curricula through the integration of e-learning, virtual simulation, and AI-supported resources into core teaching strategies (Mwogosi et al., 2025). Within this landscape, learning management system (LMS)–based tools enable the implementation of formative assessment practices such as online quizzes, self-tests, and rapid feedback mechanisms that promote continuous learning, self-monitoring, and improved academic performance among dental students (Handal et al., 2011), (Riaz et al., 2015), (Borbon & Bautista 2024). As dental education increasingly adopts simulation-based training and high-fidelity technologies, there is a growing need for effective preparatory methods that optimize student readiness and enhance learning outcomes (Mwogosi et al., 2025).

Simulation-based education supports the development of clinical competencies in dentistry, particularly in technically demanding procedures such as endodontic access cavity preparation. This stage of training allows students to acquire and refine psychomotor skills in a controlled and safe environment before transitioning to patient care. High-technology simulators provide realistic tactile feedback, visual accuracy, and opportunities for repeated practice, which are essential for mastering complex procedures. However, students often encounter challenges prior to simulation sessions, including difficulties in understanding tooth anatomy, visualizing internal structures, and sequencing procedural steps. Without adequate preparation, cognitive overload during simulation may hinder skill acquisition and reduce the overall effectiveness of training (Al-Saud, 2023). Structured pre-simulation learning activities are essential to consolidate knowledge and procedural understanding (Higgins et al., 2020).

In parallel with advancements in simulation technologies, there has been a paradigm shift in assessment practices within health professions education. Traditional models of assessment, primarily focused on summative evaluation of learning outcomes, are increasingly complemented by formative approaches that support learning processes. Contemporary frameworks distinguish between assessment of learning, assessment for learning, and assessment as learning. While assessment of learning emphasizes measurement and certification, assessment for learning focuses on providing feedback to guide improvement. Assessment as learning, however, places the learner at the centre of the process, emphasizing self-monitoring, reflection, and metacognitive development. This approach encourages students to actively engage with assessment tasks as opportunities to construct knowledge, identify gaps, and regulate their own learning strategies. Feedback, particularly when immediate and specific, plays a crucial role in facilitating these processes.

Within this context, Moodle-based quizzes represent a versatile and effective tool for implementing formative assessment strategies. The platform allows the creation of interactive quizzes with automated grading, immediate feedback, and tailored responses to student inputs. These features enable learners to receive instant information about their performance, understand their mistakes, and revisit relevant concepts. Additionally, quizzes can be designed to include explanatory feedback, hints, and references, transforming them into learning experiences rather than mere evaluation instruments. Previous studies have demonstrated that such feedback-rich assessments can enhance student engagement, improve knowledge retention, and support self-directed learning (Ryan et al., 2020). The asynchronous and repeatable nature of Moodle quizzes further allows students to learn at their own pace, which is particularly beneficial in preparing for complex clinical tasks.

The concept of assessment as learning is particularly relevant in the context of pre-simulation preparation. Interactive quizzes can prompt students to actively process information, apply theoretical knowledge, and reflect on their understanding before engaging in hands-on practice. By identifying misconceptions and reinforcing key concepts, these tools can reduce uncertainty and cognitive load during simulation sessions (Yiin & Chern, 2023). This, in turn, may allow students to focus more effectively on the development of psychomotor skills and clinical reasoning. Furthermore, the integration of immediate feedback supports the development of metacognitive skills, enabling learners to evaluate their progress and adjust their learning strategies accordingly (El Saadawi et al., 2010). Such alignment between assessment design and educational objectives reflects constructivist principles, where knowledge is actively constructed through engagement and reflection.

An important dimension in evaluating the effectiveness of educational interventions is the perspective of the learners themselves. Student perceptions of assessment tools, including their perceived difficulty, clarity, and relevance, provide valuable insights into their usability and pedagogical value. Perceived difficulty influences motivation and engagement, while clarity of questions and feedback affects comprehension and learning efficiency. Relevance, particularly in relation to upcoming clinical or simulation activities, determines the extent to which students recognize the usefulness of the learning tool. Collecting and analysing student feedback is therefore essential not only for evaluating the current implementation but also for informing iterative improvements in instructional design. In the context of digital and simulation-based education, aligning educational tools with student needs and expectations is crucial for achieving meaningful learning outcomes.

Despite the increasing use of learning management systems and e-assessment in dental education, including the implementation of Moodle-based quizzes for formative and summative purposes, and evidence that digital quizzes are perceived as engaging and useful learning tools by dental students (Pereira et al. 2022), there is limited research specifically examining Moodle-based quizzes as a form of assessment as learning in pre-simulation contexts. Studies in endodontic simulation and minimally invasive access often require prior theoretical competence or include review activities (Dale et al., 1984), yet the use of structured Moodle quiz programmes as preparatory tools for endodontic simulation training remains underexplored. This gap highlights the need for empirical investigation into how such interventions can support both cognitive and metacognitive aspects of learning in clinically oriented disciplines.

The aim of the present study is to evaluate a Moodle-based interactive quiz designed as an assessment-as-learning tool for third-year dental students preparing for simulation-based training in endodontic access cavity preparation. Specifically, the study seeks to examine students' perceptions of the quiz in terms of its difficulty, clarity, and relevance as a method for self-preparation, as well as its potential to support learning and readiness for simulation sessions.

Methodology

We conducted a cross-sectional survey through Google forms in Bulgarian – for the students trained in Bulgarian and in English – for the group trained in English among third-year dental students at the Faculty of Dental Medicine, Medical University of Plovdiv, in March 2026. The survey was administered immediately after completion of the Moodle-based interactive quiz on endodontic access cavity preparation to capture students' immediate perceptions of this assessment-as-learning activity. The quiz consisted of 11 items. Ten were multiple-choice questions and one was drag-and-drop terms on an image.

Student perceptions of the quiz were evaluated with a questionnaire comprising six statements: (1) "The level of difficulty of the test is appropriate."; (2) "The questions are clearly formulated."; (3) "The questions are difficult."; (4) "The test reflects the learning content."; (5) "I feel more confident in my knowledge of endodontic access cavity preparation after the test."; and (6) "The ability to get instant feedback on every question is useful." Each item was rated on a five-point Likert scale, where 1 = "I strongly disagree", 2 = "I tend to disagree", 3 = "I cannot decide", 4 = "I tend to agree", and 5 = "I strongly agree".

All responses were coded and analysed using IBM SPSS Statistics, version 23.0 with a level of statistical significance 0.05. For each statement, we computed relative shares for all Likert categories to summarise the distributions and means for an overall evaluation of students' ratings.

Results

The participants who did the test and responded to the survey were as follows: the Bulgarian cohort consisted of 20 students; the number of students trained in English was 30. The minimum required level for passing the test was set to 70% of the maximum score. Table 1 summarizes the statistics of the test. The internal consistency coefficient and the standard error were taken from the quiz statistics in Moodle.

Table 1. Test statistics

	Failed the test	Average score	Average time for completion	Unfinished attempts	Internal consistency coefficient	Standard error
Bulgarian	5 students	60.29%	20 min., 4 sec.	4	0.53	0.18
English	1 2 students	64.71%	24 min.	5	0.33	0.15

Table 2 presents the relative shares of the students from each cohort by Likert category in each item.

Table 2. Students' answers in relative shares by items.

Item	I strongly disagree, %		I tend to disagree, %		I cannot decide, %		I tend to agree, %		I strongly agree, %	
	Bul	Eng	Bul	Eng	Bul	Eng	Bul	Eng	Bul	Eng
1.	0	0	0	3,3	20,0	16,7	30,0	43,3	50,0	36,7
2.	0	0	0	0	10,0	6,7	40,0	43,3	50,0	50,0
3.	10,0	3,3	30,0	13,3	0,0	46,7	20,0	26,7	40,0	10,0
4.	0	0	0	10,0	10,0	6,7	40,0	30,0	50,0	53,3
5.	0	0	0	3,3	20,0	13,3	30,0	33,3	50,0	50,0
6.	0	0	0	0	10,0	16,7	30,0	26,7	60,0	56,7

Figure 1 presents the mean values of the students' agreements for each item.

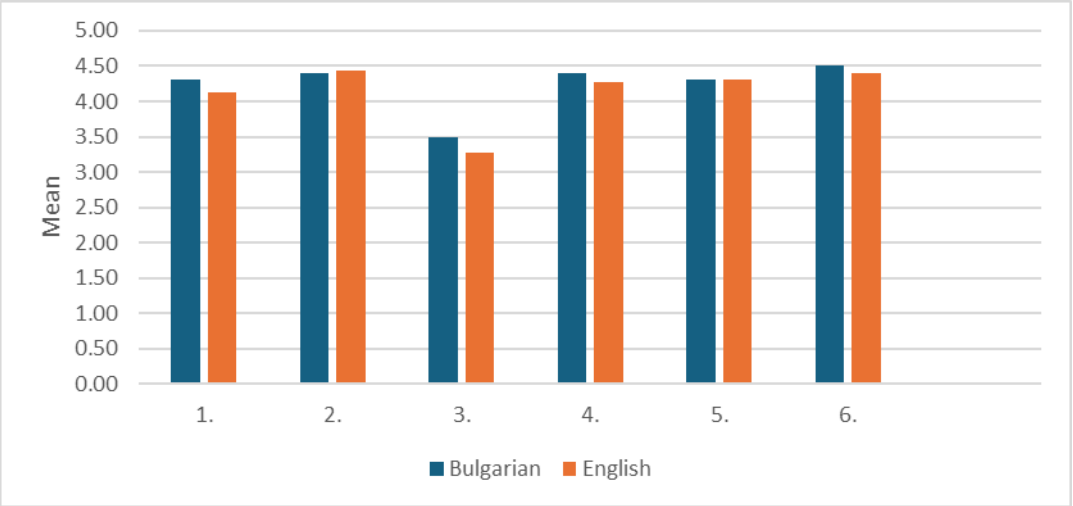


Figure 1. Mean values of the level of agreement with each item.

The Mann-Whitney test showed no statistically significant differences in the answers of the students taught in Bulgarian and those taught in English with p-values by statements as follows: 1 – 0.469; 2 – 0.912; 3 – 0.427; 4 – 0.930; 5 – 0.948 and 6 – 0.703.

Some of the respondents made comments as follows:

• Everything was on point!



- Helpful responses when u got an answer wrong
- Maybe different types of mcq questions like true and falses could be good
- I found the test a good reflection method for the lessons and the lectures held at the faculty.

Discussion

The Moodle-based interactive quiz was positively received by both third-year student cohorts. The values of the standard errors in both the English and the Bulgarian version of the quiz indicate that the scores are reliable. The internal consistency coefficients are not high, but this may be a result of the small number of test items. The quiz may function effectively as an assessment-as-learning tool in pre-simulation preparation for endodontic access cavity training after revision and addition of more test questions. The response patterns suggest that students perceived the quiz as appropriately challenging, clearly formulated, and relevant to the taught content, and that they valued the opportunity to receive immediate feedback on each question.

Most students in both the Bulgarian and English groups agreed or strongly agreed that the level of difficulty was appropriate, the questions were clearly formulated, and the quiz reflected the learning content. High proportions of "tend to agree" and "strongly agree" responses for these items, indicate that the quiz aligned well with students' expectations and the curricular objectives. At the same time, the fact that 5 Bulgarian and 12 English-speaking students did not reach the minimum required score of 70% shows that the quiz was not trivially easy and had sufficient discriminatory power to reveal gaps in understanding.

Perceptions of difficulty were more nuanced, as reflected in the item "The questions are difficult," where responses were spread across the Likert categories, particularly in the English cohort. This distribution suggests that, while some students experienced the quiz as challenging, others found it more manageable or were undecided. What is more important, many students agreed that they felt more confident in their knowledge of endodontic access cavity preparation after completing the quiz, highlighting its role not only as an evaluative tool but also as a means of reinforcing learning and supporting self-efficacy.

The very high agreement with the statement that "The ability to get instant feedback on every question is useful" underscores the importance of feedback in shaping students' learning experiences. This aligns closely with the concept of assessment as learning, in which learners actively use assessment information to monitor their understanding, identify misconceptions, and regulate subsequent study strategies. Students' comments such as "Helpful responses when you got an answer wrong" indicate that they engaged with the explanatory feedback rather than treating the quiz as a simple score-generating exercise. These findings are consistent with previous work demonstrating that feedback-rich online quizzes enhance engagement, support self-directed learning, and improve perceived preparedness in health professions education (Say et al. 2024).

From a didactic point of view, the combination of immediate feedback, clarity of questions, and alignment with course content positions the quiz as a metacognitive scaffold rather than merely a test. By confronting students with clinically relevant questions before simulation sessions, the quiz encourages reflection on prior lessons and lectures, and helps consolidate key concepts related to anatomy, access design, and procedural steps. Such engagement is particularly valuable in endodontics, where conceptual misunderstandings can later manifest as technical errors during hands-on simulation or clinical procedures.

The lack of statistically significant differences between the Bulgarian and English cohorts suggests that the quiz design – its difficulty range, wording, and feedback structure – was robust across language groups. This suggests that well-constructed digital assessments can support comparable learning experiences in diverse linguistic and cultural contexts, provided that translation and contextualization are carefully managed. At the same time, the somewhat higher number of students not reaching the required score in the English group may warrant closer analysis of item wording, prior exposure to content, or differences in academic background and language proficiency.

Students' suggestions, such as incorporating different types of multiple-choice questions (e.g., true/false), point to opportunities to diversify item formats to target higher-order reasoning and reduce the risk of cueing. Positioning the quiz not just as an assessment tool but as a reflective "checkpoint" may additionally foster a culture in which assessment is understood as part of learning rather than simply as a mechanism for grading.

Limitations and Future Directions

Several limitations should be acknowledged when interpreting these results. The study was conducted at a single institution with relatively small cohorts, which limits the generalizability of the findings to other settings and curricula. The outcomes are based solely on self-reported perceptions and descriptive test statistics; we did not examine associations between quiz performance and subsequent objective measures such as simulator performance, error rates, or long-term retention. Furthermore, the cross-sectional design, with data collected immediately after quiz completion, does not permit conclusions about sustained effects on learning or confidence.

Future research should include longitudinal designs to explore whether and how quiz performance and engagement predict later performance in simulation and clinical contexts. Comparative studies could also evaluate different feedback designs (e.g., basic correctness feedback versus elaborated explanatory feedback) or item types in terms of their impact on learning, cognitive load, and metacognitive awareness. Qualitative methods such as focus groups or think-aloud protocols during quiz completion may yield deeper insights into how students interact with feedback and use the quiz to regulate their learning strategies in preparation for endodontic simulation.

Conclusion

This preliminary study suggests that a Moodle-based interactive quiz may function effectively as an assessment-as-learning tool in pre-simulation preparation for endodontic access cavity training after careful consideration of the number and type of the test items. Students in both Bulgarian- and English-taught cohorts perceived the quiz as clear, appropriately difficult, and well aligned with the learning content, and they particularly valued the availability of instant feedback on each question. At the same time, the fact that a proportion of students did not reach the required score of 70% indicates that the quiz was sufficiently challenging to reveal gaps in understanding rather than merely confirming existing knowledge. Within these limitations, the findings support the integration of feedback-rich online quizzes into pre-simulation learning pathways to enhance readiness, promote self-monitoring, and foster confidence before hands-on endodontic training, while highlighting the need for further research on their impact on objective performance and long-term learning outcomes.

Conflict of Interest

The authors declare no conflict of interest.

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