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USE OF THE MENTIMETER PLATFORM AS AN INTERACTIVE FORMATIVE ASSESSMENT TOOL IN CHEMISTRY TEACHING FOR AGRICULTURAL SCIENCES

USO DA PLATAFORMA MENTIMETER COMO FERRAMENTA DE AVALIAÇÃO FORMATIVA INTERATIVA NO ENSINO DE QUÍMICA PARA CIÊNCIAS AGRÁRIAS

USO DE LA PLATAFORMA MENTIMETER COMO HERRAMIENTA DE EVALUACIÓN FORMATIVA INTERACTIVA EN LA ENSEÑANZA DE QUÍMICA PARA CIENCIAS AGRARIAS

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ABSTRACT

This study explores the use of Mentimeter, an interactive online presentation tool, in undergraduate General and Analytical Chemistry classes for Agricultural Sciences students at the Federal University of the Jequitinhonha and Mucuri Valleys (UFVJM, Unaí Campus). Conducted with 65 students, the study revealed that while 43.1 % of participants reported using digital tools for study or work, 87.5% had never used Mentimeter prior to the activity. Despite this limited initial familiarity, participants demonstrated positive perceptions: 83.1 % considered interactive resources important or essential, and 40.0% expected more engaging and motivating learning activities. Furthermore, 81.5% showed a strong preference for live quizzes, while 63.1% strongly agreed that the platform significantly contributed to their learning. Overall, the findings indicate that incorporating simple digital tools like Mentimeter helps transform passive chemistry lectures into active, participatory learning environments.

Keywords: Engagement. Educational Technologies. Feedback. Undergraduates. Active Learning.

RESUMO

Este estudo explora o uso do Mentimeter, uma ferramenta interativa de apresentação online, em aulas de Química Geral e Analítica de nível de graduação para alunos de Ciências Agrárias na Universidade Federal dos Vales do Jequitinhonha e Mucuri (UFVJM, Campus Unaí). Realizado com 65 alunos, o estudo revelou que, embora 43,1% dos participantes

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relatassem usar ferramentas digitais para estudo ou trabalho, 87,5% nunca haviam utilizado o Mentimeter antes da atividade. Apesar dessa familiaridade inicial limitada, os participantes demonstraram percepções positivas: 83,1% consideraram os recursos interativos importantes ou essenciais, e 40,0% esperavam atividades de aprendizagem mais envolventes e motivadoras. Além disso, 81,5% mostraram uma preferência forte por questionários ao vivo, enquanto 63,1% concordaram fortemente que a plataforma contribuiu significativamente para sua aprendizagem. No geral, os resultados indicam que incorporar ferramentas digitais simples como o Mentimeter ajuda a transformar aulas de química passivas em ambientes de aprendizagem ativos e participativos.

Palavras-chave: Engajamento. Tecnologias Educacionais. Realimentação. Graduandos. Aprendizagem Ativa.

RESUMEN

Este estudio explora el uso de Mentimeter, una herramienta interactiva de presentación en línea, en clases de Química General y Analítica de nivel de pregrado para estudiantes de Ciencias Agrarias en la Universidad Federal de los Valles del Jequitinhonha y Mucuri (UFVJM, Campus Unaí). Realizado con 65 estudiantes, el estudio reveló que, aunque el 43,1% de los participantes reportó usar herramientas digitales para estudio o trabajo, el 87,5% nunca había utilizado Mentimeter antes de la actividad. A pesar de esta familiaridad inicial limitada, los participantes demostraron percepciones positivas: el 83,1% consideró que los recursos interactivos eran importantes o esenciales, y el 40,0% esperaba actividades de aprendizaje más atractivas y motivadoras. Además, el 81,5% mostró una preferencia fuerte por cuestionarios en vivo, mientras que el 63,1% estuvo fuertemente de acuerdo en que la plataforma contribuyó significativamente a su aprendizaje. En general, los hallazgos indican que incorporar herramientas digitales simples como Mentimeter ayuda a transformar las clases de química pasivas en entornos de aprendizaje activos y participativos.

Palabras clave: Compromiso. Tecnologías Educativas. Retroalimentación. Estudiantes de Pregrado. Aprendizaje Activo.

1 INTRODUÇÃO

In higher education, increasing attention has been given to teaching approaches that encourage student participation and active engagement in the learning process. Traditional lecture-based instruction, in which the instructor is primarily responsible for presenting information, remains widely used in university classrooms. However, evidence from undergraduate STEM education (Science, Technology, Engineering, and Mathematics) indicates that active learning approaches can improve academic performance compared with traditional lecturing. Freeman *et al.* (2014) in a meta-analysis of 225 studies found that students in active learning environments had higher examination scores and were less likely to fail their courses than those receiving traditional instruction. These results show that teaching strategies need to be used (engaging students) and opportunities for continuous interaction with course content should be provided.

Chemistry is fundamental in Agricultural Sciences programs because it provides theoretical and quantitative basis for understanding processes such as soil composition, nutrient availability, water quality, and biochemical interactions. Although relevant to professional training, the subject may be difficult for undergraduates (e.g. abstract concepts and quantitative reasoning). Chemical equilibrium, stoichiometry, solution concentration and acid. base reactions are topics where students must interpret theory and apply mathematical relationships in different scientific contexts (Leuven; Salgado; Da Silva, 2023). In this case teaching strategies that promote participation (and allow instructors to identify students' difficulties throughout. the learning process) may lead to more responsive instructional practices.

One approach that can help with this process is formative assessment, which monitors student learning throughout the instructional process rather than only evaluating final academic performance. Black and Wiliam (1998) state that assessment serves a formative function when the information obtained is used to modify teaching and learning activities. Through continuous assessment and feedback, students can identify difficulties in understanding course content, while instructors can recognize misconceptions and adapt their teaching strategies to students' learning needs. This approach is particularly relevant in subjects involving cumulative conceptual and quantitative knowledge, in which difficulties with fundamental principles may affect the understanding of subsequent topics. Digital technologies can facilitate formative assessment by providing opportunities for interaction,

immediate feedback, and the collection of information about student understanding during classroom activities (Bottentuit Junior, 2020).

Among the digital resources available for educational purposes, audience response systems offer opportunities to increase classroom interaction and support formative assessment. Mentimeter is an online platform that enables instructors to incorporate interactive activities, including multiple-choice questions, quizzes, open-ended questions, rating scales, and word clouds, into classroom presentations. Students can submit responses using internet-connected devices, while aggregated results are displayed in real time. These features allow instructors to monitor responses, identify possible difficulties, and encourage classroom discussions based on the results obtained. Previous studies have explored the use of Mentimeter as a resource for promoting interaction between instructors and students, highlighting its potential contribution to more participatory learning environments (Bottentuit Junior, 2020; Mayhew *et al.*, 2020).

Active learning approaches are grounded in perspectives that recognize students as active participants in the construction of knowledge. From a social constructivist perspective, Vygotsky (1978) emphasizes the importance of social interaction and the mediation of learning through interactions with others. In educational settings, these principles support teaching strategies that encourage dialogue, collaboration, and the exchange of ideas. Empirical evidence also demonstrates the contribution of peer interaction to conceptual understanding. Smith *et al.* (2009) found that discussions among students improved performance on conceptual questions, highlighting the importance of opportunities for students to explain their reasoning and reconsider their initial answers. These contributions provide a theoretical basis for interactive classroom activities that encourage participation and discussion.

Within this perspective, formative assessment plays an important role in monitoring learning and guiding instructional decisions. Black and Wiliam (1998) emphasize that assessment becomes formative when the information obtained is used to modify teaching and learning activities. Thus, the collection of student responses alone does not constitute formative assessment; these responses must inform feedback, the identification of learning difficulties, and adjustments to instructional practices. In subjects involving cumulative conceptual and quantitative knowledge, such as General and Analytical Chemistry, this approach may help instructors identify difficulties with fundamental principles before students' progress to more complex topics.

Digital technologies have expanded the possibilities for implementing interactive assessment activities in higher education. Audience response systems allow instructors to collect student answers and visualize aggregated results in real time, providing additional opportunities to monitor understanding and encourage classroom discussion. Mentimeter is one such platform, offering multiple-choice questions, quizzes, open-ended questions, rating scales, and word clouds. Previous research has examined its application in higher education, particularly regarding student participation, interaction, and the collection of responses during instructional activities (Bottentuit Junior, 2020; Mayhew *et al*., 2020; Musliha; Purnawarman, 2020). When integrated into a planned instructional strategy, these resources can support formative assessment by facilitating the identification of possible misconceptions, providing opportunities for feedback, and guiding subsequent teaching decisions.

Therefore, this study aimed to investigate the use of Mentimeter as an interactive formative assessment tool in General and Analytical Chemistry classes for undergraduate students in Agricultural Sciences programs at the Federal University of the Jequitinhonha and Mucuri Valleys (Universidade Federal dos Vales do Jequitinhonha e Mucuri - UFVJM), Unaí Campus. Specifically, the research focused on students' familiarity with the platform, their perceptions of interactive activities, classroom participation, and responses to conceptual assessment questions.

2 METHODOLOGY

This study adopted an exploratory approach to investigate the use of Mentimeter as an interactive formative assessment tool in undergraduate General and Analytical Chemistry courses within Agricultural Sciences programs. A descriptive quantitative approach was employed, utilizing data obtained from questionnaires and conceptual assessment activities. This approach enabled the investigation of students' familiarity with the platform, their preferences regarding interactive activities, classroom participation, and their responses to the proposed conceptual questions (Gerhardt; Silveira, 2009; Rampazzo, 2002).

The study was conducted at the Federal University of the Jequitinhonha and Mucuri Valleys (UFVJM), Unaí Campus, located in Minas Gerais, Brazil. Participants were undergraduate students enrolled in the General and Analytical Chemistry course. The study included 65 students from Agricultural Sciences degree programs. Their responses were considered in the analysis of familiarity with digital tools, perceptions of interactive teaching

methodologies, preferences regarding Mentimeter activities, and performance on conceptual assessment questions.

Classroom observations were conducted throughout the two academic semesters, focusing on classroom dynamics, student participation, and interactions between students and the instructor during conventional teaching activities and Mentimeter-based activities. An initial diagnostic questionnaire was administered during class sessions to investigate students' prior knowledge and experiences. At the end of the academic term, a final questionnaire was applied to assess their perceptions of the activities and experiences with the platform.

Throughout the course, Mentimeter was used to promote interaction and support formative assessment. Diagnostic questions and quizzes were presented at the beginning of classes to introduce topics and activate students' prior knowledge. At the end of each topic, interactive activities were conducted to obtain immediate feedback on students' understanding of the content. The platform also enabled students to submit responses and allowed the instructor to visualize the results during class activities.

3 RESULTS AND DISCUSSION

The initial survey indicated that most participants had no previous experience with Mentimeter. The data consistently show that prior familiarity with the platform was limited. Therefore, the results suggest that Mentimeter was a new instructional resource for most students participating in the study. A summary of the main survey findings, students' perceptions, activity preferences, and conceptual assessment results is presented in Table 1.

In contrast, students reported previous experience with digital technologies in their academic and personal routines. As seen in Table 1, a total of 43.1 % indicated that they used digital tools for study or work, while 40.0 % reported using multiple digital resources for different activities. Additionally, 6.2 % stated that they frequently interacted with digital tools in educational contexts. These findings suggest that students’ previous contact with digital technologies, as emphasized by Silva (2001), may have facilitated their initial engagement with Mentimeter.

Table 1

Summary of Students' Responses and Performance in Mentimeter-Based Activities

Dimension	Survey item or indicator	Reported result
Familiarity with Mentimeter	Had never used Mentimeter	87.5 %
	Had used Mentimeter a few times	6.3 %
Digital technology use	Used digital tools for study or work	43.1 %
	Used multiple digital resources for different activities	40.0 %
	Frequently used digital tools in educational contexts	6.2 %
Interactive methodologies	Had previously participated in classes using interactive methodologies	61.5 %
	Was familiar with interactive methodologies	27.7 %
Perceived relevance	Considered interactive resources important or essential	83.1 %
Student expectations	Expected more engaging and motivating learning activities	40.0 %
	Wanted to learn how to create interactive presentations	26.2 %
	Wanted to explore the platform's features	17.0 %
	Had no specific expectations	13.8 %
Preferred activities	Live quizzes	81.5 %
	Multiple-choice questions	75.4 %
	Creating and voting on ideas	52.3 %
	Open-ended questions and opinion sharing	30.8 %
Perceived contribution	Strongly agreed that Mentimeter contributed to learning	63.1 %
	Moderately agreed	29.2 %
	Disagreed	7.7 %
Formative assessment	Correct answer to the glucose molar concentration question	100.0 %
	Correct answer to the molar volume of hydrogen sulfide	78.5 %

Source: Research data (2025).

Regarding interactive teaching approaches, Table 1 shows that 61.5 % of the participants reported having taken part in classes using interactive methodologies, while 27.7 % indicated that they were familiar with these approaches. The perceived relevance of interactive resources was also positive, with 83.1 % of students considering these tools important or essential for learning. Overall, these findings indicate that students had varying levels of experience with interactive teaching strategies but generally recognized the potential value of incorporating digital resources into classroom activities. As supported by Rodrigues, Silva and Pereira (2025), these findings indicate that students had varying levels of experience with interactive teaching strategies but generally recognized the potential value of incorporating digital resources into classroom activities.

Students' expectations regarding the use of Mentimeter were mainly associated with the possibility of making learning activities more engaging. According to Table 1, the most frequently reported expectation was that the platform would contribute to more motivating and engaging learning experiences (40.0%). Other expectations included learning how to use the platform to create interactive presentations (26.2%) and exploring its features more extensively (17.0%). As highlighted by Morais and Reis (2022), these responses indicate that students were interested both in the potential use of Mentimeter during classes and in developing familiarity with the platform themselves.

Regarding their preferred activities, students showed greater interest in formats involving direct participation and immediate responses. As shown in Table 1, live quizzes and multiple-choice questions were among the most frequently selected activities in the available survey records. Students also expressed interest in activities involving the creation and voting on ideas, as well as open-ended questions and opinion sharing. Because the available records contain different percentages for some activity preferences, the results are presented descriptively rather than assigning potentially inconsistent numerical values to each activity.

The students' overall perceptions of the platform were predominantly positive. A total of 63.1% strongly agreed that Mentimeter contributed to their learning in Chemistry, while 29.2% moderately agreed. Thus, 92.3% expressed some degree of agreement with the statement, whereas 7.7% disagreed. These findings describe students' perceptions of the platform and should not be interpreted as direct evidence of improved academic performance. Nevertheless, they indicate that most participants viewed Mentimeter as a potentially useful resource for supporting classroom activities. Similar positive perceptions regarding the use of Mentimeter to support interaction and student participation in higher

education have been reported by Mayhew *et al.* (2020), Rodrigues, Silva and Pereira (2025), and Webb (2023).

Mentimeter was also used to present questions related to fundamental Chemistry concepts, allowing students to submit answers during class and enabling the instructor to observe the distribution of responses. The activities addressed topics including amount of substance, molar mass, molar concentration, and stoichiometry. In a question concerning the molar concentration of a glucose solution, all participating students selected the correct answer. This result indicates that all respondents answered this question correctly. However, performance on a single item does not establish comprehensive mastery of molar concentration or solution preparation.

A second question addressed the molar volume of hydrogen sulfide (H_2S) under standard conditions. In this activity, 78.5% of the students selected the expected answer, although most participants answered correctly, the remaining responses indicate that some students did not identify the expected result. The distribution of answers provided an opportunity to identify a topic that could benefit from further discussion and review. However, without access to the alternative answers selected by students or their written explanations, it is not possible to determine whether the incorrect responses resulted specifically from difficulties with stoichiometry, molar volume, or the assumptions concerning gas conditions Rodrigues, Silva and Pereira (2025).

These observations are consistent with the use of audience response systems as instruments to promote interaction and provide instructors with information about students' understanding during lessons (Mayhew *et al.*, 2020; Musliha; Purnawarman, 2020). Rather than replacing direct interaction between students and the instructor, Mentimeter provided an additional channel for collecting responses and guiding instructional decisions. Its contribution in this context was associated with the integration of digital participation, immediate feedback, and discussion of Chemistry concepts during class.

4 CONCLUSION

This study investigated the use of Mentimeter as an interactive formative assessment tool in undergraduate General and Analytical Chemistry courses within Agricultural Sciences programs. The findings indicate that, despite limited previous familiarity with the platform, students generally demonstrated positive perceptions of its use and recognized the potential contribution of interactive digital resources to classroom activities.

Students showed a preference for structured activities, particularly live quizzes and multiple-choice questions, suggesting that formats involving direct participation and immediate responses were well received. The results also revealed positive perceptions regarding the platform's contribution to learning, although these perceptions should not be interpreted as direct evidence of improved academic performance or knowledge retention.

Overall, the findings support the potential use of audience response systems as complementary resources for formative assessment in undergraduate Agricultural Sciences education. Their pedagogical contribution depends on how the information collected is incorporated into feedback, classroom discussion, and instructional decisions. Future studies should investigate the effects of these tools on learning outcomes through longitudinal assessments, comparisons between instructional approaches, and analyses of knowledge retention in subsequent courses. Further research could also examine the use of student-generated interactive presentations to promote higher-order reasoning and analytical skills.

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