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Educational Innovation Tools to Capture and Motivate Students. Oral Pathology Case Seminars, B-Learning Mode.

Herramientas de Innovación Educativa para captar la atención y motivar a los estudiantes. Seminarios de casos de Patología Oral modalidad B-Learning.

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Summary:
B-learning is a type of blended learning that combines different teaching methods and learning styles through a combination of virtual and physical resources. The objective of this study was to understand students' perceptions and assessments of a teaching method using case seminars in an elective course on Maxillary Pathology at the Faculty of Dentistry of the National University of Tucumán. Using a virtual classroom on the Moodle platform (PM), a total of 31 students participated in a mixed learning modality: in-person theoretical classes and case seminars (SC). SC activities were administered as e-activities with individual solution (IR) in the PM. At the end of the course, an assessment was conducted using SC in the form of group solution (RG) and an anonymous self-report questionnaire. Data were collected regarding personal perceptions and assessments of the task in four areas: Interest/Enjoyment (I/D), Perceived Competence (PC), Perceived Choice (PC), and Pressure/Tension (P/T). They were also consulted about: organization, difficulties, resolution method, availability and accessibility to PM and interconsultation. All group SC evaluations yielded highly satisfactory results. The individual task was passed by 100% of the students. In the areas of R/D, the scores obtained were R/D = 4.86 ± 1.4, CP = 4.58 ± 1.3, EP = 3.86 ± 1.8, and P/T = 4.73 ± 1.9. The students' experiences and evaluations of the SC resolution task were positive. The main difficulty reported was the interpretation of microscopic images. Despite this, the overall experience was rated positively, highlighting the effectiveness of b-learning in fostering active and collaborative learning and in improving diagnostic skills in virtual and clinical contexts. The method was beneficial to the teaching-learning process.

Keywords: virtual education, e-activity, pathological anatomy, PBL, blended learning.

Resumen:
El b-learning es un tipo de aprendizaje semipresencial que combina diferentes métodos de enseñanza y estilos de aprendizaje, mediante una mezcla de recursos virtuales y físicos. El objetivo del presente estudio fue conocer la percepción y valoración de los alumnos de un método de enseñanza utilizando seminario de casos en un curso optativo de Patología de los maxilares de la Facultad de Odontología de la Universidad Nacional de Tucumán. Utilizando un aula virtual, en la plataforma Moodle (PM), se trabajó con un total de 31 alumnos cursantes con modalidad mixta, clases teóricas presenciales y seminarios de casos (SC), se les administró como e-actividades SC con modalidad de resolución individual (RI) en la PM. Al final del cursado se realizó una evaluación con SC en forma de resolución grupal (RG) y un cuestionario de autoinforme anónimo. Se recogieron datos referidos a las percepciones y valoraciones personales de la tarea en 4 áreas: Interés/disfrute (I/D), Competencia percibida (CP), Elección percibida (EP) y Presión/Tensión (P/T). Fueron consultados además acerca de: Organización, dificultades, modo de resolución, disponibilidad y accesibilidad a la PM e interconsulta. El 100% de las evaluaciones de los SC grupal arrojaron resultados muy satisfactorios. La tarea individual fue aprobada en el 100 % de los cursantes. En las áreas de I/D el valor obtenido fue de I/D = 4.86 ± 1.4, CP = 4.58 ± 1.3, EP = 3.86 ± 1.8, and P/T = 4.73 ± 1.9. Las experiencias y valoraciones de los estudiantes frente a la tarea de resolución de los SC fueron positivas.La principal

dificultad reportada fue la interpretación de imágenes microscópicas. A pesar de ello, la experiencia general fue valorada positivamente, destacando la eficacia del b-learning para fomentar un aprendizaje activo y colaborativo, y para mejorar las competencias diagnósticas en contextos virtuales y clínicos. El método fue favorecedor del proceso de enseñanza-aprendizaje.

Palabras clave: educación virtual, e-actividad, anatomía patológica, ABP, blended learning.

1. Introduction

Blended learning (b-learning) is a semi-presential learning model that integrates traditional teaching methods with digital tools, combining virtual and physical resources to optimize the educational process. This strategy represents a significant change in teaching, offering greater flexibility and access to content. Since the 1980s, the World Health Organization (WHO) has promoted new educational approaches in the training of medical professionals, emphasizing participatory and student-centered learning (1-2). In recent years, the teaching of Pathological Anatomy has evolved to incorporate digital technologies, active learning methods, and a closer connection with clinical disciplines, following the demands of educational reforms (3).

Pathological Anatomy (PA) is an essential medical specialty for the study, identification, and differentiation of normal and pathological tissues, playing a fundamental role in the diagnosis, prognosis, and understanding of diseases. In this sense, PA acts as a bridge between anatomical theory and clinical practice, allowing a comprehensive understanding of human biology and its behavior in pathological situations (4). Thistlethwaite, 2012, shows that in recent years, different training systems and methods based on clinical reasoning have proven to be very effective and, as a consequence, learning based on clinical cases has become established and widely disseminated (5). Fernández, 2017, considers that discussions of clinical cases constitute a fundamental pedagogical tool in the teaching of medicine; this method is attractive and motivating for students, bringing them closer to the real environment where their professional lives will be developed. In this way, students are trained for situations that they will surely face once they graduate (6) Consequently, we consider that the approach to teaching AP based on the diagnosis and analysis of clinical-pathological cases constitutes a tool that allows students to face real and contextualized situations. This method dynamically integrates the clinical history with clinical, radiographic and microscopic images, promoting comprehensive, active and meaningful learning. Strategies such as case seminars, with the exercise of proposing Diagnostic Hypotheses (D.H.), are based on Problem-Based Learning (PBL), and favor the integration and transversal application of knowledge within the curriculum. Recent studies, such as that of Oqbani et al. (2023), show that traditional methods based on lectures often generate dissatisfaction among students and hinder the understanding of pathology. Therefore, medical students recognize the importance of modernizing the curriculum through active activities, such as clinical case analysis and the use of virtual microscopy (VM), to improve learning (7).

The objective of this study was to evaluate how students perceive and evaluate the implementation of the Case Study and Diagnosis method in an elective course on Maxillary Pathology at the UNT School of Dentistry. This course used a blended learning (b-learning) model through a virtual classroom on the Moodle platform. It is proposed that this approach, which combines clinical case seminars with virtual microscopy, improves students' intrinsic motivation and promotes the development of diagnostic skills in oral pathology.

2. Methods

The study was conducted with 31 students who voluntarily enrolled in the elective course "Pathology of the Jaws" at the Faculty of Dentistry of the National University of Tucumán (FOUNT). The course was delivered using a b-learning approach, with a structure of three modules, each lasting three weeks. The in-person component included theoretical lectures, followed by case seminars (CSS) in which students actively participated in the expository description of the images. Students were also able to develop one or more clinical and cooperative presentations, both among peers and with guidance from the instructor, based on all the clinical and pathological information provided in the different cases, related to the topic of each in-person meeting. The final diagnoses were not revealed during the in-person session. After the in-person session in the Virtual Classroom (VC), students had

access to classes taught by two instructors (AAO and SC) and their respective case seminars, which they had to solve individually and then upload their answers within the same platform. To facilitate the process of diagnosis and analysis of the cases, support tools such as forums and chats were enabled for discussion and exchange of ideas. Each clinical-pathological case included a summary of the clinical history, clinical images, radiographic and/or magnetic resonance imaging and/or computed tomography (CBCT) studies, in addition to macroscopic and microscopic images of the lesion. These cases were selected from the scientific literature, specifically from previously peer-reviewed Case Report, Case Series, or Review articles. For example, Figures 1 A and 1 B, taken from Soluk-Tekkesin M. et al. (8), are highlighted.

The cases for the seminars were carefully selected from peer-reviewed scientific publications and academic texts specializing in oral and maxillofacial pathology. The selection was based on their clinical relevance, their representativeness of common diseases, and their educational value in helping dental students develop diagnostic skills. This strategy ensures that the content is clinically valid and rigorous, aligned with diagnostic criteria recognized in the scientific literature. Representative clinical and pathological figures from specialized scientific literature were included in the teaching materials used in the seminars. An illustrative example is presented in Figures 2 and 3, corresponding to Case 1, respectively. These show a panoramic radiographic image and a photomicrograph, accompanied by instructions aimed at describing key findings and developing diagnostic hypotheses (H.Dx). These images were taken from Soluk-Tekkesin & Wright (8) and selected for their educational value and morphological clarity.

Assessment of Learning and Student Perception

To assess the understanding and application of acquired knowledge, an integrative final assessment was implemented. This assessment focused on the diagnostic resolution of clinical-pathological cases, covering all topics covered in the teaching modules. It was conducted in groups. Students worked on preparing a diagnostic report for a total of six clinical-pathological cases presented in an expository manner. To ensure a fair and transparent assessment, a rubric was designed detailing the criteria and aspects to be considered in the evaluation of each item in the diagnostic report (Table 1). Additionally, to understand the students' experience, a self-report questionnaire was administered. This questionnaire was voluntary and anonymous, guaranteeing the privacy of the participants. It was adapted from the Intrinsic Motivation Inventory (IMI), a recognized tool for investigating students' perceptions of the activities carried out during the course (9).

Structure of the IMI ad Hoc Questionnaire.

The questionnaire consisted of 22 items exploring four core aspects of motivation and perception. 1. Interest and Enjoyment (I/E): How interesting and enjoyable the activity was. 2. Perceived Competence (PC): Students' sense of their ability to complete the tasks. 3. Perceived Choice (PC): The degree to which they felt they had control or autonomy in their learning. 4. Pressure and Tension (P/T): The level of stress or pressure experienced. 5. Each item was rated on a scale of 1 to 7, where scores of 6 and 7 indicate that the statement is absolutely true, intermediate values (3, 4, and 5) reflect a moderate degree of certainty, and scores of 1 and 2 indicate that it is not true at all. In addition to the IMI, five additional questions were included related to course organization, difficulties encountered, problem-solving methods, platform availability and accessibility (PM), and the usefulness of feedback.

For the analysis of data from the IMI questionnaire, reverse scoring was performed for items formulated in the opposite direction to the construct they measured (marked "R" in the item list). The value for each subscale was calculated by averaging the scores of the corresponding items, following the distribution:

- Interest/Enjoyment: Items 1, 5, 8, 10, 14(R), 17, 20.
- Perceived Competence: Items 4, 7, 12, 16.
- Perceived Choice: Items 3, 11(R), 15, 19(R), 21(R).
- Pressure/Tension: Items 2(R), 6, 9(R), 13, 18.

Statistical analysis

The study was descriptive and expressed in percentages. No inferential statistical tests were applied due to the small sample size and the exploratory nature of the study.

Ethical and Methodological Considerations

All information collected was used exclusively for academic and research purposes. The ethical principles of anonymity, confidentiality, and data protection were strictly maintained, in compliance with best practices in educational research. Participation in the survey was voluntary, and no financial compensation was offered.

Table 1. Rubric for group clinical-pathological case evaluation.

Criterion	Excellent	Well	Regular	Insufficient
Clinical description of the case	Accurately describe the relevant clinical features (facial asymmetry, expansion of the buccal, palatal, and lingual tables, effacement of the buccal sulcus).	It describes most of the clinical aspects, with minor errors in location and relationship with teeth.	Describes some clinical aspects with major errors in location, extent of the lesion, and relationship with teeth.	Poor/incorrect description; does not recognize key clinical signs. Asymmetry, expansion of the tables, effacement of the vestibular sulcus.
Radiographic and CT interpretation	Correctly describe the findings on the images. (radiolucent, radiopaque, mixed, unilocular, multilocular)	Adequately describes most of the findings in the images, with minor errors.	Incomplete description or with several basic errors (confusing radiolucent with radiopaque, unilocular with multilocular)	It does not describe the obvious radiographic findings, with conceptual errors.
Microscopic description	Identify structures and indicate key histological features.	Describes basic microscopic findings with acceptable accuracy.	Disorganized description or with relevant terminological errors.	Does not recognize basic structures of the epithelial lining, cell types in connective tissue, type of cell proliferation, etc. Does not use appropriate terminology.
Preparation of the presumptive and final diagnosis	Raises well-founded diagnostic hypotheses (D.Hx); the final diagnosis is correct.	The final diagnosis is correct, although with inaccuracies in the terminology or in the justification of the HDx.	The diagnosis is incomplete; radiographic and histopathological findings are lacking.	Incorrect or absent diagnosis. It doesn't justify.
Teamwork and presentation	Equal participation; clear, coherent presentation, and good time management.	Good presentation; balanced participation, although with some inaccuracies.	Disorganized or unclear presentation; uneven participation.	Confusing or poor presentation; one or more members do not participate.

3. Results

Intrinsic Motivation

100% of the Group Semester C assessments yielded highly satisfactory results. 100% of the students passed the individual assignment. In the R/D areas, the scores obtained were 4.86 ± 1.4, CP = 4.58 ± 1.3, EP = 3.86 ± 1.8, and P/T = 4.73 ± 1.9 (Figure 1).

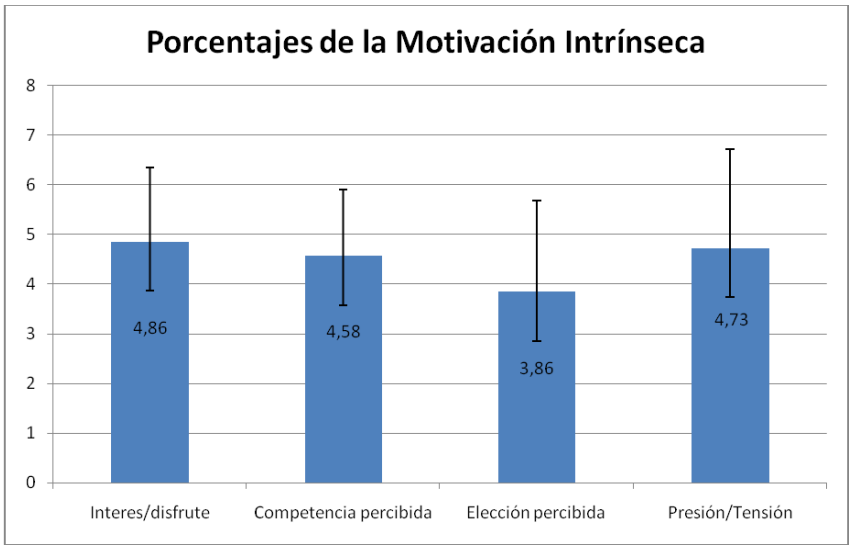

Figure 1. Results of the Intrinsic Motivation Inventory (IMI).

Forms of Organization

Regarding the organizational method for solving case seminars, 80% of students used the resources available in the AV classroom to solve the cases. 43.75% used the AV to read lectures, attend seminars, and use bibliographies. 31.25% used the AV to use the VM and also used the Internet; 18.75% compared images and microscopic patterns; and 6.25% did not organize their work in any of these ways due to lack of resources (Table 2).

Table 2. Forms of Study Organization with the Support of the Virtual Classroom.

Organization mode	Percentage
Using AV for reading theoretical classes, books or seminars	43.75%
Using AV (virtual microscopy and internet)	31.25%
Comparison of microscopic images or patterns	18.75%
I don't use AV due to lack of means.	6.25%

Table 3. Academic Consultation (peers/teachers) and Difficulties in Technological Access

Category	Answer	Percentage
Consult with colleagues or teachers	Yeah	87.5%
	No	12.5%
Difficulties accessing the platform	No	81.2%
	Yeah	18.7%
Difficulties with the Internet or computers	No	87.5%
	Yeah	12.5%

Difficulties in the learning process

Regarding the difficulties mentioned in completing the task, 46.6% reported having difficulty interpreting microscopic images, the remaining 53.4% reported no difficulties regarding microscopic analysis skills in the Sem. C. Regarding the description of how they resolved the difficulties that arose

during the completion of the task, 81.2% responded by studying and reviewing lectures and books, while 18.7% stated that they needed help from peers. Regarding the need for consultation with other classmates or teachers, 87.5% resorted to consultation with peers or teachers. 81.2% of students had no problems accessing the PM, and 87.5% did not have difficulties with the internet or computers (Table 3).

4. Discussion

The results of this study show highly satisfactory student performance in the case-solving seminar activities, both at the group and individual levels, achieving a 100% pass rate. The scores in the different areas evaluated—Interest/Enjoyment (4.86 ± 1.4), Perceived Competence (4.58 ± 1.3), Perceived Choice (3.86 ± 1.8), and Pressure/Tension (4.73 ± 1.9)—reflect a high level of commitment and a positive attitude toward the proposed activity. The Interest/Enjoyment and Perceived Choice subscales were particularly noteworthy, indicating that students valued the experience for both the enjoyment and autonomy it provided them in their learning. The score obtained in Perceived Choice confirms that students generally felt capable of tackling the assigned tasks, supporting the effectiveness of the teaching method implemented. However, the Pressure/Tension subscale suggests a moderate emotional or academic burden, likely linked to the complexity of certain activities, such as interpreting microscope images. This raises the need to further investigate the factors that may have generated discomfort or anxiety in some students. In this regard, the adaptation of the IMI questionnaire without prior local validation is recognized as a limitation, which could affect the interpretation of the results in this educational context.

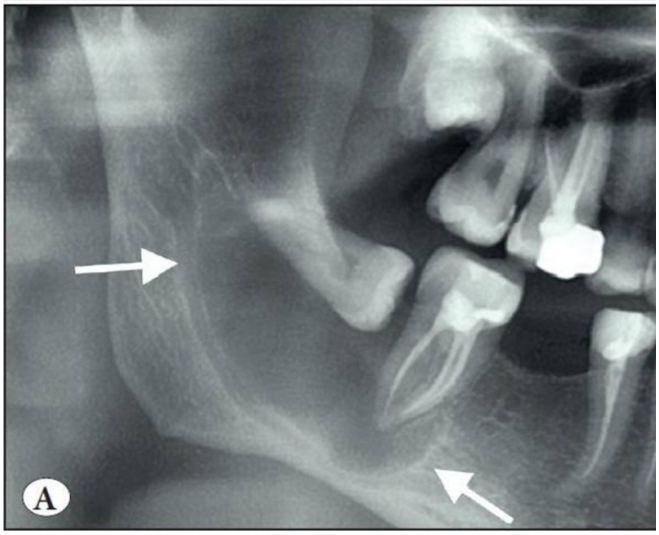

Figura 2. Caso 1. Describa el aspecto radiográfico de la imagen, indique localización, extensión de la lesión, límites/bordes de la lesión, piezas dentarias asociadas, estructuras vecinas.

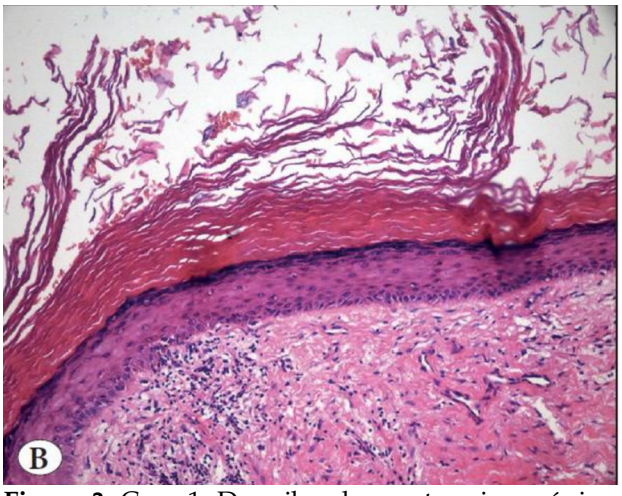

Figura 3. Caso 1. Describa el aspecto microscópico: Tipo de epitelio, tipo de queratinización, tejido conectivo.

The good performance can be explained by the positive impact of active methodologies such as problem-based learning (PBL), widely recognized in the literature as effective tools to promote clinical reasoning, knowledge integration and active student participation in their learning process, in agreement with other authors (1-2). The use of strategies such as clinical case studies and virtual microscopy has been pointed out as an effective way to bring students closer to real clinical contexts, promoting a greater understanding of the contents (10). In line with previous studies, students showed a high intrinsic motivation, which translates into a better predisposition to solve problems, investigate and deepen the contents autonomously (5-11).

The qualitative analysis of organizational modes revealed that 80% of students used the Virtual Classroom (VC) as their primary tool for organizing their studies, either through reading lectures, seminars, or bibliography (43.7%), or through virtual microscopy and the Internet (31.25%). These findings confirm the key role that educational technologies play in teaching morphological

disciplines such as pathological anatomy (4). However, our study also identified that 46.6% of students reported having difficulties interpreting microscopic images, an aspect already pointed out by other authors as a critical point in medical training (10). The majority of students (81.25%) reported having resolved these problems by reviewing lectures and bibliography, while 18.75% required support from peers. Regarding access to technological resources, the majority reported no problems with the platform or with the use of the Internet or computers, which favored the fluid development of activities and allows us to think about the consolidation of mixed or hybrid teaching environments (11-12). These findings support the idea that the incorporation of active methodologies, together with accessible technological resources, can favor meaningful learning, even in subjects traditionally structured in expository formats (6). Likewise, the basic-clinical integration proposed from the first years of training, is essential to construct a clinical perspective from morphology (12).

Our findings on the acceptance of clinical-pathological case seminars coincide with the reports of Oqbani (7), where 74% of students positively valued this methodology as an effective tool to strengthen the understanding of pathology. The integration of technological resources such as virtual microscopy, asynchronous learning platforms and interactive seminars has shown clear benefits in improving the morphological understanding of tissues, promoting critical thinking and increasing student motivation (3). In this framework, hybrid teaching models, such as b-learning, are consolidated as effective pedagogical strategies to promote autonomy, active learning and the development of clinical skills, especially in training for morphological diagnosis (3-7). The positive experience with the use of virtual preparations has also been validated by Oqbani (7), who highlighted this tool as one of the most highly valued by students to facilitate histopathological analysis.

An important limitation of this study is the small sample size (n=31), due to the fact that this was an optional course with voluntary enrollment within the Dentistry curriculum. Although the results offer valuable insights into the perception and impact of the b-learning approach in the teaching of pathology, caution should be exercised in interpreting their generalization to other educational contexts. This type of design, common in exploratory educational research, allows for the identification of preliminary trends and areas for improvement, but requires complementation with larger, multicenter studies to obtain robust evidence (3-7). Furthermore, recent literature indicates that studies focused on student perceptions provide significant input for curricular redesign, even if they have limitations in statistical scope (7).

5. Conclusions

- The methodology implemented was highly effective in developing diagnostic skills, as evidenced by good performance in group and individual assessments.
- Students adopted a multi-channel and collaborative approach, utilizing the Virtual Classroom, peer and faculty consultations, and various resources to actively and independently solve cases.
- Although technological accessibility and effective use of AV were good, a need to strengthen the interpretation of microscopic images was identified as an essential part of diagnosis.
- The proposal generated great interest and enjoyment among the students, connecting the learning process with real-life situations in their professional futures.

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Declaration of conflict of interest: The authors declare that this study has no conflicts of interest and that it has been conducted in accordance with the ethical principles established by this journal, also noting that the work has not been published in part or in full in any other journal.

Authors' contributions: Study conceptualization and development: SC and AAO; Analysis of results and original manuscript writing: AAO; Critical review of content, validation of clinical cases, and final editing of the manuscript: SC

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