

Validation of a manual for learning cephalometry

Catarina Chaves Machado¹

 [0000-0001-8745-8839](https://orcid.org/0000-0001-8745-8839)

Lara Alves Meneses¹

 [0000-0002-7462-6220](https://orcid.org/0000-0002-7462-6220)

Raissa Cardoso dos Santos¹

 [0000-0002-6982-5006](https://orcid.org/0000-0002-6982-5006)

Lucio Mitsuo Kurita²

 [0000-0002-9676-4376](https://orcid.org/0000-0002-9676-4376)

Polyanna Maria Rocha Novais¹

 [0000-0002-6416-3162](https://orcid.org/0000-0002-6416-3162)

Paulo Leonardo Ponte Marques¹

 [0000-0001-8349-9772](https://orcid.org/0000-0001-8349-9772)

¹Universidade de Fortaleza (UNIFOR), Fortaleza, Ceará, Brasil.

²Universidade Federal do Ceará (UFC), Fortaleza, Ceará, Brasil.

Correspondence:

Paulo Leonardo Ponte Marques

E-mail: paulomarques@unifor.br

Received: Aug 05, 2022

Approved: Apr 13, 2024

Last revision: Sept 27, 2024

<https://creativecommons.org/licenses/by-nc/4.0/deed.en>



Abstract This study aimed to validate a manual for learning cephalometry in a private undergraduate Dentistry course. This methodological study had quantitative and qualitative approaches and was conducted in four phases. The first three phases involved the application of a Likert scale questionnaire to measure the Content Validity Index. The fourth phase had a qualitative approach and was conducted by interviews with a semi-structured script. The research had 46 participants, including 4 former teaching assistants, 32 undergraduate students, and 10 postgraduate students in Orthodontics. Numerical data were analyzed by percentages based on the validation index, and excerpts from interview responses were analyzed using content analysis. In the first phase, conducted with former teaching assistants, all participants (N=4; 100%) indicated applicability of the manual. In the second phase, with undergraduates, 22 participants (68.7%) identified the manual as a facilitator in learning. In the third phase, with postgraduates, eight (80%) mentioned that the manual would have professional utility. The results of quantitative phases indicated the manual as a facilitator of the teaching-learning process (N=46; 78.2%), with applicability in undergraduate education (N=42; 91.3%), and usefulness for professionals (N=42; 91.3%). Three thematic categories emerged from the fourth phase, confirming the quantitative results: integration of content into the course; simplified understanding; and importance for the future. At completion of the process, the manual was validated as teaching material and will be used as a facilitating tool to achieve learning objectives and as a reference in the field.

Descriptors: Education, Dental. Orthodontics. Cephalometry.

Validación de un manual para el aprendizaje de la cefalometría

Resumen El objetivo de este estudio fue validar un manual para el aprendizaje de cefalometría en una carrera privada de Odontología. Se trata de un estudio metodológico con enfoque cuantitativo y cualitativo, realizado en cuatro fases. Las tres primeras fases implicaron la aplicación de un cuestionario en escala Likert, para medir el Índice de Validez de Contenido (CVI). La cuarta fase tuvo un enfoque cualitativo y se realizó a través de entrevistas con un guión semiestructurado. La investigación contó con 46 participantes, entre ellos 4 ex monitores, 32 estudiantes de pregrado y 10 estudiantes de posgrado en Ortodoncia. Los datos numéricos se analizaron mediante porcentajes basados en el cálculo del CVI y los extractos de las respuestas de la entrevista mediante la técnica de análisis de contenido. En la primera fase, realizada con ex monitores, todos los participantes (n=4; 100%) destacaron la aplicabilidad del manual. En la segunda fase, con estudiantes universitarios, 22 participantes (68,7%) señalaron el manual como facilitador del aprendizaje. En la fase tres, con estudiantes de posgrado, ocho (80%) indicaron que el manual sería de utilidad profesional. Los resultados de las fases cuantitativas apuntaron al manual como facilitador del proceso de enseñanza-aprendizaje (n =46; 78,2%), con aplicabilidad en la graduación (n =42; 91,3%); y útil para el profesional (n =42; 91,3%). De la cuarta fase surgieron tres categorías temáticas: integración de contenidos al curso; comprensión simplificada; e importancia para el futuro. Al final del proceso, el manual fue validado como material didáctico y será utilizado como instrumento para facilitar el logro de los objetivos de aprendizaje y fuente de consulta en el área.

Descriptor: Educación en Odontología. Ortodoncia. Cefalometría.

Validação de um manual para o aprendizado de cefalometria

Resumo O objetivo deste estudo foi validar um manual para o aprendizado em cefalometria em um curso de graduação em Odontologia privado. Trata-se de um estudo metodológico com abordagem quantitativa e qualitativa, realizado em quatro fases. As três primeiras fases tiveram aplicação de questionário em escala Likert, para mensurar o Índice de Validade de Conteúdo (IVC). A quarta fase teve abordagem qualitativa e foi realizada por meio de entrevista com um roteiro semiestruturado. A pesquisa teve 46 participantes, sendo 4 ex-monitores, 32 estudantes de graduação e 10 pós-graduandos em Ortodontia. Os dados numéricos foram analisados por meio de percentuais a partir do cálculo do IVC e os trechos com as respostas das entrevistas por meio da técnica de análise de conteúdo. Na fase um, realizada com ex-monitores, todos os participantes (n=4;100%) apontaram a aplicabilidade do manual. Na fase dois, com graduandos, 22 participantes (68,7%) indicaram o manual como facilitador da aprendizagem. Na fase três, com pós-graduandos, oito (80%) apontaram que o manual terá utilidade profissional. Os resultados das fases quantitativas apontaram o manual como facilitador do processo de ensino-aprendizagem (n =46; 78,2%), com aplicabilidade na graduação (n =42; 91,3%); e útil para o profissional (n =42; 91,3%). Da fase quatro, emergiram três categorias temáticas: integração do conteúdo ao curso; compreensão simplificada; e importância para o futuro. Ao final do processo, o manual foi validado como material didático e será utilizado como um instrumento facilitador do alcance dos objetivos de aprendizagem e fonte de consulta na área.

Descritores: Educação em Odontologia. Ortodontia. Cefalometria.

INTRODUCTON

Cephalometry is the measurement and interpretation of human skull measurements from radiographs. It can also be defined as the measurement of the skull, soft and hard tissues from landmarks established in these images. This complementary examination was developed to assist in the diagnosis of deviations from normality of the face and is used to standardize the study of lateral cephalograms, also contributing to the planning and dental treatment of patients¹⁻³. Among the established parameters, there are three essential standards for a cephalometric analysis: skeletal, dental and facial profile⁴.

This technique of skull measurement also proposes to establish a prognosis for the treatment of orofacial deformities and is important for studies in edentulous individuals to analyze the numerical and morphological variations occurring among populations. Its major limitation is the observation of images of three-dimensional structures from a two-dimensional perspective, which can cause some distortion problems. Computed tomography, an examination that reduces such distortions, is another more accurate technique for diagnosing and planning dental treatments. However, it is still expensive and requires computers with specific settings⁵⁻⁷.

The teaching-learning process in Orthodontics, the Dentistry specialty that most deals with cephalometric analyses, is a challenge, since theoretical knowledge is required in addition to practical skills for detailed diagnosis, which is often difficult. Therefore, it is recommended to use all resources available to analyze the patient's apparent problem and establish an appropriate treatment plan, otherwise it may fail, frustrating both patient and dentist⁸.

In the academic context, the exchange of experience and information between students and professors in undergraduate courses is evidenced when new teaching methodologies are implemented, or even strategic learning mechanisms that can be used in different situations, making the lectures more didactic and useful⁹. For that purpose, teaching materials, which are resources defined as products used in education for pedagogical mediation, are fundamental for the construction of knowledge^{10,11}.

Considering that cephalometric analysis presents challenges in both academic and professional contexts, besides its understanding, it is necessary to exercise its practice by auxiliary educational support materials. The general objective of

this study was to validate the teaching material developed for learning cephalometry in an undergraduate Dentistry course.

METHODS

The methodological study had quantitative and qualitative approaches. According to Polit (2021)¹², the methodological study focuses on the development, validation and evaluation of existing tools or strategies.

The study setting was the University of Fortaleza, an institution in Northeast Brazil, ranked as the fifth best among Brazilian private universities in the Times Higher Education ranking¹³, standing out in teaching, research, knowledge transfer and international vision.

At this university, two professors, one with a MSc degree and the other with a PhD, developed, based on their academic experience and in the context of dental and radiographic clinics, a teaching material to facilitate the study of Orthodontics in the field of cephalometric tracings and analysis. Called "Manual of Introduction to Cephalometry", it was designed to be used in the teaching-learning process in the discipline of Pediatric Clinic III, included in the eighth semester of the Dentistry course curriculum.

The content covered aims to perform a simplified cephalometric analysis, with data gathered from different classical analyses, focused on introducing students to the field of Orthodontics, offering an overview that interconnects the contents of anatomy, physiology and pathology of the craniofacial complex. Topics as history of cephalometry, method of radiographic image achievement, construction of cephalogram with identification of anatomical structures of interest, cephalometric points, tracing of lines and planes and measurement of angles and linear measurements necessary for the interpretation of data achieved are explained in the respective teaching material⁸.

The research for manual validation had participation of 46 individuals, including four former monitors of the pediatric clinic discipline, 32 undergraduate Dentistry students who had already coursed this discipline and 10 dental professionals postgraduates in Orthodontics who had had contact with the manual during their undergraduate studies. The undergraduate students were recruited at the university, and the postgraduate students by active search in specialization courses in Orthodontics in the city.

The validation process was conducted in four phases, with data collection in the last trimester of 2021. The first three phases had a quantitative approach, with application of questionnaires with responses on a Likert scale to measure the percentage of agreement. The first phase included four former monitors of the discipline including this subject in their pedagogical project. The inclusion of these participants is justified because they are more familiar with the manual. The second phase included undergraduate Dentistry students, who had used the manual in the semester prior to data collection. Only postgraduate students participated in the third and fourth phases.

Participants were intentionally invited to answer a questionnaire containing questions about the usability, applicability, formatting and importance of the manual. Responses were marked on a Likert scale, containing the options: I totally disagree; I disagree; I neither disagree nor agree; I agree; and I totally agree. It was previously established that, to validate the manual, a percentage equal to or greater than 75% would be required in the criteria facilitation of learning, applicability and usefulness, considering the consolidation of responses of all participants in the options agree or totally agree.

The questionnaires were distributed by a link to an electronic form on Google Forms®. Collected data were organized in an electronic spreadsheet to allow quantitative analysis by percentages and absolute numbers. Based on the responses, the Content Validity Index (CVI)¹⁴ was identified. This index was calculated by dividing the number of participants responding agreement by the total number of participants, followed by multiplication by 100 to use percentages.

In the fourth phase, data collection comprised individual interviews, based on a semi-structured script applied only to postgraduate students in Orthodontics, who functioned as judges in the validation process. The guiding questions aimed

to assess the usefulness of the manual, its importance in learning and relevance in postgraduate studies. Two trained researchers conducted the interviews on dates and times scheduled according to the convenience of each participant, and the interviews lasted a maximum of 20 minutes.

Data from this phase were recorded and the statements were transcribed into a text editor. Each participant received a code (PG followed by an Arabic numeral from 1 to 10) to protect their identity. The Bardin Content Analysis technique¹⁵ was then used, with the following phases: pre-analysis of transcription, exploration of material with exhaustive reading, processing of results with inference, interpretation, and thematic categorization based on the homogeneous passages that were repeated. Data analysis was performed by four researchers with MSc and PhD degrees.

All participants accessed and signed an informed consent form electronically. The research was approved by the Institutional Review Board of the University of Fortaleza under CAAE 48068021.8.0000.5052 and report n. 4.834.035.

RESULTS AND DISCUSSION

The results indicated validation of the manual based on previously defined criteria. Table 1 shows the result of the CVI with the three groups of participants. All participants in the group of former monitors (n = 4; 100%) and postgraduate students (n = 10; 100%) fully agreed that the manual facilitates teaching and learning and is applicable. Eight postgraduate students agreed that the manual is professionally useful.

Table 1. Content Validity Index of the phases that used quantitative approach.

Criteria	Phase 1 Former monitors	Phase 2 Undergraduates	Phase 3 Postgraduates	Content Validity Index
Manual as a facilitator of the teaching-learning process	4 (100%)	22 (68.7%)	10 (100%)	36/46 (78.2%)
Applicability in graduation	4 (100%)	28 (87.5%)	10 (100%)	42/46 (91.3%)
Professional usefulness	4 (100%)	30 (93.75%)	8 (80%)	42/46 (91.3%)

The Content Validity Index, considering all participants, was above 75% in all criteria. Most participants considered the manual as a facilitator of the teaching-learning process (n=46, 78.2%); with applicability in undergraduate courses (n=42, 91.3%); and useful for professionals in the area (n=42, 91.3%).

The validation with high percentages of agreement indicates that the manual is an important tool, with emphasis on its applicability in the teaching process and professional utility, since it is an important topic for the knowledge of general dentists. Despite being a complex topic, mastering radiographic cephalometry requires dedication and theoretical and practical involvement, and new teaching materials have been extremely useful in professional practice, especially in postgraduate Orthodontics courses⁸.

During undergraduate studies, the students must discern and have the maturity to acquire the habit of studying, which can be financially and temporally costly, especially in areas in which they do not intend to deepen the knowledge or specialize. The use of easily accessible educational materials helps to develop an analytical reading, enabling them to express opinions and make decisions that will be useful in practice¹⁶.

The evaluation of content by judges in the area, considering aspects as experience and qualifications, enhances the instrument validity and is one of the procedures used to increase reliability¹⁴.

Three thematic categories emerged in the interviews conducted with postgraduate students in the field of Orthodontics: Content integration into the course; Simplified understanding; and Importance for the future. These themes will be addressed below.

Thematic category 1 – Content integration into the course

Cephalometry is an essential Orthodontics content for the correct diagnosis and treatment planning in patients with craniofacial disorders. These unfavorable characteristics can affect muscular, bony and/or dental structures and often require a multidisciplinary approach. Mainly for beginners, cephalometry helps to guide the diagnosis and treatment planning in a safer manner¹⁵.

This topic was described by participant PG1: "[...] Orthodontics is not only about teeth; it is about growth and bones. Thus, certainly, in the development stage we can intervene with orthopedics before the problem even sets in, intervening in the growth period to avoid the appearance of a disorder that might require surgical treatment [...]."

Also, as mentioned by PG2: "[...] when I arrived at the Orthodontics course I was years ahead of everyone else, in the diagnosis and the clinical daily routine. Thus, even if I did not make an orthopedic device, I would be able to indicate it, so we saved many patients from surgeries, many patients who already came to me having attended a pediatric dentist and diagnosed as Class III or Class II".

There are several challenges in studying cephalometry, including visualizing anatomical structures, locating cephalometric points, and basic knowledge of angular and linear measurements. Additionally, there are several analyses consisting of different data and interpretations, most of which were prepared in Higher Education Institutions³.

Conversely, PG3 discussed the difficulties with the discipline content and the use of teaching materials as a research source: "[...] for me, when I was in college, it was very complex, you know?! I didn't understand it very well, [...] the theoretical part itself, the theoretical basis itself, I could put the degrees there and other aspects in my analysis, but to make the diagnosis I always had to go back to theory to be able to know what each point was, or what that influenced."

The excerpt highlights that the manual, despite facilitating the teaching process, should not be used as a sole and isolated tool in learning cephalometry; rather, other means should also be used. Although software is being widely used for this purpose, the disadvantage is the financial cost of acquiring it. In this context, knowing how to perform a cephalometric analysis manually is essential¹⁻⁵.

PG4 claimed to have no recollection of the craniofacial anatomy covered in the manual and, when asked about the subject, reported: "Wow, I don't even remember [laughs]. That part about the points you're talking about? The cephalometric points?"

When the student is unable to use the teaching material provided, understanding the content becomes difficult, creating a gap in knowledge. This importance is highlighted not only to achieve a passing grade, but also as a practical basis for diagnosis in Orthodontics. The reasons for not learning include the lack of use or even its incorrect use as the only source of research on the subject.

Knowledge about malocclusions and cephalometry is related to the imbalance in craniofacial development, which can be influenced by genetic and environmental factors and can directly affect the stomatognathic system, compromising the swallowing, chewing and speech functions. The diagnosis of such disharmony requires theoretical and practical knowledge, which ranges from the etiology of disease to determination of related morphofunctional characteristics, also evidenced by the cephalometric study^{16,17}.

Thematic category 2 – Simplified understanding

Cephalometric analysis is frequently used to study dentoskeletal characteristics, mainly for orthodontic planning, and the treatment prognosis of orofacial deformities. Identifying points for a more accurate analysis is of utmost importance for better planning of such treatments⁵. However, the different terminologies from different analyses can impair the understanding, depending on the experience and knowledge of the operator³.

This theme emerged in the speech of participant PG6: “[...] in the specialization the professor asks us to analyze in different manners and using different types of analyses, because there are several types and the manual helps us to understand and simplify more, not looking at so many numbers. We are targeted directly at that point, with that necessary information, to really simplify the situation.”

The idea that the different teaching methodologies and the simplified cephalometric analysis contained in the manual of introduction to Cephalometry facilitate student learning appeared in the speech of PG7 during his academic life: “Since the part of the Manual is really simplified for the early observation of principles by the student. Of course, when you go to do the specialization you have more in-depth studies, you see more points, but I think it is possible to really see the basic part.”

Such discourses corroborate the idea that Cephalometry is a subject that should be approached in a simple and practical manner in undergraduate courses, so that students can understand it, and it should be further explored in postgraduate Orthodontics courses^{6,18}.

Regarding simplified understanding, PG5 reported that: “[...] a part of this material explains the reason for each point, and connects each point. [...] we only know how to perform a true cephalometric analysis when we know the points, which path goes from where to where. Since the manual explains the function of each, separately, it was extremely important.”

Similar data were obtained in studies at the universities of Vikarabad and Ohio, when postgraduate students in Orthodontics emphasized the importance of cephalometric analysis for the diagnosis of dentoskeletal alterations. In the Ohio study, 80% of individuals who participated in the research stated that different tools and methodologies are fundamental to the teaching-learning process of this subject¹⁸.

Emphasizing the knowledge of cephalometry in undergraduate studies, there were reports of advantages compared to those who did not use the manual in their courses, as reported by PG8: “[...] because many colleagues did not know how to identify the landmarks and connect them and calculate the measurements. Some colleagues who attended other colleges [...] thus it was much more beneficial even for learning other analyses, because we can have a better understanding and learn faster”.

According to PG9, the manual is brief and complete: “[...] When you go to the library you have to borrow more than two books because they do not have everything in one, and the manual is kind of a compilation, which in addition to making it easier, it is well explained and we can understand things better. It is very complete and manages to be punctual and at the same time it is a summary that you don't miss much, because since it deals with measurements there is not much to do... They are measurements... And the manual helps you a lot with this, it is different from other sources, which is also very difficult.”

Although this resource is indispensable for some students, for others it can become a problem, because its use requires discipline, autonomy and self-management of learning¹². Additionally, it was developed as a complementary material to summarize content and encourage greater knowledge of the specialty of Orthodontics.

Thematic category 3 – Importance for the future

The National Curricular Guidelines (DCN) indicate that the training of dentists should include comprehensive health care, and this professional should have a solid technical-scientific foundation, besides being attentive to individual needs¹⁹. In the context of cephalometry, more accurate diagnosis will contribute to the best way to perform treatment, including, if needed, referral to a specialist.

The objective of orthodontic treatment is no longer only to establish ideal occlusion; it is also necessary to achieve harmony with the facial soft tissues¹. There is disagreement among orthodontists regarding the need to use radiographic

cephalometry, weighing the benefits of radiography against the risks of exposure to radiation. However, knowing how to perform an analysis manually, even in this digital age, becomes necessary, especially for beginners in diagnosis and treatment planning⁵.

Regarding the use of the manual in the future, PG5 mentions: "I do recommend it! That material is unique because it explains cephalometry very clearly when we were starting to study orthodontics. It is a turning point, [...] I still have it to this day."

The teaching materials used by students must meet certain requirements to be effective means for the construction of knowledge, meeting the proposed objectives, addressing content clearly and effectively, having justifications, being within the psychosocial context and covering the profile of academics²⁰.

Usability is confirmed in the speech of PG10: "My experience was great because, in this case, cephalometry is already a subject somewhat complicated, which involves calculations, many methods and then the handout [manual] describes everything very precisely and it is as if they were conceptual maps, I work a lot like that, it addresses everything, in an organized manner, and we can learn in an organized manner, thus my experience with the manual was great, it made things much easier."

When asked about the use of the manual, PG3 described his experience as follows: "[...] I think that this cephalometry content is already very rich, very dense, it is kind of a shock. With the manual we were able to understand how it worked."

PG9 considered that the use of the manual was significant for his learning: "Look, that manual helped me a lot! Because everything was written in it, in detail"

During their undergraduate studies, students benefit from various types of methodologies, content and presentation methods, however, each discipline requires different approaches to elucidate the perception and construction of student knowledge.

The protagonist of the teaching-learning process should be the student; however, there are means that guide and enhance the construction of knowledge, including teaching materials that must have accessible, methodological language expressing the professors' intentions for the proposed activities, even in distance learning^{20,21}.

PG10 stated that the manual was essential for his learning: "[...] cephalometry is not easy to learn, it is very complex, but this manual helps a lot because it is very detailed and has everything we need to know according to the analysis proposed in college, right?! In my opinion, it helped a lot in learning".

PG8 also describes how this learning resource helped her in her undergraduate and graduate studies: "[...] it helps, you know, in terms of actually learning. When we started the graduate studies, we already had a better understanding of the subject. It is different from some other people who are graduates, in specialization, as if it were from scratch, right? ... So, it is a better understanding of how we get to specialization, knowing more about the subject".

Although the teaching of cephalometric analyses at universities is based on theoretical and practical classes, there is difficulty in replicating this learning, given the existence of various techniques used by professionals in Radiology and Orthodontics. Considering the effectiveness and understanding of this type of study, current technologies create a perspective on radiographic cephalometry²².

To date, there are no experience reports or even research in the literature validating manuals for studying cephalometry in undergraduate studies.

This study points out, as a limitation, the lack of a more specific description of the social characteristics of participants, since only their academic qualifications were sought. Another limitation was the low number of participants in the

quantitative approach. However, since this is a topic taught only in the eighth semester of the course, only final-year students would be eligible, limiting the number of participants.

The methodological aspects of this research are highlighted as a potential advantage, with validation of the teaching material by different groups of participants, not only by experts in the field. Validation of a manual that has potential to be used as a reference for other courses and universities is also highlighted as relevant, especially by its future digitalization or transformation into an app for use on smartphones.

CONCLUSION

Based on criteria established in this methodological study, the Introduction to Cephalometry Manual was validated as a teaching material, constituting an instrument that facilitates the achievement of learning objectives in undergraduate courses and a reference source for professionals in the field.

REFERENCES

1. Hlongwa P. Cephalometric analysis: manual tracing of a lateral cephalogram. *S Afr Dent J* [Internet]. 2019;74(6):318-322. doi: <http://dx.doi.org/10.17159/2519-0105/2019/v74no6a6>
2. Pattanaik S. Evolution of Cephalometric Analysis of Orthodontic Diagnosis. *Indian J Forensic Med Toxicol* [Internet]. 2019;13(4):1830-1834. doi: <https://doi.org/10.1590/S2176-94512013000300011>
3. Ludwig B, Bister D, Schott TC, Lisson JA, Hourfar J. Assessment of two e-learning methods teaching undergraduate students cephalometry in orthodontics. *Eur J Dent Educ* [Internet]. 2015;20(1):20-25. doi: <https://doi.org/10.1111/eje.12135>
4. Vilella OV. Manual de cefalometria. Thieme Revinter; 2018.
5. Golshah A, Dehdar F, Imani MM, Nikkerdar N. Efficacy of smartphone-based Mobile learning versus lecture-based learning for instruction of Cephalometric landmark identification. *BMC Med Educ* [Internet]. 2020;20(287):1-8. doi: <https://doi.org/10.1186/s12909-020-02201-6>
6. Sinha N, Reddy KM, Nidhi G, Shastry YM. A cephalometric analysis of Class II dentate subjects to establish a formula to determine the occlusal plane in Class II edentate subjects: a neo adjunct. *J Indian Prosthodont Soc* [Internet]. 2017;17(3):226-232. doi: https://dx.doi.org/10.4103/jips.jips_21_17
7. Jodeh, DS, Kuykendall LV, Ford JM, Ruso S, Decker SJ, Rottgers SA. Adding Depth to Cephalometric Analysis. *J Craniofac Surg* [Internet]. 2019;30(5):1568-1571. doi: <https://doi.org/10.1097/SCS.0000000000000555>
8. Machado CC, Martins MGA, Araújo DB, Araújo BBJ. Manual de iniciação à Cefalometria radiográfica como guia e orientação de estudo – sua efetividade no curso de Odontologia da Universidade de Fortaleza antes e durante a pandemia da COVID-19. In *Anais do 12º Encontro de Práticas Docentes da Universidade de Fortaleza*; 2020:19-23 [cited 2021 Mar 27]. Available from: <https://uol.unifor.br/encontroscientificos/2020/encontro/3715>
9. Gomes MP, Ribeiro VM, Monteiro DM, Leher EM, Louzada RD. O uso de metodologias ativas no ensino de graduação nas ciências sociais e da saúde: avaliação dos estudantes. *Cien Educ* [Internet]. 2010;16(01):181-198. doi: <http://dx.doi.org/10.1590/s1516-73132010000100011>
10. Pappis L, Wisch T, Dewes A. Plano de desenvolvimento institucional: perspectivas sobre contextos emergentes na/da educação superior. *PolEd* [Internet]. 2020;14(1):17-30.
11. Silva DM, Santana JR, Vasconcelos FH. Formação docente para o desenvolvimento de recursos educacionais digitais: uma revisão sistemática da literatura. # Tear: *Rev Educ Cien Tecnol* [Internet]. 2022;11(1):1-20. doi: <http://dx.doi.org/10.35819/tear.v11.n1.a5657>
12. Polit DF, Beck CT. Fundamentos de pesquisa em enfermagem: avaliação de evidências para a prática da enfermagem. Artmed; 2021.
13. Times Higher Education. World University Rankings [Internet] [acesso em 10 de Janeiro de 2024]. Disponível em: <https://www.timeshighereducation.com>
14. Alexandre NM, Coluci MZ. Validade de conteúdo nos processos de construção e adaptação de instrumentos de medidas. *Cien Saude Colet* [Internet]. 2011;16(7):3061-3068. doi: <https://doi.org/10.1590/S1413-81232011000800006>
15. Mendes RM, Miskulin RG. A análise de conteúdo como uma metodologia. *Cad Pesqui* [Internet]. 2017;47(165):1044-1066. doi: <https://doi.org/10.1590/198053143988>
16. Galvão AR, Angelo MF, Couto JVO, Galvão AR. Desenvolvimento de um aplicativo web para marcação de pontos cefalométricos. In *Anais dos Seminários de Iniciação Científica*; 2018. doi: <https://doi.org/10.13102/semic.v0i22.3986>

17. Zheng W, Zhang X, Dong J, He J. Facial morphological characteristics of mouth breathers vs. nasal breathers: A systematic review and meta-analysis of lateral cephalometric data. *Exp Therap Med* [Internet]. 2020;19(6):3738-50. doi: <https://doi.org/10.3892/etm.2020.8611>
18. Tavares CA, Allgayer S. Open bite in adult patients. *Dental Press J Orthod* [Internet]. 2019;24(5):69-78. doi: <https://doi.org/10.1590/2177-6709.24.5.069-078.bbo>
19. Brasil. Resolução CNE/CES nº 3, de 21 de junho de 2021. Institui as Diretrizes Curriculares Nacionais do curso de graduação em Odontologia e dá outras providências [cited 2023 Mar 29]. Available from: <http://portal.mec.gov.br/docman/junho-2021-pdf/191741-rces003-21/file>
20. Rosalin BC, Cruz JA, Mattos MB. A importância do material didático no ensino a distância. *Rev online Pol Gest Educ* [Internet]. 2017(especial 1):814-830. <https://doi.org/10.22633/rpge.v21.n.esp1.out.2017.10453>
21. Soares LV, Colares ML. Educação e tecnologias em tempos de pandemia no Brasil. *Debates Educ* [Internet]. 2020;12(28):19-41. doi: <https://doi.org/10.28998/2175-6600.2020v12n28p19-41>
22. Helal NM, Basri OA, Baeshen HA. Significance of cephalometric radiograph in orthodontic treatment plan decision. *J Contemp Dent Pract* [Internet]. 2019;20(7):789-793. doi: <https://doi.org/10.5005/jp-journals-10024-2598>

Conflict of interest: The authors declare no conflict of interest.

Funding: No funding to declare.

Authors' contributions: Study design and planning: CCM, LAM, RCS, PLPM, PMRN. Data collection, analysis and interpretation: CCM, LAM, RCS, LMK, PLPM. Manuscript preparation or revision: CCM, LAM, RCS, PLPM. Approval of final version: PLPM. Public responsibility for the manuscript content: CCM, LAM, RCS, LMK, PLPM, PMRN