USE OF SIMULATION TECHNOLOGY FOR TEACHING OF FACIAL ANALYSIS IN SPEECH-LANGUAGE THERAPY

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ABSTRACT

The objective was to develop and evaluate technological resources for teaching in facial analysis. **Methods:** The study included 20 Speech-Language Therapy students, who studied (1st stage) and trained the facial anthropometric measurements (2nd stage) by the Invivo5® software (experimental group – EG), individuals of the *In Situ* group (control group – CG) and Speech-Language Therapy group (PG), who collected measurements from the same individual (3rd stage). **Results:** The Interactive Tutorial was composed by: "use of caliper", "evaluating the patient" and "use of software" (1st stage). The CG used the *In Situ* training to solve doubts, reporting the possibility to improve the practice (2nd stage). There was no statistical difference between values obtained by EG and CG, there was difference in measurement of the lower lip and time between PG and students (3rd stage). **Conclusion:** There is effectiveness of simulation since there were no differences between traditional and simulated teaching methods.

Keywords: Speech, Language and Hearing Sciences. Anthropometry. Interactive Tutorial. Computer Simulation. Teaching Materials.

INTRODUCTION

Anthropometry is the science that aims to measure the size, weight and proportions of the human body (Heymsfield & Stevens, 2017). Specifically, for determination of facial type, cephalometry is one of the most used means and involves measurement of craniofacial structures on lateral cephalograms. However, it is not always included in the speech-language therapy routine, besides the need for radiation and possibility of image distortion (Cutovic et al., 2014). Thus, it is fundamental to achieve resources to make this type of analysis reliably and easily inserted in the daily routine of these professionals, such as measurement by caliper or tape, obtaining the measurements and locating the points directly on the individual's face.

The reliability of measurements depends on the accurate location of anthropometric points, maintenance of head in adequate position and patient's compliance. The practice of clinician and/or researcher is fundamental factor in the quality, accuracy and interpretation of these measurements (Cattoni et al., 2009; Heymsfield & Stevens, 2017).

For this reason, knowledge on anthropometry has been increasingly used in the clinical routine of speech-language therapy, aiding in the assessment, diagnosis, prognosis and therapeutic planning. Facial measurements allow classification of facial type, evaluation of dental occlusion, facial harmony, orofacial musculature, shape and configuration of craniofacial structures, and aids the evaluation of mastication, swallowing, voice, breathing and speech functions (Cattoni et al., 2009).

Besides the clinical use of anthropometry, these sciences may also have a forensic application, for the purpose of facial biometric identification. In recent years, the number of judicial requests for identification of individuals captured by video surveillance has grown, for comparison of facial images with a determined suspected individual. In this sense, the application of knowledge on Orofacial Motricity, regarding the analysis of facial morphology and anthropometry, has become a great aid to solve cases of judicial interest, increasingly inserting the speech-language therapist in this environment (Baldasso et al., 2016).

During the last decades, the use of technological resources has grown considerably for the purpose of education and assistance in the fields of education and health. By receiving information by technologies, the student interprets, is renewed and modified, which are paradigm transformations in the teaching and learning processes (Zilma Silveira Nogueira Reis, Maria do Carmo Barros de Melo, Edison José Corrêa, Alamanda Kfoury Pereira, Dimitri Bassani dos Santos, 2016).

Simulation has been used as an additional learning method, which allows retention of knowledge for a longer time, and is more pleasurable than traditional teaching. Computer simulation is a computer-mediated training aiming to construct models of a real or fictitious system, in a dynamic and simple manner, to enable the exploration of imaginary or real situations, allowing the formulation of hypotheses, tests and analysis of results without the possible risks of a real situation (Lieberth & Martin, 2005).

One example of the use of simulator in speech-language therapy is the audiometry simulator used by undergraduate and graduate students (Lieberth & Martin, 2005), a computer game about head and neck anatomy and physiology (Rondon et al., 2013), and a 2D computer game and 3D computer model on anatomy and physiology of the orofacial myofunctional system (Rondon-Melo & De Andrade, 2016).

In this context, the introduction of simulation as a teaching method in Speech-Language Therapy can aid the acquisition of manual skills. Thus, the development of interactive materials and adaptation of computer programs for training of Speech-Language Therapy students may be an alternative to virtually test the identification and achievement of orofacial anthropometric measurements several times, before contact with a real patient.

The objective was to develop and adapt technological resources for teaching in Orofacial Motricity, specifically concerning facial analysis, and to evaluate the effectiveness of simulation for the learning process.

METHODS

ETHICAL ASPECTS

The study was approved by the Institutional Review Board of the involved institution (CAAE number 55623216600005417).

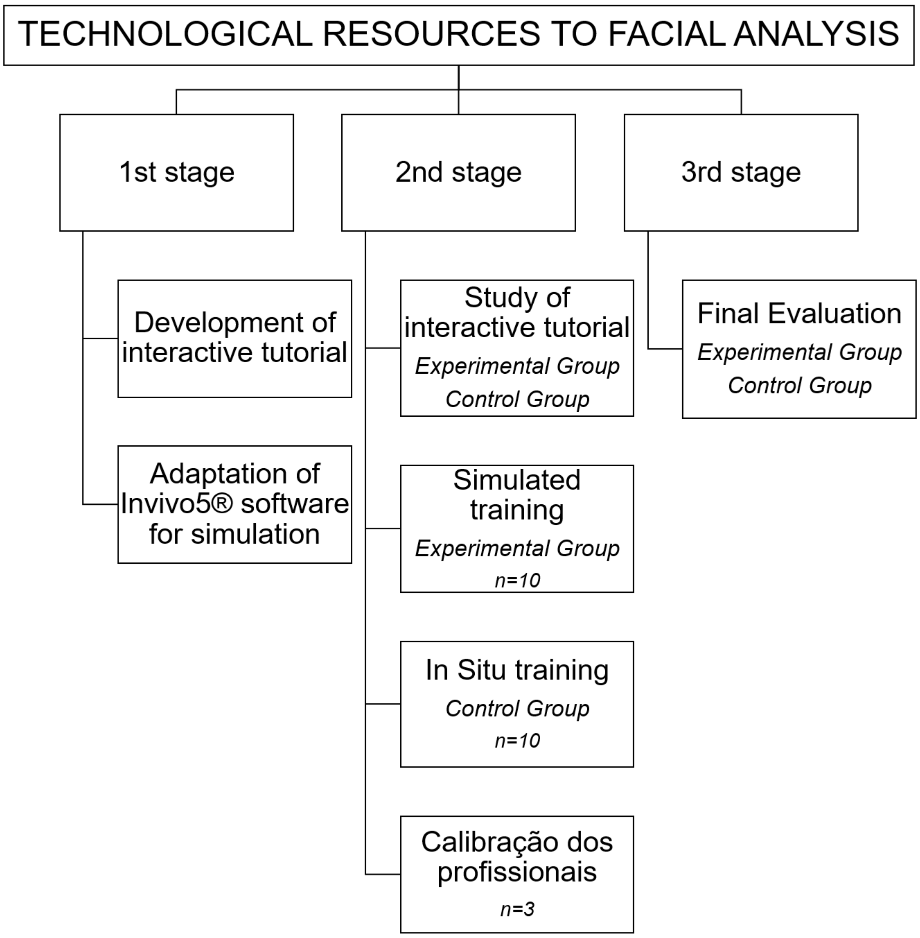
SAMPLE

A total of 24 second-year undergraduate Speech-Language Therapy students were invited, who had completed the discipline "Orofacial Motricity II". The 20 students included were randomly divided into two groups, balanced as to the previous knowledge about the subject, as checked by the final grades of the discipline Orofacial Motricity II ($p = 0.24$).

The study excluded participants who did not attend the meetings and trainings or did not participate in any stage of the study, which did not occur.

Three speech-language therapists working in the field of Orofacial Motricity, with at least three years of experience in facial analysis, were also invited. This group participated in a previous calibration, so that all professionals presented the same evaluation criteria, only after the final stage of the study, called "Final Evaluation". The sequence and details of the study are demonstrated in Figure 1.

Figure 1 – Flowchart demonstrating the procedures of the study stages.



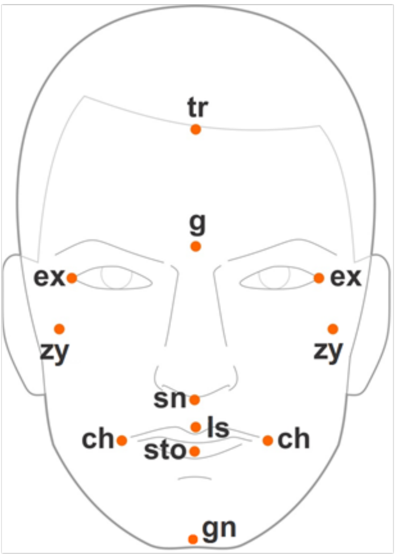
FIRST STAGE

Development of interactive tutorial

The interactive tutorial was built from the updated literature on Orofacial Motricity about evaluation protocols used in the speech-language therapy clinic, to help the student to dynamically learn the exact location of anthropometric points (Figure 2) (Caple & Stephan, 2016; Cattoni, 2006).

Figure 2 – Orofacial anthropometric points and measurements found in the literature.

Orofacial anthropometric points [9, 10]	Orofacial anthropometric measurements [9, 10]
• Glabella (g) • *Trichion* (tr) • Gnathion (gn) • External cantus of right eye (ex) • External cantus of left eye (ex) • Subnasale (sn) • Labrale superius (ls) • Stomion (sto) • Right cheilion (ch) • Left cheilion (ch) • Right zygomatic (zy) • Left zygomatic (zy)	• Height of upper lip (sn-sto) • Height of lower lip (sto-gn) • Filtrum height (sn-ls) • Upper facial third (tr-g) • Middle facial third (g-sn) • Lower facial third (sn-gn) • Facial width (zy-zy) • Facial height (g-gn) • Distance between left external eye canthus and left cheilion (ex-ch) • Distance between right external eye canthus and right cheilion (ex-ch)



Source: Designed by the author

The project included participation of a designer, who was responsible for image layout, selection and processing and content structuring. In addition, the HTML5 language was used by a programmer, allowing presentation of the tutorial in an executable software, permitting the structuring and presentation of content in a technological and integrated manner.

Adaptation of Invivo5® software for simulation

The Invivo5® is a software developed by Anatomage (San Jose, California, USA) to assist dental professionals. Its tools enable the rapid reconstruction of a 3D model from tomographic sections, besides identification of cephalometric points and achievement of linear and angular measurements. Despite being directed to the fields of implantology and temporomandibular dysfunction, it has different resources that also allow simulations of orthognathic surgeries and other applications.

Due to these characteristics, this software was selected for use as a simulation tool for training of facial analysis. Five virtual face models were selected, allowing students to contact a different image each training day.

SECOND STAGE

Study of interactive tutorial

The students could access the interactive tutorial at any time; however, in order to ensure that they studied the content developed, they were asked to perform presential study for two hours, distributed in four presential meetings, lasting 30 minutes each, for two weeks.

After completing the tutorial study, the students were divided into two groups (experimental and control). The experimental group performed the simulated training on the computer software, while the control group performed *in situ* training using a caliper on members of the group.

Simulated training – Experimental group

Students in the experimental group were trained to achieve the anthropometric measurements on the Invivo5® for two weeks. Each student performed the training five times, at different times and faces.

In each training, the student was instructed to achieve the facial measurements and take notes on a data collection form provided by the researcher, and then repeat the procedure and notes for the second time.

Measurement were obtained on the software with the face in frontal position, followed by face rotation, enabling three-dimensional view and correction of measurements. These procedures lasted approximately 20 minutes.

***In Situ* training – Control group**

Students in the control group trained the facial measurements on real people, five times, for two weeks. On each training day, the students achieved the measurements on a different face, so that they had contact with different facial types and measurement variations. In each training it was necessary to identify the anthropometric points on the individual to be evaluated, using an eye pencil, and then perform the orofacial anthropometric measurements and record them on the data collection form, twice.

Calibration of professionals

The speech-language therapists were previously trained and calibrated with measurement of the individual's face used in the final evaluation, to present similar results and a higher degree of reliability for comparison with the students. Initially, they had access to the interactive tutorial, to observe the location of points and anthropometric measurements employed in the study.

THIRD STAGE

Final evaluation

At this stage, all students and speech-language therapists performed the orofacial anthropometric measurement on the same individual, who remained seated with the feet on the floor, head in usual position, occluded lips and eyes closed. No further instruction was given, since the approach should be directed by each study participant.

Each measurement was obtained twice using the Digimess Pro-Fono® digital stainless steel caliper. The participants recorded all values on the data collection form without having access to previous notes.

The time for accomplishment of each stage of final evaluation was measured by participant: marking the points with the pencil, achieving measurements for the first time, measuring for the second time.

STATISTICAL ANALYSIS

The comparisons between results (facial measurements) and time for accomplishment of groups were performed as follows:

- Experimental Group x Control Group
- Experimental Group x Professionals Group
- Control Group x Professionals Group

The comparison between groups was performed by one-way analysis of variance (ANOVA) and the Tukey test was applied to analyze the significant results. The tests considered a significance level of 5%.

Also, the differences between first and second measurement obtained in each group were analyzed.

RESULTS

FIRST STAGE

Development of interactive tutorial

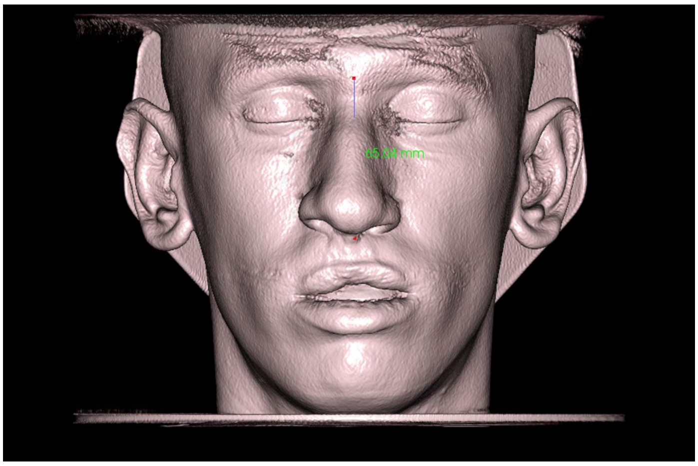
Two images were used to represent the face, one using a computer model representing a virtual face and the other using a photograph of a male individual, representing a real human face. There was a static index with the twelve points and ten anthropometric facial measurements, located on the left corner; a face image that might be selected by the user as virtual or real; and written definition of the selected point or measurement was also provided.

The tutorial also included three subsections, located at a fixed index on the right side of the screen: "using the caliper", "evaluating the patient" and "using the software". The section "using the caliper" was designed to present the standardized instrument used for *in situ* facial measurement, presenting the parts of the instrument, instruction for handling and functioning, by a video demonstrating the identification of points and achievement of measurements. The section "evaluating the patient" addresses the positioning and instructions that should be given to the patient during facial evaluation. The last section "using the software" addressed the use of the Invivo5® software for the EG, with step-by-step software use, patient tomography selection, 3D soft tissue image preparation, rotation and identification of points and measurements (there was a total of ten instructions, all properly illustrated).

Adaptation of Invivo5® software for simulation

The Invivo5® software has several visualization features, including "Volume Render", which allows exposure of an individual in three dimensions and exploration of internal structures. This feature has several controls that allow displaying the face in different combinations of color tones, densities, and types of tissue. Each option provides better visualization of certain anatomical structures, soft tissue profiles, airway, and more. The option selected for this study was "Soft Tissue 2". There is also the option "Distance Measurement", which allows identifying two points on the face, showing the linear distance between them (Figure 3).

Figure 3 – Demonstration of identification of orofacial anthropometric measurement "Middle facial third" using the option "Distance Measurement".



In addition, it allows rotation of the face at different angles to provide a three-dimensional view of the created image, confirming the location of identification of anthropometric points. This rotation can be done manually, using the mouse, or using the toolbar, which guides the face in eight different positions.

SECOND STAGE

Study of interactive tutorial

The meetings solved doubts arising during the period concerning the location of points or measurements, or even positioning of the examiner in front of the patient. The students made positive comments regarding the use of technology for teaching of facial analysis, mentioning that the tutorial proved to be a simple, clear, objective, didactic, illustrative and easy to understand tool, with useful information, providing greater familiarity with the points and anthropometric measurements, enhancing their identification and providing quick memorization. They also highlighted the relevance of instructions concerning the positioning in front of the patient and handling the caliper.

Simulated training – Experimental group

The simulated training occurred as described in the methods; however, not all tomographies allowed identification of the Trichion point, thus measurement of the upper facial third height (tr-g) was not performed by this group. In addition, during the use of the software, the students could ask questions for the researcher and receive guidance on the handling and marking of measurements.

Most images selected for analysis presented facial imbalances, since they were obtained from patients with indication for surgery. Thus, the study provided students experience with measurements on asymmetrical faces and facial changes, which they reported as positive during training, since they could have a different practice from what they had already learned and because it was more challenging to locate some points.

Students were very keen about the technology and made some comments about using the Invivo5® as a simulated teaching method for facial analysis. They mentioned that training aids the memorization of points and provides greater familiarity with measurements, proving to be a rich resource for learning, since it allows better preparation for the clinic. They considered interesting to test other learning methods and even mentioned that it was easier than on real people. They presented greater difficulty in initial meetings to handle the mouse and understand the face rotation functions, but these were enhanced by training, as well as the accuracy in identifying the points. They also commented on the positive experience of measuring difficult and irregular faces, and that this methodology should be implemented for undergraduate teaching.

***In Situ* training – Control group**

The students were trained on five people from their own group, without repetition, following all recommendations described in the method. During training, the students could ask questions for the researcher and receive guidance on how to handle the caliper and mark the measurements. The students made positive comments regarding the *in situ* training, reporting that it allowed greater practice improvement, increased the confidence and safety, being faster, providing greater accuracy in scoring points and greater ability in handling the caliper. In general, they were very satisfied with the meetings and noticed great evolution throughout the training.

Calibration of professionals

The professionals performed the identification of all facial points using the eye pencil. Then, they discussed the positioning of each point until consensus was reached. Each professional performed all orofacial measurements twice and compared the inter-examiner results. Measurements presenting discrepancies were discussed and reassessed by each until they were accepted by all.

THIRD STAGE

Final evaluation

After three to seven days of interactive tutorial study and completion of facial analysis training, all students and speech-language therapists evaluated the same individual. Since the experimental group did not train the "upper facial third" measurement, this was excluded from the final evaluation.

The remaining nine measurements were obtained twice, and the mean values were obtained per group in the first and second measurements, thus providing a mean. It can be observed that nearly all measurements presented differences smaller than 1 mm between the two evaluations, except for one, demonstrating accuracy regarding intraexaminer reproducibility.

Table 1 presents the means and standard deviations of the mean values obtained between the first and second orofacial anthropometric measurements for each aspect, separated by group.

Table 1 – Presentation of means and standard deviations for each aspect of orofacial anthropometric measurements, in millimeters

Aspect	PG (n=3)	CG (n=10)	EG (n=10)
	Mean ± SD	Mean ± SD	Mean ± SD
Middle facial third	59.75 ± 1.81	61.36 ± 1.90	60.81 ± 3.68
Lower facial third	61.76 ± 0.92	58.58 ± 2.48	59.07 ± 2.35
Upper lip	20.23 ± 0.24	21.02 ± 1.15	20.61 ± 1.60
Lower lip	41.56 ± 0.18	37.09 ± 2.23	38.23 ± 2.37
Filtrum height	11.09 ± 1.17	12.16 ± 0.84	12.31 ±0.91
Facial height	118.55 ± 1.08	120.06 ± 3.07	118.92 ± 4.60
Facial width	113.32 ± 1.21	117.11 ± 3.96	115.59 ± 6.41
Left eye canthum to left Cheilion	69.76 ± 0.25	69.81 ± 1.33	69.85 ± 1.63
Right eye canthum to right Cheilion	68.98 ± 0.05	69.50 ± 1.61	69.30 ± 1.03

Legend: **PG** = Professionals group; **CG**= Control group; **EG**= Experimental group; **SD** = standard deviation; **L** = left; **R** = right.

The comparison between experimental and control groups revealed no statistically significant difference between any of the values obtained by the students, demonstrating that the training methodology did not interfere with the achievement of results.

When the two groups of students were compared with the group of professionals, it was observed that only the lower facial third and lower lip measurements exhibited statistically significant difference, either in the first or second measurement, or in the mean value, as shown in Table 2.

Table 2 – Comparison of values obtained for each group for the lower lip measurement and p value.

Groups comparison	Measurements (mm)		p value
PG x CG	**PG (n=3)**	**CG (n=10)**	
1st measurement	41.52	36.86	0.03*
2nd measurement	41.60	37.32	0.01*
Mean	41.56	37.09	0.02*
PG x EG	**PG (n=3)**	**EG (n=10)**	
1st measurement	41.52	37.84	0.09
2nd measurement	41.60	38.63	0.09
Mean	41.56	38.23	0.08

CG x EG	CG (n=10)	EG (n=10)	
1st measurement	36.86	37.84	0.66
2nd measurement	37.32	38.63	0.35
Mean	37.09	38.23	0.49

Legend: (*) – Significant values ($p<0.05$); **PG** = Professionals group; **CG** = Control group; **EG** = Experimental group; **mm** = millimeters; Tukey test.

Each procedure performed during the final evaluation was timed. Thus, Table 3 presents the means and standard deviations of the time, in minutes, that each group took to complete the marking of facial points, the first and second measurements.

Table 3 – Presentation of means and standard deviations of the times for achievement of measurements, in minutes

Aspect	PG (n=3)	CG (n=10)	EG (n=10)
	Mean± SD	Mean± SD	Mean± SD
Identification of points	0.83 ± 0.03	1.72 ± 0.46	1.96 ± 1.20
First measurement	2.52 ± 0.34	4.82 ± 1.50	5.24 ± 1.15
Second measurement	2.86 ± 0.09	4.45 ± 0.93	4.43 ± 1.04

Legend: PG = Professionals group; **CG** = Control group; **EG** = Experimental group; **SD** = standard deviation.

Concerning the time each group took to conclude the procedures, there was no significant difference between the results of control and experimental groups. However, comparison between students and professionals revealed differences for all procedures, evidencing that the professionals' experience allows faster achievement of measurements than the students. The times for each group and p value are presented in Table 4.

Table 4 – Comparison of times each group took to achieve the first and second measurements, in minutes, and p value.

Groups comparison	Time (minutes)		p value
PG x CG	**PG (n=3)**	**CG (n=10)**	
1st measurement	2.52	4.82	0.03*
2nd measurement	1.86	4.45	0.04*
PG x EG	**PG (n=3)**	**EG (n=10)**	
1st measurement	2.52	5.24	0.01*
2nd measurement	1.86	4.43	0.04*
CG x EG	**CG (n=10)**	**EG (n=10)**	
1st measurement	4.82	5.24	0.74
2nd measurement	4.45	4.43	0.99

Legend: (*) – Significant values ($p<0.05$); **PG** = Professionals group; **CG** = Control group; **EG** = Experimental group; Statistical test: Turkey.

DISCUSSION

The aim of this paper, which aimed at the insertion of simulation for teaching in anthropometric facial measurements, was not to replace the professor or traditional teaching methods, but to stimulate this extension, allowing the students to have an additional alternative for learning.

The interactive tutorial was explored in its several features, including animations, images, texts and video, which is suggested by several authors to enhance teaching (Baldasso et al., 2016; Lieberth & Martin, 2005; Zilma Silveira Nogueira Reis, Maria do Carmo Barros de Melo, Edison José Corrêa, Alamanda Kfoury Pereira, Dimitri Bassani dos Santos, 2016). The literature proposes the Microsoft Power Point software to create interactive tutorials (Henkel, 2010). However, to assure interactivity and a more sophisticated esthetics, this study employed the HTML5 language, which supports the latest multimedia content for video, audio and animation within the browser (Reimers & Stewart, 2015).

In speech-language therapy, objective and quantitative diagnostic methods are extremely relevant, thus the caliper is an important resource for facial evaluation (Cattoni, 2006; Cattoni et al., 2009). Patient positioning is also a determining factor at the time of assessment, since the body posture during measurement may alter the outcomes due to the relationship between the stomatognathic system and the cranio-cervical complex (Villanueva et al., 2004). Therefore, the selection of these subjects within the interactive tutorial is justified. An illustrated step-by-step was also provided to the EG regarding the use of the Invivo5® software for simulated training, providing basic instructions for the next step.

In the surveyed literature, no reports were found regarding the development of an interactive tutorial with subjects related to the teaching of Orofacial Motricity. In Speech-Language Therapy, there are tutorials for teaching in audiology (Yates & Campbell, 2005). Although not yet published, the application "Orofacial Anthropometric Measurements: measurement procedures" (Cattoni, 2006) aims to present the evaluation stages of orofacial anthropometric measurements by explanatory and practical videos. Though not described as a tutorial, the application seems to have very similar functions with the tool developed in this work.

The present study did not directly evaluate the effectiveness of the interactive tutorial; however, the students reported positive points with its utilization. The literature shows effectiveness in the use of interactive tutorials for teaching, allowing the construction of knowledge (Henkel, 2010; Kobak et al., 2011).

Many authors propose that anthropometric points should be previously marked on the skin, to increase the precision and accuracy during evaluation using a marker pen (Ramires et al., 2010), dermatographic pencil (Nascimento et al., 2013) or eye pencil (Sassi et al., 2015). This study used the latter because it is easier to remove from the skin and allows a thinner line, increasing the accuracy of the procedure. It should be mentioned that all students did not know this method.

Due to its number of features, studies have used the Invivo5® for different purposes, focusing on implantology (Alzoubi et al., 2016), volumetric airway assessment (Li et al., 2015), quantification of surgical access to the internal auditory canal and temporal bone measurements (Master et al., 2016). However, no reports were found in the surveyed literature regarding its application to measure orofacial anthropometric measurements or for simulated training. The literature shows that measurements on a three-dimensional face are much more realistic than on two-dimensional photographs, resembling a real evaluation (Ozsoy et al., 2009; Yitschaky et al., 2011). Thus, the paid license software Invivo5® met the criteria to be used as a simulator and was used in this study.

According to Moro et al. (2017)(Moro et al., 2017), the utilization of virtual devices, including augmented reality, allows learning by practical immersion experiences, corroborating the results of the present study, since the authors also demonstrated positive perspectives for the effective use of virtual and augmented reality as a means to supplement the content of lessons in Education in anatomy (Moro et al., 2017).

The literature states that good educational softwares should not only bring theoretical content, but also aim to provide practical experiences and application of theoretical basis for problem solving (Rondon et al., 2013). For this reason, this study aimed to associate theoretical concepts (interactive tutorial) and practice (traditional and simulated method). Studies have shown that simulation-based learning is equivalent to the traditional learning method (Lieberth & Martin, 2005; Rondon et al., 2013), which was also observed in the present study, since there was no statistically significant difference in the results achieved in the final evaluation between the experimental and control groups.

Considering that the actual value of the variable measured in this study is unknown, it was decided to employ a group of professionals experienced with facial analysis, who were carefully calibrated, since the experience is not enough to guarantee accuracy. More experienced professionals tended toward overconfidence interfering with the accuracy of the information from the clinical evaluation (Yang et al., 2012).

There was a difference between CG and PG in the lower lip measurement, which presented statistically significant difference (Tables 1 and 2). No reports of studies were found evaluating this measurement and reliability. The evaluations of inter- and intraexaminer orofacial measurements at two different times were considered homogeneous with Orofacial Motricity specialists, indicating that data achieved by different professionals can be considered reliable (Fernanda Veloso et al., 2008).

Concerning the time required to complete the final assessment (Tables 3 and 4), there was no statistically significant difference in the comparison between CG and EG, which demonstrates that, although students in the EG did not use the caliper and pencil, they did not present difficulties that would require more time handling these instruments. Professionals were faster than students to achieve the measurements, justified by their previous experience. However, analysis of the time of marking with the pencil revealed no significant difference between students and professionals, because the professionals were not used to this practice either. Studies report a period of 10 to 30 minutes for the completion of evaluation (Bossle et al., 2015; Fernanda Veloso et al., 2008). In the present study, in the average, students took 11 minutes to mark and achieve the measurements, while professionals spent an approximate average of minutes.

It should also be considered that the computer software used in this study has a paid license, thus not being accessible to everyone. Also, the Invivo5® tools used for simulated training correspond to a small portion of the amount of resources available in this software, and it is not financially viable to purchase it only for this purpose. Thus, future studies might consider the design of a specific open source software for orofacial anthropometric measurements, on three-dimensional faces, focusing on a simulated learning environment. In this sense, the importance of student training in the utilization of emerging technologies is highlighted, allowing future professionals to be familiar with the use of technologies in the work field (Ainslie & Bragdon, 2018).

Despite the positive findings in the present study, further research is still needed to confirm that learning by the use of simulators is comparable to traditional learning. In addition, in the field of Orofacial Motricity, additional studies are necessary to develop technological resources for teaching in this area, which is still scarcely addressed.

CONCLUSION

An interactive tutorial was developed, and the Invivo5® software was adapted as a technological tool and as a simulated learning environment using the computer for teaching in Orofacial Motricity, specifically regarding facial analysis training. The similar results of students trained by technology and those trained by traditional methods demonstrate the effectiveness of simulation in the learning process of facial anthropometric measurements.

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FIGURE LEGENDS

Figure 1 – Flowchart demonstrating the procedures of the study stages.

Figure 2 – Orofacial anthropometric points and measurements found in the literature.

Figure 3 – Demonstration of identification of orofacial anthropometric measurement “Middle facial third” using the option “Distance Measurement”

