Teaching-learning practices and methods for the elderly: support for pedagogical and accessibility guidelines

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Abstract—This research full paper presents an investigation on pedagogical practices and educational methods used by professionals who work in the teaching of the elderly. The study of the ageing process is one of the most significant research trends of the 21st century and represents new social, educational and computational challenges. Increased life expectancy and the number of elderly elevate the heterogeneity in the segment, beyond the age. This research focuses on education and mobile learning (m-learning) application. Considering the elderly audience, it is necessary to develop m-learning apps based on accessibility and pedagogical proposals, since the elderly may have their physical and cognitive abilities compromised due to age. Currently, there are consolidated accessibility guidelines for software development. However, these guidelines do not regard cognitive, language and learning disabilities. These points are necessary for the process of developing m-learning applications, especially those specific to the elderly user. Thus, this paper aims to present the results of a survey applied with 33 professionals (teachers, pedagogues, gerontologists and others) involved in the education of the elderly. Issues involving teaching practices for the elderly, content preparation, interactivity, and motivation are addressed. This study is part of a larger project aimed to contribute to the development of accessibility and pedagogical guidelines that aim to assist in the process of developing m-learning applications focused on the elderly.

Index Terms—teaching-learning, practices, methods, m-learning, elderly.

I. INTRODUCTION

The elderly person is so named "because of the differences they exhibit in appearance, strength, functionality, productivity and performance of primary social roles compared to non-elderly adults" [1]. The concept of the elderly is different from one country to another. Elderly people are those aged 60 or over in developing countries and in developed countries are those aged 65 and over [2]. However, there is no exact definition of the concept of the elderly, as it has different meanings for each society [3].

Currently, the number of elderly people grows daily. According to the United Nations Population Fund [3], there are about 15 countries with more than 10 million elderly people and seven of them are in development. By 2050, 33 countries are expected to have 10 million people aged 60 and over, including five countries with more than 50 million seniors. That is, this population is growing at a faster rate than the total population in almost all regions of the world.

This population growth makes countries to adapt and create new legislation for this audience, aiming to enable better rights for this population. One of these rights is that of education.

In this context, the concept of m-learning emerges as a new possibility for the teaching-learning process. According to Kraut [4], m-learning involves the use of mobile technology, alone or in combination with other Information and Communication Technologies (ICT), to allow learning anytime and anywhere. Learning can develop in different ways: using mobile devices to access educational resources, connect with others or create content, inside and outside the classroom. A mobile application is responsible for mediation between the device and the user. A mobile application, according to the Cambridge Dictionary[1], "is a software that operates on cell phones", but it can be extended to tablets, smartphones e Personal Digital Assistants (PDA).

The benefits of m-learning go beyond ease of access, convenience and communication. Mobile devices enable users to use applications, specific learning environments, access to *Web*, collaboration tools, social networks, *e-books*, etc. [5]. Therefore, it is necessary that these applications are developed to serve all types of audience, including the elderly.

The aging process can bring limitations to people, such as: cognition, vision, hearing, memory, information processing, language and communication, mobility, among others. Currently, there are consolidated accessibility guidelines (Web Content Accessibility Guideline - WCAG 2.1., for example) for software development and improve access for people with some kind of limitation. However, these guidelines do not regard cognitive, language and learning disabilities [6]. These points are necessary for the process of developing m-learning applications, especially those specific to the elderly user.

As part of more comprehensive research, this article aims to present the results of a survey applied to 33 professionals (teachers, pedagogues, gerontologists and others) involved in the education of the elderly. The main goal is to verify pedagogical practices and educational methods used by professionals who work in the teaching of the elderly. The answers obtained will compose the data related to the exploratory and descriptive phase of the method by Rusu et al. [7] and will contribute to the development of accessibility and pedagogical

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[1]http://dictionary.cambridge.org/

guidelines denominated M-Learning Guideline for the Elderly (MLGE) that aim to assist in the process of developing m-learning app focused on the elderly.

This remainder of this paper is organized as follows. Section II presents a background about the elderly, the education of this audience and accessibility guidelines. In Section III, the organization and development of the survey are presented. Section IV shows the main results of the survey. Section V presents the MLGE. Finally, Section VI summarizes our conclusions and perspectives for future work.

II. BACKGROUND

The individual's abilities to learn, remember, solve problems and have knowledge of the world are fundamental to his sense of identity and adaptability [8]. These abilities are dependent on the individual's quality of life. The quality of life can prolong the functional capacity of the elderly, in order to give greater independence and autonomy to that citizen [9].

One of the ways to enable a better quality of life for the elderly is to facilitate their access to education and enable their learning in face of their characteristics and needs. In this perspective, questions about continuing education and learning for the elderly are discussed in the following section.

A. Permanent education and elderly learning

Permanent education or continuing education are very common terms and have different meanings. The term can be characterized as adult education, in which a set of activities aim to train an individual after school, or an educational and pedagogical process that occurs throughout a person's life [1].

With a focus on aging, permanent education can be a possibility to serve and support the elderly, in order to assist them with their ability to reflect, to make decisions for themselves, aiming at independence and autonomy [10]. In the field of Gerontology, permanent education is given with the involvement of the elderly in educational initiatives aimed at expanding information (reading and writing, computer education, health, foreign languages), updating and cultural development (tourism, arts, philosophy and psychology), social appreciation (programs for living with the younger generations), living with other elderly people and developing citizenship [1].

Aiming to attend such aspects in the permanent education of the elderly population, it is necessary that their teaching and learning process be adapted to their needs and keep them always motivated in the face of educational challenges.

According to Lima [10] there are some reflections on the learning of the elderly:

- Build a curriculum and methodology that encourage the elderly to learn, uniting the will of these people with real possibilities of development.
- Enable the elderly to have access to ICTs, being closer to the available information, expanding their knowledge.
- Develop a specific pedagogy focused on the elderly, allowing greater autonomy and quality of life for the student.

- Motivate and awaken the creativity and imagination of the elderly, helping them to seek new solutions to problems
- Prepare teachers for new challenges, knowing how to deal with the conservative side of the elderly and, at the same time, with the new paradigm of aging, innovative attitudes that encourage questioning and boldness.
- Help the learner to trigger positive behaviors, acting as a facilitator of attitudes of reorganization and appreciation.
- Link education and health in the education of the elderly. Self-image and positive self-esteem reflect new knowledge and new possibilities.
- Respect and encourage the student with different critical approaches, the elderly should be seen as an apprentice and the chosen methodology must follow its rhythm.
- Transform the individual's social and historical reality based on dialogical and dialectical pedagogy.
- Search for ways to accelerate the educational process with a focus on citizenship of elderly students.

In order for the elderly to have a better quality of life, access to education and feel less impact of the aging process, it is necessary to find ways to incorporate them into society, change established concepts and use new technologies, with innovation and knowledge. The goal is to achieve fair and democratic equity in the distribution of services and facilities for the fastest growing population group in several countries [11].

Thus, it is necessary to consider the education of the elderly in the current context, in which the use of ICTs is increasing in the educational field. In fact, digital technologies can facilitate access to knowledge, as they create a generalized exchange of knowledge [12].

B. Accessibility guidelines

Guidelines (or set of recommendations) are essential in the context of Human-Computer Interaction (HCI). According to Rocha and Baranauskas [13], the guidelines constitute a framework that assists the designer in making consistent decisions, through the elements that make up the product, and should be understood and applied in a contextualized way. Guidelines correspond to the principles that guide the designer.

To ensure the accessibility of software and content from the Web, the World Wide Web Consortium created the Web Accessibility Initiative (WAI), which brings together individuals and organizations from around the world to develop strategies, guidelines, and resources that help making web accessible to people with disabilities or any type of limitation. A document proposed by this initiative was Web Content Accessibility Guidelines (WCAG). These guidelines address the accessibility of web content on desktops, laptops, tablets and mobile devices. Created in 1999, WCAG is in 2.1 version, updated in 2018. [6].

Considering the international standard, WCAG is organized as follows [6]:

- **Principles:** four principles that constitute the foundations to guarantee Web accessibility: perceptible, operable, understandable and robust.

- **Guidelines:** are below the principles. They comprise a total of 13 guidelines that provide the basic recommendations that authors must follow to produce more accessible content for users with different capabilities.
- **Success criteria:** for each guideline, testable success criteria are provided to allow the guidelines to be used where requirements and compliance tests are needed.
- **Sufficient and advisory techniques:** composed of a variety of techniques. The techniques are informative and fall into two categories: those that are of a sufficient type to satisfy the success criteria, and those that are of the advised type, that is, go beyond what is required in each of the criteria of success.

Despite being a consolidated guideline in the area of accessibility, WCAG 2.1. (and other guidelines derived from it) do not specifically address accessibility for the elderly. In addition, they do not address cognitive, language and learning issues [6]. Thus, the survey in the next section aims to verify which practices can be inserted in the construction of a guideline for m-learning apps, based on experiences and practices in the teaching of the elderly.

III. SURVEY DESIGN

According to Kitchenham and Pfleeger [14] a survey is a comprehensive research method that aims to collect information to describe, compare or explain knowledge, attitudes and behaviors, in addition to being a method widely used in academic research. This survey was based on the seven steps presented by Kasunic [15]:

1. Identify the research objectives;
2. Identify and characterize target audience
3. Design sampling plan;
4. Design and write questionnaire;
5. Pilot test questionnaire;
6. Distribute questionnaire;
7. Analyze results and write report.

In this way, the first step was to identify the objective, as follows:

Verify pedagogical practices and education methods used by professionals who work in the teaching of elderly people.

The target audience were professionals with experience in the education of the elderly (teachers, pedagogues, gerontologists and others). The intended results were:

1. List of pedagogical practices and methods of education for the elderly.
2. Overview of professionals in the area in relation to teaching-learning of elderly students.
3. Theories or approaches to teaching the elderly.

The questions were asked based on the pedagogical requirements of the *ReqML-Catalog* [16] and in a face-to-face interview with 6 pedagogues or teachers of the elderly. Following, the survey was evaluated by two specialists in Education and two specialists in Software Engineering. A pilot test was carried out with two participants and the final

questions followed according to Appendix A. In total, 42 people responded to the full survey. However, only 33 of them worked with the elderly, so only responses from people with experience were considered.

IV. RESULTS

A. Profile of the participants

The data presented here refer to the response of 33 respondents working in different areas involving the education of the elderly (gerontologists, teachers, pedagogues, psychologists, nursing, physiotherapy, among others). In order to obtain an educational profile of the participants, we asked their highest degree earned. Figure 1 shows that postgraduate (*Lato sensu*) degree represents the highest degree among most (48%) of the respondents, followed by Master's degree (19%), Doctorate's degreee (17%), Graduate's degree (9%) and Postdoctoral (7%).
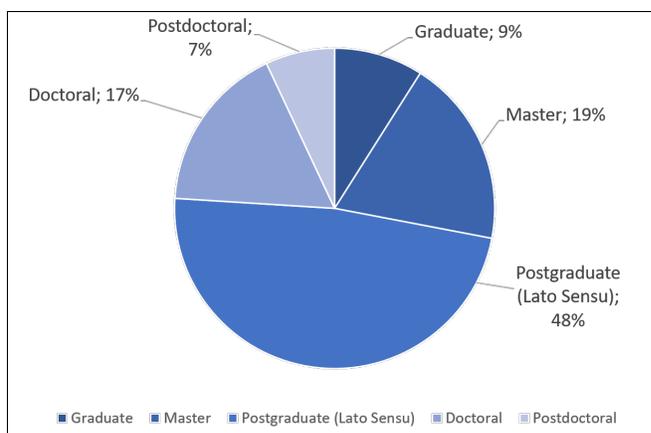

Fig. 1. Respondents' highest degree.

Regarding experience as an educator for the elderly, most have between 1 - 5 years of experience (36.3%), followed by less than one year (27.2%), more than 10 years (21.2%) and 5-10 years (15%) - Figure 2. The data shows that the participants have experience in the area.
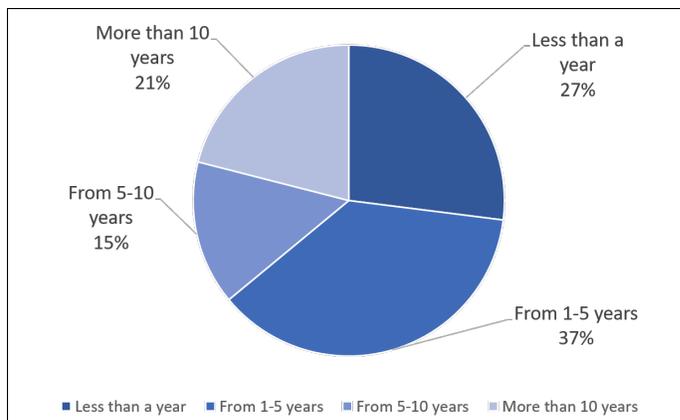

Fig. 2. Respondents' experience time.

B. Educational practices, methods and assessments

As for the content, we asked if it was prepared differently for elderly students. In total, 78% answered "Yes" (Figure 3).
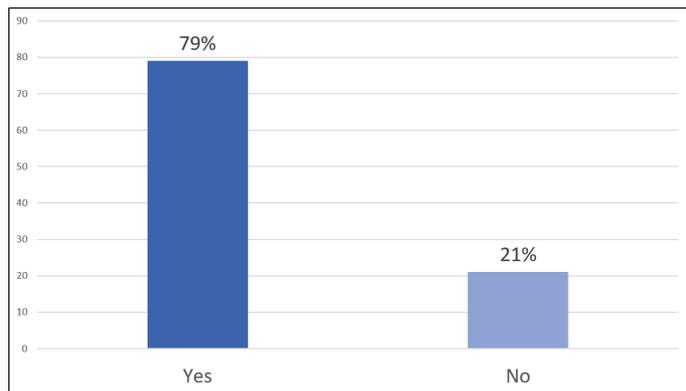

Fig. 3. Different content preparation for the elderly.

The differences mentioned in relation to content preparation are in the Table I. The main difference pointed out by the respondents was "Content bases on day-to-day concepts and experiences" (66.7%).

TABLE I
PREPARATION OF CONTENT USED BY RESPONDENTS

Differences content	Respondents
Content with more writing and reading activities	7
Content with less writing and reading activities	8
Content with more illustrations	15
Repeating contents	14
Objective content	10
Content based on day-to-day concepts and experiences	22

Other options were mentioned, such as:
- Practice applied inside and outside the classroom.
- Meaningful content and based on the student's experience.
- Active learning methodologies.
- Larger font size and illustrations.
- Avoid childish content.

Table II shows different teaching-learning techniques or methods used by the respondents. "Classes with group activities" are the most used with among 85% of professionals.

TABLE II
EDUCATIONAL TECHNIQUES AND METHODS USED BY RESPONDENTS

Educational techniques and methods	Respondents
Expositive classes	25
Theoretical classes	9
Practical classes	21
Dialogic classes	26
Classes with group activities	28

Other techniques and methods were cited by the respondents as follows:
- Mix the use of printed material.
- Classes with repetition.
- Offer individual help.
- Use digital technologies.
- Use of games.

Respondents presented their opinion on stimulating the interactivity of elderly students (Table III). Most of the respondents (88%) apply work in group.

TABLE III
INTERACTIVITY PROPOSALS USED BY RESPONDENTS

Encourage interactivity	Respondents
Group work or in pairs	29
Asking individually	19
Interdisciplinary activities	18
Activities carried out outside the classroom	12
Feedback through electronic forms or in writing	8

In addition to the options presented, respondents cited the following ways of working with interactivity among students:
- Collective activities with the class.
- Help among the students themselves.
- Automatic feedback on electronic forms.

The survey showed that most elderly education professionals use specific pedagogical practices in the classroom (Figure 4).
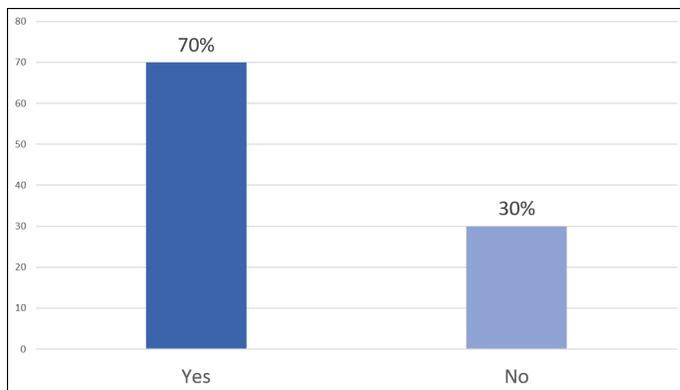

Fig. 4. Use of specific teaching practices.

The most widely used practice is "Valuing the knowledge that elderly students bring with them and the achievements acquired in their daily lives" (91%) - Table IV. In addition to the items presented, respondents also cited the use of music as a pedagogical practice.

According to the data, 85% of respondents makes an evaluation of the teaching-learning process (Figure 5).

Evaluations are performed, as shown in Table V. Most of them usually perform diagnostic evaluation (89%) to assess the students' teaching-learning process. Other evaluations were cited by professionals, such as: exercises to do at home and conversation and oral evaluation.

| Pedagogical practices	Respondents
Use texts and activities that encourage reading and writing	14
Use digital resources and technologies available at school	9
Promote student leadership through active methodologies	9
Valuing the knowledge that elderly students bring with them and the achievements achieved on a daily basis	21
Propose activities that generate interaction, collaboration and creation among students	19
Create strategies to reframe the notion of "error", which is necessary for the student's development process	15
Recognize and celebrate students' good attitudes and achievements	16
Promote interdisciplinary projects	12
Work on scientific projects with students based on topics of interest	4
Encourage the use games in learning	9
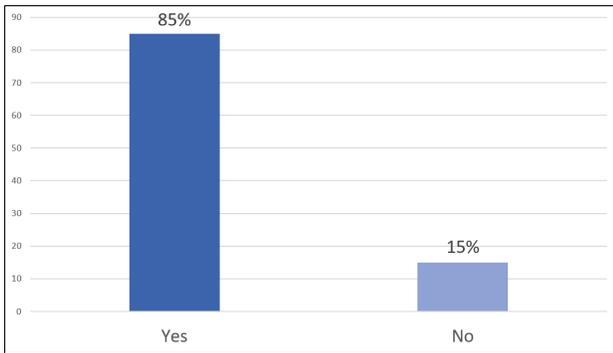
Fig. 5. Evaluation of the teaching and learning process.

Type of evaluation	Respondents
Summative (classificatory)	5
Formative (parent company)	18
Diagnostics (analytical)	25
Self-evaluation	13

C. Difficulties encountered in teaching the elderly

In addition to the questions presented, we verified the difficulties of students and teachers in relation to the content of the classes. The main difficulties presented by the respondents regarding the preparation of classes for the elderly are shown in the Table VI.

As for the main difficulties learned by students about to with concerning the monitoring of classes, are shown in Table VII. In addition to the difficulties presented, the respondents mentioned the students' lack of patience in learning.

Difficulties	Respondents
Manage time to teach topics	20
Check the follow-up of the sequence of the topics taught	6
Encourage everyone to participate in the classroom	16
Reinforce the content, with more examples	8
Associate the content presented to previous experiences	10
Use metaphors or mechanisms that are independent of the present	4
Make students remember the content covered above	23
Repeat the same topic many times	15

Difficulties	Respondents
Little time when topics are presented	11
Monitoring the sequence of the topics taught	6
Participation with everyone in the room	7
Understanding of the content	18
Lack of association between the content presented and their experience	13
Use of current metaphors or mechanisms	6
Little time for extra-class study	21
Difficulty memorizing the topics covered	23

D. Use of mobile devices in the classroom

Despite being professionals who deal with elderly students, most have already used a mobile device in the classroom. Opinions on the use of these devices were positive. We present some testemonials next:

> **Respondent A.** Some students are already well familiar with the use of mobile resources, use it to search for recipes, handicrafts and social networks.
> **Respondent B.** They are very fond of using these devices, because in many cases at home there is no person with the patience to teach them how to use and know all the applications, networks and devices.
> **Respondent C.** It was a super rich experience, because in addition to working on reading and writing, which is a permanent activity, the class learns to use the cell phone and the internet as a useful tool in the most varied situations of daily life, a world of possibility.
> **Respondent D.** It was a great experience, when done with supervision it is motivating, since many elderly people still do not use technological equipment, they have the desire to learn.

In addition, the survey verified whether these professionals believe that the use of mobile devices helps in the education of the elderly. Figure 6 shows that 97% of educators said "Yes".
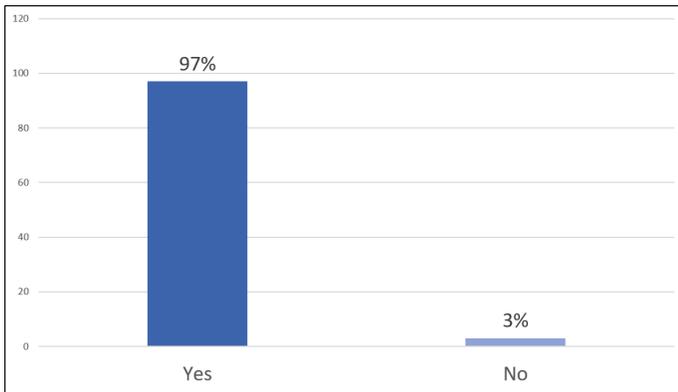
Fig. 6. Mobile devices in education.

From the survey data, an educational and accessibility guideline for m-learning applications will be developed. The next section briefly introduces the MLGE.

V. M-Learning Guidelines for the Elderly (MLGE)

MLGE[2] is a pedagogical and accessibility guideline focused on the elderly. It is under development and following the method of Rusu et al. [7] which consists of the following phases: exploration, description, correlation, explanation, validation and refinement. The survey presented in this paper was part of the exploratory phase. MLGE is organized as follows [13]:

- **Guideline:** Guideline name.
- **Description:** Brief description of the guideline.
- **Example:** Practical example of using the guideline.
- **Support:** Possible user limitations that the guideline attend.
- **Category:** Category based on requirements catalog [16].
- **Source:** Source from which this guideline was based.

The pedagogical guidelines were organized according to the study of *ReqML-Catalog* (Principles: Learning, Content and Interactivity). The data presented in the survey served as a basis for the construction of the pedagogical guidelines, together with data from a semi-structured interview.

For example, a topic mentioned a few times by respondents in the survey was repetition of content. Thus, a guideline called "Repetition of Content Presentation" was created, as follows:

- **Guideline:** Repeating Content Presentation.
- **Description:** The same content must be presented more than once in the application, using different media or not.
- **Example:** Text content can also be presented via audio or video. Or, it can be inserted again in the application in more than one activity, task, or page.
- **Support:** Memory; Information Processing.
- **Category:** Motivation, knowledge effectiveness.
- **Source:** Interview and questionnaire with specialists.

The accessibility guidelines were based on the Web Content Accessibility Guidelines (WCAG 2.1.) and are organized with

the following principles: Perceptible, operable, understandable and robust [6].

The main differences between WCAG 2.1. and MLGE accessibility guidelines are: structure and organization, focus on the elderly and on native m-learning app. Therefore, not all WCAG guidelines can be found in the MLGE or vice versa. The following is an example of an accessibility guideline.

- **Guideline:** Contrast.
- **Description:** The visual presentation of the text and text images must have a contrast ratio.
- **Example:** The application should have an option for the user to increase or decrease the contrast between the background and the content presented on the screen, according to their needs.
- **Support:** Vision.
- **Source:** Adapted from WCAG 2.1.

VI. Conclusions and Future Work

This paper presents an investigation on pedagogical practices and educational methods used by professionals who work in the teaching of the elderly. In total, there were 33 respondents working in different areas involving the education of the elderly (gerontologists, teachers, pedagogues, psychologists, nursing, physiotherapy, among others).

The data showed that most of these professionals prepare the content of their classes differently for the elderly, paying special attention to content based on day-to-day concepts and experiences. In addition, they seek to use group activities, dialogic and expository classes as the main educational techniques and methods. They seek to promote interactivity through group activities and generally use diagnostic evaluation with students.

Among the most used pedagogical practices are: "Valuing the knowledge that elderly students bring with them and the achievements achieved on a daily basis" and "propose activities that generate interaction, collaboration and creation among students".

Based on the survey data, it was possible to build the MLGE, a pedagogical and accessibility guideline for m-learning applications focused on the elderly. The next steps are to finalize the guidelines and carry out evaluations with specialists and software engineers.

As future work, we intend to conduct other surveys involving information technology and education of the elderly, as well as with a larger number of participants and elderly users.

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[2]Access Link: https://bit.ly/mlgeguideline

APPENDIX

A. Survey questionnaire

* Required

1. What's your name?

_____

2. How old are you?

_____

3. Which is your highest degree earned?*

○ Bachelor's degree
○ Postgraduate degree (*Lato Sensu*)
○ Master's degree
○ Doctoral degree
○ Postdoctoral
○ Other: _____

4. What is your background?*

_____

5. Do you work or have you worked as an elderly educator (over 60 years old)?*

○ Yes
○ No

6. How long have you been (or have worked) as an educator for the elderly (over 60 years old)?*

○ Less than a year
○ From 1 to 5 years
○ From 5 to 10 years
○ More than 10 years

7. The content of your classes is (or was) prepared differently for older students (over 60)?*

○ Yes
○ No

8. What are the differences in the preparation of this content? Select the options below.*

☐ Content with less writing and reading activities.
☐ Content with more illustrations.
☐ Content with fewer illustrations.
☐ Contents that are repeated.
☐ Objective content.
☐ Content based on day-to-day concepts and experiences.
☐ Other: _____

If you wish, justify your answer to the question?

_____

9. What teaching or learning techniques or methods do you seek to work in your classes with these elderly students (over 60 years old)?*

☐ Expositive classes.
☐ Theoretical classes.
☐ Practical classes.
☐ Dialogic classes.
☐ Objective content.
☐ Classes with group activities.
☐ Other: _____

If you wish, justify your answer to the question?

_____

10. How do you usually encourage interactivity between students-teachers, students-students and students-school (feedback, communication between students, collaboration and cooperation) with regard to the care of elderly students (over 60 years old)?*

☐ Group work or in pairs.
☐ Asking individually.
☐ Interdisciplinary activities.
☐ Activities carried out outside the classroom.
☐ Feedback through electronic forms or in writing.
☐ Other: _____

If you wish, justify your answer to the question?

_____

11. Do you use any specific pedagogical practice to motivate or engage these students more?*

○ Yes
○ No

12. Which one (s) do you prefer to adopt?*

☐ Use texts and activities that encourage reading and writing.
☐ Use digital resources and technologies available at school.
☐ Promote student leadership through active methodologies.
☐ Valuing the knowledge that elderly students bring with them and the achievements achieved on a daily basis.
☐ Propose activities that generate interaction, collaboration and creation among students.
☐ Create strategies to reframe the notion of "error", which is necessary for the student's development process.
☐ Recognize and celebrate students' good attitudes and achievements.
☐ Promote interdisciplinary projects.
☐ Work on scientific projects with students based on topics of interest.
☐ Encourage the use of games in learning.
☐ Other: _____

If you wish, justify your answer to the question?

_____

13. Do you usually carry out an evaluation of the teaching and learning process of your elderly students (over 60 years old)?*

○ Yes
○ No

14. What types of evaluation do you perform?*

☐ Summative (classificatory).
☐ Formative (parent company).
☐ Diagnostics (analytical).
☐ Self-evaluation.
☐ Other: _____

If you wish, justify your answer to the question?

_____

15. Which of the difficulties below do you face when preparing your classes when considering elderly students (over 60 years old)?*

☐ Manage time to teach topics.
☐ Check the follow-up of the sequence of the topics taught.
☐ Encourage everyone to participate in the classroom.
☐ Reinforce the content, with more examples.
☐ Associate the content presented to previous experiences.
☐ Use metaphors or mechanisms that are independent of the present.
☐ Make students remember the content covered above.
☐ Repeat the same topic many times.
☐ Other: _____

If you wish, justify your answer to the question?

_____

16. Which of the difficulties below do you believe your elderly student (s) (over 60 years old) face with regard to content monitoring and learning?*

☐ Little time when topics are presented.
☐ Monitoring the sequence of the topics taught.
☐ Participation with everyone in the room.
☐ Understanding of the content.
☐ Lack of association between the content presented and their experience.
☐ Use of current metaphors or mechanisms.
☐ Little time for extra-class study.
☐ Difficulty memorizing the topics covered.
☐ Other: _____

If you wish, justify your answer to the question?
_____

17. Do you use or have used mobile devices (cell phones, smartphones or tablets) in the classroom with your elderly students (over 60 years old)?*

○ Yes
○ No

18. How was your experience using mobile devices?*
_____

19. Do you believe that the use of mobile devices (cell phones, smartphones or tablets) for educational purposes, could assist in the teaching-learning process of elderly students (over 60 years old)?*

○ Yes
○ No

20. Why?*
_____

21. If you wish, leave new comments or information that you consider important:
_____
_____
_____

REFERENCES

[1] A. L. Neri, "Keywords in gerontology (portuguese)," 2005.

[2] C. Santos and S. Sidney, "Theoretical-philosophical conceptions about aging, old age, elderly and gerontogeriatric nursing (portuguese)," *Brazilian Journal of Nursing*, vol. 63, no. 6, 2010.

[3] H. UNFPA *et al.*, "Ageing in the twenty-first century: A celebration and a challenge," 2012.

[4] R. Kraut, *Policy guidelines for mobile learning*. UNESCO, 2013.

[5] N. F. Duarte Filho, "A contribution to the establishment of a reference architecture for mobile learning environments (portuguese)," Ph.D. dissertation, University of São Paulo, 2016.

[6] W3C. (2018) Web Content Accessibility Guidelines (WCAG) 2.1. [Online]. Available: https://www.w3.org/TR/WCAG21/

[7] C. Rusu, S. Roncagliolo, V. Rusu, and C. A. Collazos, "A methodology to establish usability heuristics," in *ACHI 2011*, 2011.

[8] S. K. Whitbourne, *Adult development and aging: Biopsychosocial perspectives*. John Wiley & Sons, 2008.

[9] A. L. Neri, "Contemporary paradigms about human development in psychology and sociology (portuguese)," *Development and aging: biological, psychological and sociological perspectives*, vol. 2, pp. 11–37, 2001.

[10] M. P. LIMA, "Educational gerontology: a specific pedagogy for the elderly (portuguese)," *A new concept of old age. São Paulo*, 2001.

[11] M. F. Lima-Costa and R. Veras, "Public health and aging (portuguese)," 2003.

[12] P. Levy, *Cyberculture (portuguese)*, 2010.

[13] H. V. Rocha and M. C. C. Baranauskas, *Design and evaluation of human-computer interfaces (portuguese)*. Unicamp, 2003.

[14] B. A. Kitchenham and S. L. Pfleeger, "Personal opinion surveys," in *Guide to advanced empirical software engineering*. Springer, 2008, pp. 63–92.

[15] M. Kasunic, "Designing an effective survey," Carnegie-Mellon Univ Pittsburgh PA Software Engineering Inst, Tech. Rep., 2005.

[16] G. W. Soad, M. L. Fioravanti, V. Falvo, A. Marcolino, N. F. Duarte Filho, and E. F. Barbosa, "Reqml-catalog: The road to a requirements catalog for mobile learning applications," in *2017 IEEE Frontiers in Education Conference (FIE)*. IEEE, 2017, pp. 1–9.