

# Catalog of pedagogical practices, theories and teaching procedures for the elderly: contributions to the development of m-learning guidelines

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**Abstract**—This research presents a catalog of pedagogical practices, theories/methods, and teaching procedures for the elderly. Aging is a natural part of life and is a process of progressive and differential degradation. The COVID-19 pandemic highlighted the urgency of care for the elderly public. During the lockdown period, this audience's use of digital technologies grew, especially mobile devices. Despite the increase in the use of these devices, we see that the apps have not been developed considering the particular characteristics of the elderly, since aging can bring challenges and changes related to physical, sensory, perceptual, or cognitive issues. In the context of m-learning apps, it becomes even more urgent to consider pedagogical and accessibility aspects for this audience through specific guidelines for this domain. However, to propose such a guideline, it is necessary to know to define the scope and understand the user's context. Focusing on this context, we could mention AGE Guidelines - a set of m-learning pedagogical and accessibility guidelines for the elderly. This paper aims to discuss some aspects of the experimental and description phases to develop such guidelines: the establishment of a catalog of pedagogical practices, theories/methods, and teaching procedures. To create this catalog, six interviews with teachers specialized in the education of the elderly were carried out. Based on Bardin's method, the interviews were recorded and transcribed for later analysis. As a contribution, we expect that the presented catalog will help construct new educational artifacts, including pedagogical practices, theories/methods, and teaching procedures that effectively enable the teaching and learning process of the elderly in practice.

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

## I. INTRODUCTION

The world is facing a longevity and aging revolution. According to World Population Prospects [1], one in six people worldwide will be over 60 in 2050, compared to one in 11 in 2019. The increase in the elderly population was also confirmed by the World Health Organization (WHO), which stated that the proportion of people aged 60 and over will reach 2 billion in 2050 [2]. Likewise, life expectancy changes. In the past, the chance of survival for people over 60 years old was less than 50%, and currently, this number represents 90% in countries with a higher life expectancy [1].

These changes have impacts on different social levels [3]. In March 2020, the COVID-19 pandemic was decreed by the World Health Organization (WHO). From the beginning,

studies showed that people over 60 were the most vulnerable to the disease. The pandemic forced governments to adopt drastic and immediate public health measures to minimize the impacts of the disease. The moment showed that issues related to longevity and life expectancy are even more urgent.

In this period, digital technologies became great allies of the elderly population since social isolation proved to be effective in controlling the disease. With periods of lockdown, despite not replacing physical and face-to-face interactions, social interactions became increasingly scarce. The use of technologies enabled online connections that minimized elderly individuals' loneliness, providing them with more care and attention in the moment of crisis [4].

This fact also caused the use of smartphones to increase. According to the report presented by the company App Annie<sup>1</sup>, Brazilians spent 35% more time using their smartphone in the first four months of 2021 than compared the same period in 2019. Regarding the educational area, emergency remote<sup>2</sup> teaching has boosted the development of mobile learning (m-learning) apps with increasingly integrated and complete solutions.

M-learning involves the use of mobile technology, alone or in combination with other Information and Communication Technologies (ICTs), to enable learning anytime and anywhere [5]. It presents flexibility and adaptation that have made it possible to democratize access to education. Considering the elderly audience, it is increasingly necessary to develop m-learning apps that are accessible and based on pedagogical proposals since the elderly can have their physical, mental, and learning abilities compromised by age [6].

There is a document that aims to assist in the process of developing computer systems by prescribing a set of accessibility guidelines. The Web Content Accessibility Guidelines (WCAG), for example, is an international standard that covers a wide set of recommendations that aim to make web content more accessible [7]. Although these guidelines are used worldwide and cover recommendations that serve different types of users, they still have limitations regarding language and

<sup>1</sup>Report - App Annie (<https://bit.ly/relatorio-usosmatphones>)

<sup>2</sup>Emergency Remote - Porvir (<https://bit.ly/porvir-ensinoremoto>)

learning, as well as elements that address cognitive user issues [7]. In addition, they are not specific to m-learning apps or elderly users and may lead to gaps in systems in this domain.

Therefore, a set of pedagogical and accessibility guidelines that support the development of m-learning apps was established, entitled *Mobile Learning Pedagogical & Accessibility Guidelines for the Elderly (AGE)*. To specify the proposed guidelines, we followed the methodological structure defined by Quiñones *et al.* [8], which has the following phases: exploratory, experimental, descriptive, correlation, selection, specification, validation, and refinement.

This paper aims to discuss some aspects of the experimental and description phases for the development of such guidelines: the establishment of a catalog of pedagogical practices, theories/methods, and teaching procedures. To create this catalog, six interviews with teachers specialized in the education of the elderly were carried out. It is important to point out that the target audience of this research is those aged 60 years or older, following the Brazilian classification for elderly people.

The organization of this paper is as follows. Section II presents related work in the context of guidelines. Section III summarizes the methodology used to build the catalog presented in this study. Section IV shows the main results of the research, emphasizing the development of a set of pedagogical and accessibility guidelines. Finally, Section V outlines our conclusions and perspectives for future work.

## II. RELATED WORK

Three relevant documents that promote usability and accessibility in mobile web or native applications are available: Mobile Web Best Practice (MWBP), Mobile Web Application Best Practice (MWABP), and Material Design (MD).

The first one, Mobile Web Best Practice, specifies best practices for delivering web content to mobile devices. Such recommendations refer to the content provided by the application [9]. The second is the Mobile Web Application Best Practice (MWABP) sets out recommendations designed to facilitate the development and delivery of web applications on mobile devices [10]. Recommendations are offered to creators and maintainers of mobile sites, organized by title, what they mean, how to do it or implement it, and the features needed. The third is the Material Design (MD), an adaptable system of guidelines, components, and tools supporting the best user interface design practices. Its goal is to streamline collaboration between designers and developers and help teams create usable products (usability), in addition to focusing on Android applications and devices [11].

In addition to the documents presented, some research has considered developing guidelines for mobile applications. The book by Nielsen [12], for example, features an illustrated usability guide covering topics such as mobile development strategies, small-screen design, mobile writing, usability comparisons, and new perspectives for the future. It is a book that is based on international studies and expert opinions, and, although it does not focus specifically on accessibility or is a

*de facto* guideline, it addresses crucial issues in the area of mobile app development.

Still, in terms of usability, Inostroza and Rusu [13] carried out a mapping on design guidelines for touch-sensitive mobile devices. The research presents a set of 12 usability heuristics specific to this domain, with technical and design issues. Within a more general view, Nicastro *et al.* [14] revisited the existing interface design strategies and proposed a set of guidelines composed of 27 rules (guidelines) distributed among physical, empirical, syntactic, semantic, pragmatic world and social world. These researches minimally address methods and aspects related to the development of guidelines but mainly focus on usability and technical and design details.

Specifically for accessibility, Schefer *et al.* [15] proposed a set of guidelines called MobiDeaf. These guidelines support the construction of mobile social networking applications for deaf users, and their development considers user experience and technical issues. The guidelines were proposed based on case studies and the 3C model (Communication, Cooperation, and Coordination), in addition to following the methodology of Rusu *et al.* [16].

In another context, with a focus on accessibility, Moura [17] proposed a set of guidelines for games on mobile devices. As a methodology, they investigated other guidelines and analyzed the data using the content analysis method. In addition, they followed the WCAG framework and performed expert and user evaluations.

Moving on to the mobile educational applications domain, we can highlight some relevant research. Debevc *et al.* [18] check the accessibility of an educational application, considering Human-Computer Interaction (HCI) factors. The authors present a set of WCAG guidelines organized by the audience of users with disabilities that each guideline seeks to assist. In addition, it highlights some guidelines that can be used for the development of mobile educational applications, based on a literature review, considering technical and design aspects.

The research by Arrigo *et al.* [19] addresses accessibility issues in mobile educational applications for people with disabilities through the development of the online environment called AMobiLe. The application was developed based on “design for all” and WCAG accessibility guidelines.

In a more current perspective, Nacheva *et al.* [20] presents an accessibility assessment approach for mobile educational applications, focusing on people with disabilities and the elderly. The proposal aims to help improve the speed of cognitive operations, information selection, and decision making and optimize the memorization system. Despite focusing closer on the present research, their results aimed at developing intelligent educational systems (Smart Education Development), objective accessibility evaluation criteria and do not suggest pedagogical practices focused on the elderly user or the construction and structuring of guidelines for this audience.

Although these researches and documents are of great importance to promote usability and accessibility to computer systems, there is still a gap in terms of guidelines specific to the elderly public, and that meet their learning needs. After

all, for the elderly to have a better quality of life, access to education, and feel a reduction in the impact related to the aging process, it is necessary to find ways to incorporate them into society, change concepts already established and use new technologies, with innovation and wisdom, in order to achieve equity in the distribution of services and facilities for the fastest growing population group in our country [21], [22].

### III. METHODOLOGY

This article aims to present one of the steps to build AGE 1.2 guidelines. These guidelines were developed from the method of Quiñones *et al.* [8]. To reach its final version, it went through several phases, evaluations, and redesign, integrating several versions of *Mobile Learning Pedagogical and Accessibility Guidelines*, which are namely: MLGE 1.0, AGE 1.1. and AGE 1.2.

We also aim to deliver a catalog with pedagogical practices, theories, and teaching and learning methods for the elderly, referring to the experimental and descriptive phases of Quiñones *et al.* [8]. The catalog was established based on interviews carried out with Brazilian teachers in *Youth and Adult Education*. In addition, a survey was developed with 33 more participants, focusing on other professionals in the field of education [23] - Figure 1.

According to Quiñones *et al.* [8], the experimental phase aims to perform the analysis of data obtained through different experiments to collect additional information. In addition, in this study, the descriptive phase was characterized by categorization and coding. In other words, the results obtained in the experimental phase were structured and highlighted in order to select the most important data for the study and formalize the main concepts associated with the research [8].

In order to identify pedagogical practices, procedures and teaching theories/methods that are actually used in the context of the education of the elderly, semi-structured interviews (A) were carried out with working professionals, such as teachers in *Youth and Adult Education* - course offered to young people and adults who did not have the opportunity to start or complete elementary or secondary education at the appropriate age in Brazil [24]. In this exploratory phase, six participants shared their professional experience throughout the interviews, which were recorded and transcribed in their entirety. Table I presents the main characteristics of the respondents.

After the interviews were carried out and transcribed, the descriptive phase began. In this step, it is necessary to separate or group the main points and select and prioritize the most important information [8]. We adopted the content analysis method of Bardin [25].

#### A. Content analysis

Content analysis can be defined as a set of communication analysis techniques that, through systematic and objective content description procedures, allow the deduction of knowledge related to a given context [25]. This technique is based on

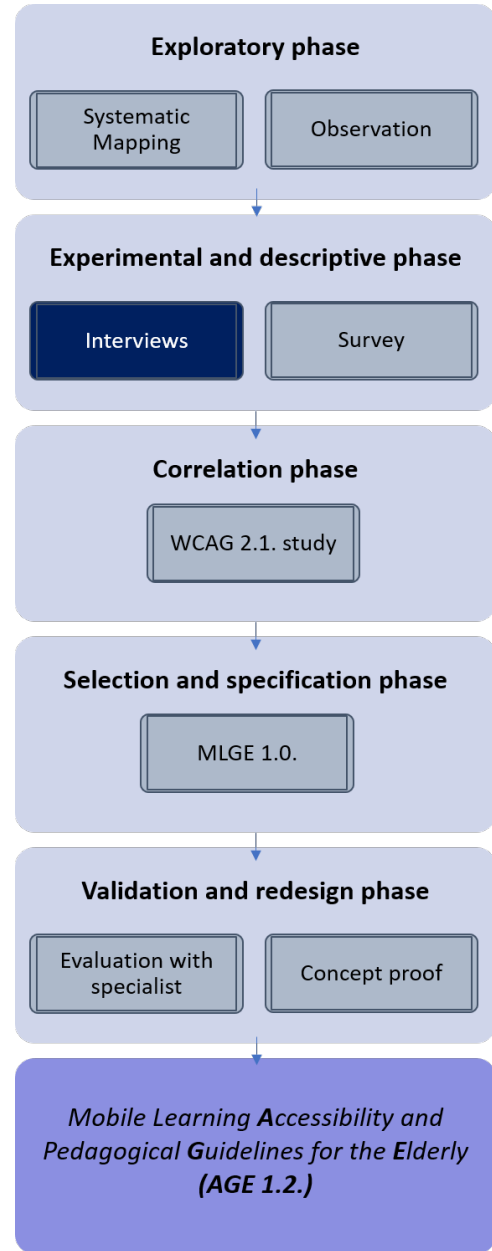


Fig. 1. AGE 1.2 set creation phases - Adapted from Quiñones *et al.* [8]

three main points: (i) organization (pre-analysis); (ii) coding (material exploration); (iii) categorization.

The **organization (pre-analysis)** stage consists of organizing the documents, formulating the hypothesis or objective and preparing the indicators that will support the final interpretation. At this stage, the first step was to organize the interviews into text files and perform a general reading of what was captured.

Thus, a research question was defined that guided the coding and categorization steps: *What pedagogical practices, procedures and teaching theories/methods are considered in the teaching and learning process of the elderly?*

In addition, it was necessary to verify the type of research

TABLE I  
CHARACTERISTICS OF THE RESPONDENTS.

ID	Age	Highest degree	Course	Time experience
P1	63	Graduated	Mathematics and Pedagogy	Could not inform
P2	66	Graduated	Magisterium	12 years
P3	48	Master Degree	Biological Sciences	18 years
P4	35	Graduated	Mathematics and Pedagogy	5 years
P5	31	Graduated	Pedagogy	1 years
P6	35	Graduated	Magisterium	4 years

that would be carried out, following the classification of deductive or inductive. Deductive research is a method that starts from a general concept to more specific points. On the other hand, inductive research starts from something specific to generalize [26]. The present research used the deductive method, since a previous bibliographic research was carried out in order to theoretically support the concepts related to pedagogical practices, teaching theory/method and teaching procedures. In addition, two PhD researchers in the field of Education were consulted in relation to the defined concepts.

The next step in content analysis is **coding (material exploration)**. This step takes place when the raw data are systematically transformed and, through clipping, aggregation and enumeration, it allows for a representation of the content.

To start this step, the registration and context units were chosen. The registration unit corresponds to the content segment that will be considered as the base unit, that is, that will give meaning to the encoding. The context unit serves as a support for the record unit, facilitating its understanding as a whole [25]. In this case, the units were organized as follows:

noitemsep,nolistsep

- **Register Unit** → practices, procedures and methods/theories identified.
- **Context Unit** → line number where the registration unit is located.

To facilitate this process, a subtitling procedure was used for coding based on colors (green, purple, orange and yellow), as follows: pedagogical practices (green color), teaching theory/methods (purple color), teaching procedures (orange color), teaching practices and procedures (yellow color). Thus, whenever an interviewee mentioned something related to pedagogical practices in his speech, for example, the passage was highlighted in orange. This caption was modified as necessary, based on the reading and identification of terms in the interviews.

In order to avoid any interpretation problems during the coding stage, the research terms were conceptualized, exemplified and analyzed by three researchers in the area of Informatics in Education who carried out the validation of the selected elements and participated throughout the process, discussing the main doubts about ratings. The terms used were defined as follows:

- **Pedagogical practices (PP)** → They aim to guarantee the teaching of contents and activities considered

fundamental for the formation of the student, starting with the planning and systematization of the dynamics of the learning processes, passing through processes that go beyond learning. In this way, the teacher must know how to structure these practices based on different sources and incorporate them into their teaching process [27]. Examples of practices: use of technologies in the classroom, repetition of concepts in activities, contents integrated with different disciplines, among others.

- **Theory/teaching method (TM)** → They are represented by philosophical and psychological conceptions that seek to explain the ends and means of education, based on a set of ideas and concepts, organized in a logical and coherent way [28]. Examples of theories/methods: Freirian theory, expository method, traditional school, and others.
- **Teaching Procedures (TP)** → They are given by the action and fulfillment of the methods, that is, the operationalization of the methods [29]. Examples of procedures: I work with the class in groups, I make the students fill in the blanks, I write on the blackboard and then they copy, among others.

Finally, in the **categorization stage (treatment of results, inference and interpretation)** of the [25] content analysis, the codes were taken from the interviews and gathered into groups of coded elements, being regrouped and analyzed. The Table II presents an example of this step, organized by the codes taken from the interview, the line in which the codes were taken and the code exemplified after the analysis.

#### IV. RESULTS

With the concepts previously defined and, from the organization presented above, the coded data were systematized and structured in a general catalog with the pedagogical practices (PP), theories/methods (TM) and teaching procedures (TP) used by the interviewed teachers (Table III). The catalog was organized with a number of identifiers for each of the coded data, organized by their category. In addition, it presented the final code from the analysis. In total, 16 codes were available in the pedagogical practices (PP) category, 5 codes in teaching theories and methods (TM) and 14 codes in the teaching procedures (TP) category.

The data obtained were of great importance for the elaboration of the first version of the pedagogical and accessibility guidelines for m-learning apps - MLGE 1.0. Each item in the interview catalog was adjusted and its text transformed

TABLE II  
EXAMPLES OF CATEGORIES OF PEDAGOGICAL PRACTICES.

Category	Code Taken from Interview	Lines	Simplified Code
Pedagogical practice	<i>“Always repeat, repeat, repeat”</i>	165	Promote the repetition of certain concepts and contents
Teaching method/theory	<i>“They come with this traditional school thing a lot”</i>	1.119 - 1.120	Traditional classes.
Teaching procedure	<i>“I bring extra activities or take a book”</i>	24 - 25	Extra activities / Use of books and handouts

TABLE III  
CATALOG OF PEDAGOGICAL PRACTICES, TEACHING METHODS AND THEORIES, AND TEACHING PROCEDURES.

Identifier	Code
PP-01	Use of digital technologies in the classroom
PP-02	Use of image and audio for learning
PP-03	Search for news
PP-04	Proposal of traditional classes
PP-05	Application of differentiated and creative activities
PP-06	Promote the repetition of certain concepts and contents
PP-07	Activities with games
PP-08	Content interdisciplinary
PP-09	Address topics known to students (according to their experience)
PP-10	Content adaptation
PP-11	Content contextualization
PP-12	Interactive groups
PP-13	Use of small, simplified texts
PP-14	Use of written language
PP-15	Spontaneous writing
PP-16	Day-to-day problem solving
TM-01	Lectures
TM-02	Paulo Freire method
TM-03	Dialogic classes
TM-04	Diagnostic evaluation
TM-05	Traditional classes
TP-01	Extra activities
TP-02	External resources and materials
TP-03	Student follow-up
TP-04	Text interpretation
TP-05	Writing text on the blackboard
TP-06	Literacy activities
TP-07	Correct activities and students when necessary
TP-08	Praise students to encourage their learning
TP-09	Knowledge about the student
TP-10	Adaptation of activities
TP-11	Merge activities and class styles
TP-12	Conversations and exchange of experiences
TP-13	Group information sharing
TP-14	Continuous student assessment

into a guideline. The items of the questionnaire were analyzed and those complementary to the interviews were considered, as well as comments or suggestions from the participants. For example, one topic mentioned a few times by survey respondents was content repetition. Thus, a directive called “Replay content over and over again” was created, as shown in IV. This first version of the set of pedagogical and accessibility guidelines underwent new evaluations and analyses and was adjusted to a final and more complete version, called **AGE 1.2.**

TABLE IV  
EXAMPLE OF GUIDELINE - MLGE 1.0.

Learning Principle
<b>Guideline 1.1:</b> Replay content over and over again. <b>Description:</b> The same content must be presented more than once in the application, in different media or not. <b>Example:</b> Text content can also be presented by audio or video. Or, it can be re-entered into the app on more than one activity, task, or page. <b>Support:</b> Memory; Processing information. <b>Category:</b> Motivation; knowledge effectiveness. <b>Source:</b> Interview and research with experts [23].

#### A. AGE 1.2. Guidelines

AGE 1.2. is organized as follows: (i) Introduction; (ii) Layers of Guidance; (iii) Compliance; (iv) AGE. AGE 1.2 is composed of 13 guidelines and 30 success criteria, divided into principles: operable, understandable, robust and perceptible. The guidelines access link is: <https://camiladiasoliveira.github.io/age-pt/>. Figure 2 presents an overview of AGE guidelines.

In this section, the use of the guideline in practice will be discussed, considering the first guideline of AGE 1.2. set, *Guideline 1.1. Comfortable aesthetic content* - Table V.

TABLE V  
AGE 1.2. - GUIDELINE 1.1.

<b>Principle:</b> Perceptible <b>Guideline 1.1. Comfortable aesthetic content</b> <b>Description:</b> Propose themes or subjects that make the user feel comfortable and calm in order to later advance their knowledge. <b>Limitations it supports:</b> Language and Communication; Information Processing. <b>Source:</b> Survey [23] and Interviews.
<b>Success criteria (SC) 1.1.1. Objectivity and ease (Level A):</b> The initial content must be objective, without approaching complex themes and outside the reality of the user. <b>Example: Basic activities that fit into the student’s daily context.</b> <i>An exercise should start with basic questions that are part of the user’s daily context (e.g. a math problem involving a grocery bill, a bank payment or involving day-to-day experiences).</i>
<b>Success criteria (SC) 1.1.2. Advancement of knowledge (Level AA):</b> The content covered must remain at the same level of difficulty, until the user feels comfortable learning about new subjects. <b>Example: Activities with evidenced percentage of correct answers.</b> <i>The student performed several activities and for him to advance in the content, it is necessary to have a percentage of correct answers, demonstrating knowledge and naturalness in relation to the subject.</i>

Principles	Guidelines	Level A	Level AA	Level AAA
1. Perceptible	1.1. Comfortable aesthetic content	1.1.1. [1]	1.1.2. [1]	
	1.2. Information Architecture (mini-AI)	1.2.1..1.2.2..1.2.3. [3]		
	1.3. External Resources and Materials			1.3.1. [1]
	1.4. <i>Feedback and appreciation</i>	1.4.1..1.4.2..1.4.3. [3]		
2. Operable	2.1. Diagnostic evaluation		2.1.1..2.1.2. [2]	
	2.2. Learning level monitoring	2.2.1. [1]	2.2.2. [1]	
	2.3. Different difficulty levels	2.3.1. [1]	2.3.2. [1]	
	2.4. Literacy	2.4.1. [1]	2.4.2. [1]	
3. Understandable	3.1. Content Repetition	3.1.1..3.1.2. [2]	3.1.3. [1]	
	3.2. Comprehension activities			3.2.1. [1]
	3.3. User profile	3.3.1. [1]	3.3.2. [1]	
	3.4. Pedagogical practices	3.4.1..3.4.2. [2]	3.4.3. [1]	3.4.4. [1]
4. Robust	4.1. Collaboration and interaction	4.1.1. [1]	4.1.2. [1]	4.1.3. [1]
	<b>Total:</b>	<b>16</b>	<b>10</b>	<b>4</b>

Fig. 2. Overview - AGE 1.2

*Guideline 1.1. Comfortable aesthetic content* includes a description, limitations it supports and the source, as mentioned earlier. To have it considered in the development of mobile educational applications, it is necessary to meet the success criteria it contains and verify its compliance levels, that is, which criteria are paramount. In addition, there needs to be an interpretation of these criteria so that they can be implemented in a practical way and make sense in the context of the application being built.

Figure 3 shows two different scenarios: (a) how to apply; and (b) how to not to apply the *Success criteria 1.1.1. Objectivity and ease (Level A)*. In the first figure (3. a) a simple mathematical problem is presented, with items that can be easily identified by the student (television and clock), thus being in accordance with the description of the guideline. In addition, the exercise brings a summing activity that fits into different contexts of people's daily lives, whether when buying goods, going to the supermarket, paying a bill, checking a recipe, among other practices. Figure 3.(b) brings a more complex activity that requires prior knowledge of the student. Note that this example may be applicable in some cases, but as an initial activity it would not be suitable. In addition, reading functions is not something trivial or commonplace, so this activity depends on more study time.

It is worth noting that *Success criteria 1.1.1. Objectivity and ease* has level A, that is, it is necessary that this criterion be considered during the application development process, as it is the minimum level of compliance. The *Success criteria 1.1.2. Advancement of knowledge*, present in the same *Guideline 1.1.*

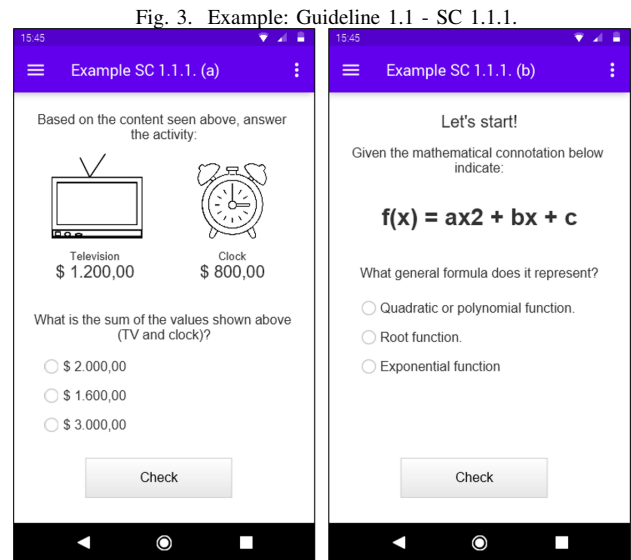


Fig. 3. Example: Guideline 1.1 - SC 1.1.1.

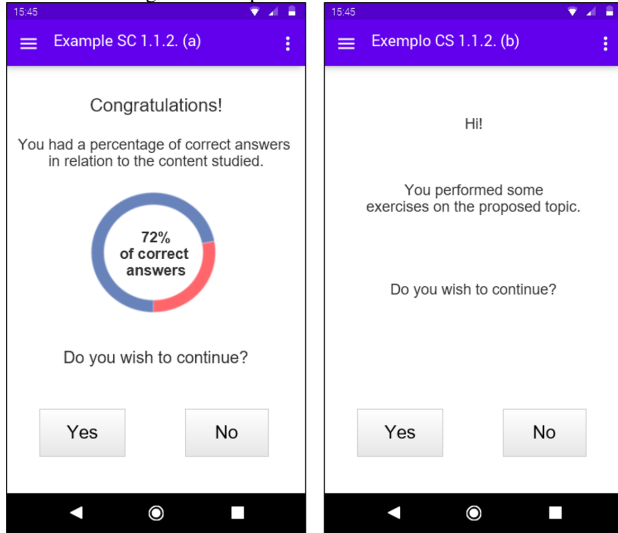
*Comfortable aesthetic content*, is at AA level, meaning that the mobile educational application must first meet the first level (A) to later meet the level of this success criterion (AA).

Figure 4 presents an example that (a) applies and (b) does not apply in this case of advancement of knowledge. In the first image, we can see a percentage of correct answers given by the student, indicating that from this percentage it is possible to advance in studies. In this case, the next activities should be of a higher level of difficulty, until the senior can feel familiar with the new topic and move forward again. The second



image (b) shows a screen without much information about the student's progress in the application. In this way, the person cannot know if they are evolving and may be carrying out activities without actually understanding the scenario/content presented.

Fig. 4. Example: Guideline 1.1 - SC 1.1.2.



In order to exemplify the use of AGE 1.2. guideline set, only two examples were discussed. However, this same idea can be applied to the other guidelines, not only to be used for the construction of prototypes, but throughout the development process (analysis, coding, testing, etc).

Also, it is worth mentioning that some examples of the set of pedagogical and accessibility guidelines were defined based on formal education criteria (covering mathematics, Portuguese, and so on). However, the guidelines are not specifically aimed at this type of content, and may be applicable to informal education that addresses topics of cooking, agriculture, sewing and other subjects of interest to the elderly.

The catalog of pedagogical practices, theories, teaching and learning methods for the elderly enabled the development of pedagogical and accessibility guidelines.

## V. CONCLUSIONS AND FUTURE WORK

This paper aimed to discuss some aspects of the experimental and description phases for the development of AGE guidelines. To this, we established a catalog of pedagogical practices, theories/methods, and teaching procedures. To create this catalog, six interviews with teachers specialized in the education of the elderly were carried out.

The interviews were recorded and transcribed for later analysis based on Bardin's method. The research question that guided the data extraction step was the following: What pedagogical practices, procedures, and teaching theories/methods are considered in the teaching and learning process of the elderly? To answer the research question, we analyzed and summarized the data gathered from the interview, which was presented in this article as a pedagogical practices catalog.

In short, two artifacts were presented: (i) a catalog with 16 pedagogical practices, 5 theories and teaching methods, and 14 teaching procedures most used by teachers who work with the elderly public; and (ii) the final result of the construction of AGE Guidelines, describing how the interviews effectively helped in their development and how the catalog was used as an input.

As a contribution, we can highlight that the presented catalog will help in the design, construction and validation of new educational artifacts, including pedagogical practices, theories/methods, and teaching procedures that indeed contribute to the teaching and learning process of the elderly in a real-world scenario.

It is important to emphasize that this exploratory phase with professionals in the education of the elderly was extremely important for the process of developing AGE Guidelines. AGE Guidelines were developed considering the whole process of developing m-learning applications and can be used by programmers, designers, evaluators, and other computing professionals. However, we acknowledge that the sample size may be a threat to the validity of the result.

Thus, as future work, new studies will be considered to evaluate the set of guidelines (AGE 1.2.), such as: user testing, proof of concepts, experiments with developers and seniors, among others. We also intend to regularly conduct new interviews to keep catalog updated, so it can contribute to the update of AGE 1.2 and also to the proposal of a new set of heuristics and other artifacts for the development of m-learning apps.

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## APPENDIX

### Interview Questionnaire

\* Required

1. What's your name? \_\_\_\_\_
2. How old are you? \_\_\_\_\_
3. Which is your highest degree earned? \_\_\_\_\_
4. What is your background? \* \_\_\_\_\_
5. In which city(ies) do you work as a teacher? \_\_\_\_\_
6. How long have you worked as a teacher in Youth and Adult Education classes? \_\_\_\_\_
7. Do you work with elementary school, high school, or both classrooms (contents)? \_\_\_\_\_
8. How many elderly students do you have in your classroom on average? (Try to capture the percentage inside the classroom). \_\_\_\_\_
9. Is the content of your classes differently prepared to include older students? \_\_\_\_\_

- Yes
- No

10. If yes to the previous question, what are the differences in relation to the preparation of this content? (Examples: more illustration, more repetition, more writing, among others.). \_\_\_\_\_

11. What teaching and learning techniques or methods do you seek to work in your classes with these elderly students? (Examples: lectures, theoretical, practical, among others.). \_\_\_\_\_

12. How do you usually work/encourage interactivity between student-teachers, student-students and student-school feedback, communication between students or collaboration) regarding the care of older students? (Examples: group or pair work, asking individually, interdisciplinary activities, among others). \_\_\_\_\_

13. Do you use any specific pedagogical practices to motivate or engage these elderly students more?

- Yes
- No

14. If yes to the previous question, which one(s) do you prefer to adopt? (Examples: monitoring of students with learning difficulties, resolution and/or discussion of day-to-day problem situations, socialization, collaborative learning, among others). \_\_\_\_\_

15. How do you usually carry out the evaluation of the teaching and learning process of your elderly students? (Examples: traditional assessments, group assessments, using ICT, among others). \_\_\_\_\_

16. What difficulties do you face when preparing/teaching your classes when considering elderly students? (Example: time management to teach the topics, encourage everyone to participate, reinforce the content with more examples, among others). \_\_\_\_\_

17. What difficulties do you believe your elderly student(s) face when it comes to monitoring content and learning? (Example: time topics are taught, participation and socialization with everyone, understanding of content, and others). \_\_\_\_\_

18. Do you use or have you used mobile devices (smartphones or tablets) in the classroom with your elderly students?

- Yes
- No

19. If yes to the previous question, how was that experience? \_\_\_\_\_

– If you wish, you can leave new comments or information that you think is important: \_\_\_\_\_

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