

# Expert-based Assessment of an Augmentative and Alternative Communication Tool

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## ABSTRACT

Nowadays, current technology provides new challenges to improve skills on people with special necessities. In fact, persons with communications needs can take advantage of new devices and mobile applications to interact and communicate easily and in the most straightforward way. In this paper, we present Easy Communicator application (ECO), an Augmentative and Alternative Communication (AAC) tool that facilitates functional communication to people with complex communication needs. ECO provides a user interface intended for both final users and experts/educators, allowing to configure the most important options for a suitable communication session. This system takes two different views into account: the Communication Manager and the Communication User. We have analyzed ECO and carried out a formative evaluation with experts, mainly related to the Manager Communication view. The idea was to assess usability and accessibility concerning AAC tools. This way, we asked evaluators to walkthrough the tool and complete two different questionnaires intended to measure perceived usability and check the most important accessibility requirements. Results were positive and provided evidences of usability and the achievement of accessibility requirements. All in all, such results will be used to refine existing requirements and create new ones to improve the tool and accomplish a summative evaluation with final users.

## CCS CONCEPTS

• **Human-centered computing** → Accessibility • **Human-centered computing** → Accessibility technologies • **Human-centered computing** → Accessibility systems and tools

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## KEYWORDS

Accessibility; Alternative and Augmentative Communication; Mobile Application; Expert Evaluation.

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## 1 Introduction

Augmentative and Alternative Communication (AAC) systems are oriented to users who cannot use natural language due to temporary or permanent impairments, or for whom the use of natural language implies a significant effort.

In all cases, this kind of communication tries to provide an alternative to natural language for communication and therefore allow these users to communicate satisfactorily in their daily life. Many different types of people use AAC devices in order to communicate, since disorders affecting their ability to communicate can result from physical, intellectual, congenital and acquired disabilities, in addition to progressive disorders. For example, people with autism spectrum disorder (ASD) use AAC devices due to one of the keys defining elements of autism is that an individual exhibits impairment in both verbal and nonverbal communication [16].

Various types of AAC tools are available. Some may use unaided techniques, such as gestures and sign language, while others can employ low-technology devices like communication-symbol books and letter/word boards. Additionally, there are high-technology AACs which use technological aids comprised of both peripherals and AAC software, specifically designed to assist with the complex communication needs of certain individuals [20]. Pictograms are one of the most used resources in AAC. A

pictogram is a schematic symbol that represents an idea or concept in a manner that allows communication across language barriers. Therefore, for people who have this kind of language difficulties, a pictogram is not only a way to express ideas and feelings, but also a tool to interpret, understand and ultimately transform their ideas into pictures in a schematic and efficient way. Thus, pictograms may represent many types of concept: objects, animals, persons, feelings, actions, or even grammatical elements.

The number of existing AAC applications based on pictograms with the purpose of enhancing the communication and interaction of users with communication problems is huge. Although many of these tools are widely used and easily available, it has only been in recent years that developers have considered to follow User-Centered Design (UCD) techniques to implement this kind of applications. In considering the iterative User-Centered Design, it should be clear that people with disabilities can be part of this process so the target levels for accessibility can play an important role in the overall process [19]. However, in many cases users with disabilities are only considered at the end of the design and development process as evaluators of the final systems, and not in other intermediate phases like requirement analysis or application design.

This paper presents the Easy Communicator application (ECO now on), an AAC tool designed using a UCD approach to make functional communication easier for individuals with complex communication needs. Firstly, the design process is described. Secondly, a formative evaluation by experts of the Communication Manager view has been carried out. The results obtained from this study indicate that AAC best practices are followed by ECO. Finally, suggestions regarding new requirements and elements to integrate into this communication tool are presented.

## 2 Related work

Alternative and Augmentative Communication AAC devices are used by people with special communication needs in order to be able to participate in society, with their families and in their schools, among many other everyday situations. A multitude of different AAC devices exist due to the fact that end users have a wide range of communication needs [24]. Advancements in technology, especially in the mobile technology sector with regards to smartphones and tablets, have greatly improved the customization and portability of AAC devices and provided powerful new communication tools [14]. Mobile technologies, such as touch-screen smartphones and tablets, have become much more commonplace. The wide range of apps offered for these devices include those that assist in communication, which have helped to transform AACs from low-tech to more high-tech devices. They have provided new symbol sets, layouts, organizations, selection techniques and even output [2]. The creation and prevalence of these digital technologies have, potentially, made it much easier to meet the wide range of communication needs for a large, varied group of people with impaired communication abilities [9]. As mobile technologies

have become more readily available, acquiring AAC apps has become easier and taking into account the low price of these devices, relatively speaking, when compared to the cost of traditional systems, significant changes have occurred with regards to the manner in which AAC solutions are accessed by both individuals with complex communication needs and their families [13] [14] [21].

In recent years, many AAC developments have used a UCD approach when designing and developing applications [10] [18] [22]. However, only some works have also performed heuristic evaluations with experts in both accessibility and disabilities of target users. This has proven to be a good idea as many accessibility and usability issues can be found by experts and then corrected before target users evaluate the applications. For example, AraBoard [1] is a set of tools focused on creating pictogram boards using a computer, smartphone or tablet. The aim of this tool is to support the creation and use of communication boards adapted to the particular needs of each user. An accessibility evaluation of AraBoard was carried out in [2], where accessibility experts evaluated the tool by using two lists of checkpoints extracted from accessibility standards and related work in the domain of AAC. The results from the study indicated a high level of accessibility in AraBoard, and reported some suggestions about new requirements to integrate in the tool. PICTAR [12] is another tool on AAC for people with autism, which has been evaluated by usability experts [11]. PICTAR is a web application based on a service of translation from text to pictograms in order to help teachers and tutors in the creation of new pictogram materials from texts like daily routines, stories or news. In [15] authors present an application for multi-touch tablets to support the improvement of empathy for children with autism. They conducted an evaluation with three academic researchers having skills in software usability and accessibility, who detected a total of 21 problems in the first prototype. The mobile social application presented in [7] aims to aid the children with autism in learning basic interaction skills, which consist of introducing basic emotions and gestures. Five evaluators were involved in its heuristic evaluation, in order to enhance the user interface of the mobile social application. The results from the evaluation concluded that all evaluators agreed with all the applied heuristics. In [3], authors report on developing collaborative activities to enhance language skills of children with autism. They adopted a multi-touch tablet iPad as a platform to support quiz and storytelling activities. A total of four evaluators carried out the heuristic evaluation. In this work, a simple questionnaire with statements crafted from design heuristics statements was presented.

## 3 ECO: Easy Communicator app

The Easy Communicator application has been proposed as an Augmentative and Alternative Communication tool addressed to achieve a single goal: to ease the communication between people whatever the capabilities they have. Therefore, attending users requirements becomes key for the ECO design and its subsequent deployment.

Accordingly, a User-Centered Design has been used as the guideline for the application design. In the iterative design process, many users have been involved, since the requirements specification to the evaluations of the prototypes. In the first iteration, the tool was developed for a child with ASD and his family. In the next iterations, one special education school, one special work center, one ordinary school, and two geriatric centers were incorporated successively into the process. So then, new users such as students with special needs and their teachers; workers with disability and their tutors; or elderly people with their caregivers were incorporated for testing and proposing further improvements. Next subsections describe three key points of the tool development: the context definition, the requirement analysis, and the application design.

### 3.1 Context definition

The first step consists of understanding and specifying the context in which the application is going to be used, i.e. identifying the potential population which the tool is addressed to, how and why they will use the application and in which conditions. Attending the goal of ECO, the context is defined according to the following points:

- A wide range of potential users. ECO is thought as a wide spectrum AAC tool. Therefore, its design must be addressed to attend a wide range of users, with noticeable different communication capabilities: from people with severe communication issues (e.g. users framed in the autism spectrum) up to teachers specifically skilled in working with this kind of tools.
- Simple user structure. To ease the user interaction with ECO, two main roles are proposed: Communication User and Communication Manager. The former is set to the users who are the natural target of the application, i.e. those with some kind of communication handicap. The counterpart is the Communication Manager, who will be the responsible for setting up the application so that it fits the requirements of all the Communication Users under their care.
- Deployment in several contexts. Since ECO will support a wide range of users, it is reasonable to think that it will be used in multiple and diverse scenarios as well. For instance, ECO is proposed to be used in elder people centers, special work centers or simply the family environment.
- Addressed to professional and regular Communication Managers. Communication managers have a deep knowledge about the Communication Users under their care. However, they often have different goals when using the application, which are indeed tied to the specific needs of communication users. For instance, parents could just want a way to communicate with their children effectively, whilst a professional educator could be interested in calibrating the degree of communication disability a user has. Furthermore, not all the Communication Managers will be skilled the same when it comes to dealing with a computer application.

Accordingly, ECO design has to produce a flexible tool capable of 1) providing any kind of content and 2) fitting the needs, skills and goals of both the communication users and managers.

### 3.2 Requirement analysis

The second step in the UCD process is to detail the requirements, i.e. all the aims of users and all the restrictions of the system provider, according to the context definition. The requirements that ECO has to fulfill have been gathered in Table 1.

**Table 1. System requirements**

Identifier	Explanation
REQ1	A message has to be considered as the minimum communication unit. Thus, a message has to consists of both a content to be shown and the way the user interacts with that content.
REQ2	The structure of the information has to match the context that the application is going to be used at. This means not only the environment but also the goals, needs and skills of the users dealing with the application.
REQ3	Content cannot be tied to the application. Thus, contents can be taken either from external sources (e.g. network repositories, USB drives, etc.) or device sensors (e.g. camera, microphone, etc.).
REQ4	Content and dynamic of use must be coordinated.
REQ5	Communication user and manager areas have to be clearly differentiated.
REQ6	Content and dynamics of use can be created, stored, reused and shared.
REQ7	Content and dynamics of use can be adjusted according to the Communication Manager interests.
REQ8	Maximizing the usability according to the specific context and users being involved.
REQ9	The application has to work with any media useful for communication purposes, which involves at least images, photos, audio and video files, avatars and texts.
REQ10	The way in which the content is presented must be able to adapt according to communicator user. This involves at least the color, size, position and way to interact with the content.
REQ11	Simplicity must rule the application in all the activities related to communication users.
REQ12	The interaction with the application has to be intuitive.
REQ13	The application design has to be appealing to all communication users.
REQ14	The application has to support multiple languages.

### 3.3 Application design

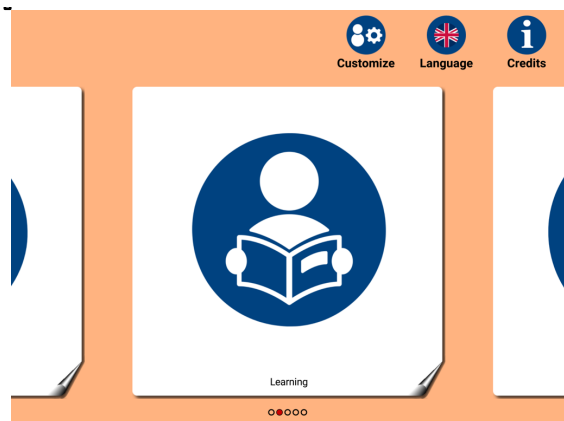
The next step in the UCD approach is to propose solutions for the application. These design solutions are iteratively proposed until reaching a definitive solution, which will be assessed in the last step to check if the requirements are properly fulfilled.

The design of the ECO application structures the information in three levels: users, categories and messages. Messages are the basic pieces of content used for communication, so that REQ1 requirement is fulfilled. Categories and users morph into several concepts according to the context the application applies. For instance, in a home environment the users are the children and

the categories can be sets of actions these children want to take (e.g. eat-related actions); in an educational center user can be lectures (e.g. learning, diary, emotions, etc.) and categories can be sets of concepts (e.g. colors, continents of the world, numbers, days of the week, etc.). This capability to adapt the information structure to both the user the context is addressed by requirement REQ2.

Figure 1 shows the main activity of the application, which leads to the two well defined areas in which the application is divided: the Communication User and the Communication Manager. The former is thought as an AAC tool, whilst the Communication Manager area provides a way to edit the content and fit the dynamics of use and application design to the user's interests. That is, requirements REQ3, REQ5, REQ6, REQ7, REQ8.

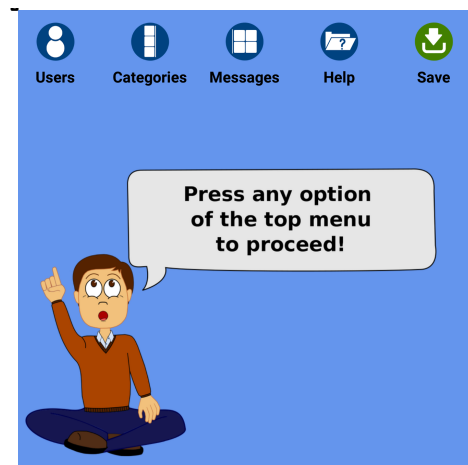
As it can be seen in Figure 1, the plain and direct design of the sections, with simple and appealing images aiming to make the application both intuitive and appealing to the user, addressing thus the requirements REQ12 and REQ13. Only a few actions are thus allowed: changing the language (to attend the requirement REQ14); accessing the Communication User area by selecting any of the users defined by the Communication Manager and logging into the Communication Manager area by pressing the customize button.



**Figure 1: The main activity of the application**

The Communication Manager area follows the same design criteria, as shown in Figure 2. Options are structured in the same way for users, categories and messages. This covers requirements REQ2, REQ8 and REQ12. Users section allows the Communication Manager to manage the application users, i.e. to create new users or to remove or edit those already included in the application.

Any user can be exported or imported, which allows the Communication Manager to backup their users, move them to another device or take benefit from the contents created by other Communication Managers. The same applies to categories, which can be created, removed, edited, imported and exported, fulfilling thus requirement REQ6.



**Figure 2: Communication Manager area**

Once a user is selected, a new left-sided slide bar appears. This bar shows all user's categories, so that the Communication Manager can select the one which he/she is interested to work in. Tapping one category loads all associated messages, as shown in Figure 3. As shown in Figure 4, a message can include a text, a sound, an image and a video, just as demanded in requirements REQ4 and REQ9.

All the content included in the message is shown sequentially, with a defined lapse of time between each piece of media, so that the user has enough time to process the information properly. Thus, firstly the image and the text are shown and after a while, the video and audio (if present) are played. Media (audio, image and video) can be taken by means of the device sensors (e.g. camera) or provided as a file, according to requirement REQ3. Moreover, the font (family, size and foreground and background colors) and the image background can be tuned according to the manager's interests, satisfying thus requirement REQ10. The same applies to user and category elements, where any media can be added and tuned according to the purpose of the element.



**Figure 3: Messages loaded after tapping a category**

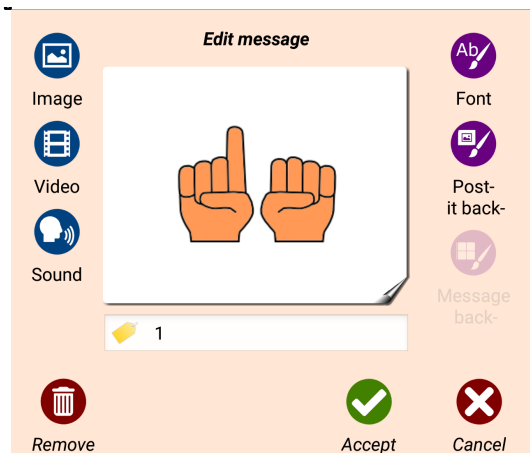


Figure 4: Message details

Message dynamics can be changed according to user's needs and the manager's goals, which fulfills what is requested in requirements REQ7 and REQ11. This dynamic tuning is achieved by:

- Changing the message layout. The message layout can be changed according to the user's skills and the nature of the category. The layout represents the amount of messages shown at once in the screen. If the category includes more messages than those shown in the screen, they can be reached by scrolling up or down. As it is shown in Figure 5, the layout follows a matrix shape of size from 1x1 message up to 6x6 messages, which, according to the screen size of regular devices, fits most of user's and manager's necessities.
- Sorting the information elements. Users, categories and messages can be sorted according to the manager's interests. Furthermore, both manager and user requirements. Thus, messages can be shown in the specific order the manager sets them or place those messages randomly to avoid the user to develop patterns according to the place the messages are settled.
- Message dismiss. When the Communication User picks a message in the Communication User area, ECO draws it in the screen and presents sequentially all its contents. Once all the contents are finished the message is dismissed. The Communication Manager can decide the way in which messages are dismissed according to the communication user's skills and the purpose of the category where the message is included in: automatically by the system (according to a certain timeout) or manually by the Communication User (by clicking over the message). In the case of automatic dismiss, the manager can set the timeout according to the user's skills.

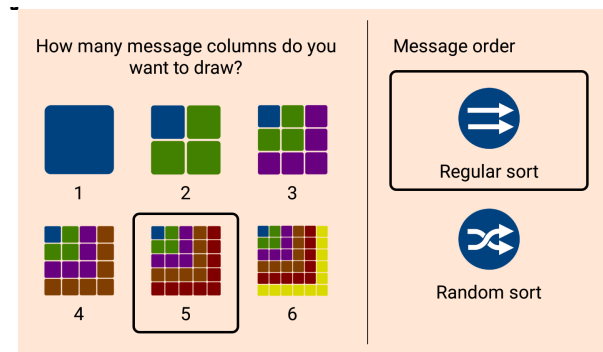


Figure 5: Message layout and display order

## 4 Evaluation

We have carried an evaluation only for the Communication Manager module included in the ECO tool. The idea is to determine the perception on usability and accessibility based on the best practices in AAC systems, and according to expert criteria. The objective was to detect main usability and accessibility problems that will be revised later on.

### 4.1 Research Questions

In order to conduct our evaluation, we propose the following research questions that will be answered through the evaluation results:

- RQ1: Can ECO be considered usable according to expert criteria?
- RQ2: Does ECO fit the most important accessibility requirements based on the best practices in AAC systems, according to expert criteria?

### 4.2 Method

The evaluation consisted on a controlled experiment accomplished with a set of experts. Experts were asked to carry out an inspection evaluation based on an initial interaction with ECO and the completion of two different questionnaires that will be described down below: a SUS (System Usability Scale) questionnaire [4, 6] and a heuristic checklist on accessibility requirements with regards to AAC systems [2].

This way, we provided experts with an initial overview of ECO, download guidelines and instructions for the evaluation (about 10 minutes). Then, we provided experts with a set of usage scenarios so they could walk through ECO and explore the main functionalities intended for expert users. We also measured the time that every expert spent to complete each usage scenario. Once they finished, we asked participants to fill in the two questionnaires and report some additional questions about strengths and likely improvements focused on the analyzed tool. Finally, we carried out a statistical analysis to compare the results obtained from the questionnaires filled in by experts. To carry out this task, we analyzed the results from the SUS questionnaire and

also utilized an inter-rater reliability (kappa-value) technique to measure expert agreement with respect to the heuristic checklist. Besides, we analyzed other qualitative information obtained from experts, comparing and discussing the results obtained.

### 4.3 Evaluation Questionnaires

We used a SUS questionnaire to measure perceived usability from experts after they interacted with ECO. SUS is a valuable questionnaire with a high psychometric validity to measure perceived usability. It consists of 10 questions (half of them are positive, while the others are negative) that experts rated using a 5-point Likert scale (where 1 means strongly disagree and 5 means strongly agree). Also, SUS provides a method for combining the 10 scores obtained on a wider scale between 0 and 100. The result from the evaluation of the 10 questions has to be interpreted as a whole, and not separately [23]. The outcome obtained represents a measure for the perceived usability.

In addition, we utilized a heuristic questionnaire based on a checklist of 16 checkpoints to validate accessibility in a specific domain such as AAC systems. This questionnaire has been inspired by different works and standards to analyze and capture accessibility requirements that AAC tools must meet for people with special communications needs. The checklist is shown in Table 2, where checkpoints are gathered into categories (a total of 6). Measurable checkpoints should be evaluated by each expert using the following values: “No” when the checkpoint is not satisfied, “Yes” when the checkpoint is satisfied, “Partial” when the checkpoint is partially satisfied, and “NA” when the checkpoint does not apply.

**Table 2. Checklist proposed to evaluate accessibility requirements in a specific domain such as AAC systems.**

#	Checkpoint categories and evaluable checkpoints
<b>Categories, profiles and configuration settings</b>	
1	Allows users to create and edit different semantic categories
2	Allows users to create and edit profiles for different types of use
<b>Theme communication boards and configuration settings</b>	
3	Permits box sizes to be changed
4	Permits box layouts, positions and orientations to be changed
5	Provides a different background color for each semantic category
<b>Content: Pictographic symbols and configuration settings</b>	
6	Allows for the upload of external pictures
7	If it allows external pictures, users are informed about which sizes and formats can be used
8	Allows the inclusion of: a picture along with a caption/text; the pictures are distinguished from the caption/text; only a picture; only a caption/text
9	Pictures and captions/texts must be easy to understand
<b>Output: Messages and configuration settings</b>	
10	Provides flexibility regarding the number of messages
11	Provides speech output, digitized speech output or synthetic speech output
12	Provides flexibility with regards to the size and editing of messages
13	Allows users to select and adjust the volume
<b>Input: Access and configuration settings</b>	
14	Permits access via a haptic interaction. Enough space is provided to allow for the movements needed to reach all

	boxes. Accuracy (boxes are large enough to click comfortably)
15	Allows access via Assistive Technology
<b>Online documentation, help and support services</b>	
16	Provides understandable and accessible documentation and help

### 4.4 Participants

We recruited 5 experts to participate in the evaluation. They were 2 men and 3 women with ages between 37 and 49 years old ( $M=42.6$ ,  $SD=5.2$ ). As for their background, they are university educators having advanced skills and years of experience in accessibility ( $M=5$ ,  $SD=4.6$ ) and autism spectrum disorder ( $M=6.2$ ,  $SD=2.7$ ).

According to existing bibliography, formative evaluations can be achieved with a more reduced set of participants than summative ones. Although there is not a fixed number, recruited participants should be selected according to the objective of the evaluation and the kind of the problems expected to find [5]. In this case, 5 experts can be considered as a representative figure [17] to find most important usability problems (over 85%) that will be considered to refine the ECO tool in next iterations.

### 4.5 Usage Scenarios

In order for experts to evaluate ECO, we proposed the following usage scenarios. Those can be meant as walkthroughs including different tasks intended to cover the principal functionalities that the tool provides for experts and educators:

- Scenario 1: Create, export and share a new user.
- Scenario 2: Configure the tool's settings according to the new user created in Scenario 1.
- Scenario 3: Create two different messages and associated categories according to the settings provided in Scenario 2.

All scenarios are interdependent, so they have to be performed in strict sequential order for all participants.

### 4.6 Apparatus

To perform the different usage scenarios, we asked experts to utilize their own tablets. In general, experts utilized Lenovo and Samsung Galaxy tables, featuring different models (Tab4, Tab S2 and Tab S4) and screen sizes (10" and 10.5"). Android OS version ranged from 7.0 to 8.1.

### 4.7 Results and Discussion

Figure 6 shows the results obtained from the SUS questionnaire for each expert. In general, an average value of 86 was obtained ( $SD=5.5$ ), denoting a high perceived usability [23] for ECO.

As for the heuristic checklist, an inter-rater reliability analysis using kappa statistic was accomplished to determine agreement among experts. Specifically, a Fleiss' kappa [8] was calculated to evaluate the agreement with the ratings obtained from the heuristic questionnaires filled in by the 5 experts. In contrast to other statistics, such as Scott's pi or Cohen kappa, which are suitable only for two raters, Fleiss' kappa works for any number of raters. The kappa value comprises a real number between 0 to 1, where 1 means agreement and 0 means disagreement. A



significant kappa=71.7% at p-value < 0.05 was obtained, denoting a substantial agreement among experts [8]. Figure 7 depicts the agreement among expert in a graphical way, where option 1 (no), 2 (partially) and 3 (yes) are represented in axis Y, whereas the different checkpoints shown in Table 2 are represented in axis X; "NA" was never selected by experts for any checkpoint.

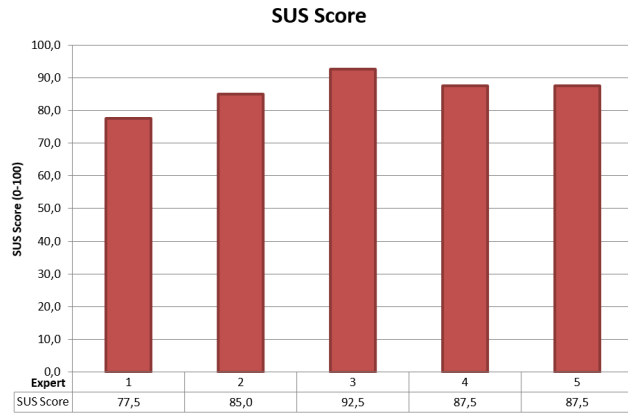


Figure 6: SUS score by expert

As shown in Figure 7, all the experts agreed that the categories, user profiles, and configuration setting requirements are perceivable in the evaluated tool. Users have complete freedom when creating categories and user profiles for different types of use. ECO provides flexibility with regards to the number of messages and external pictures that can be displayed on screen, in addition to offering either digitized speech output or synthetic speech output for messages.

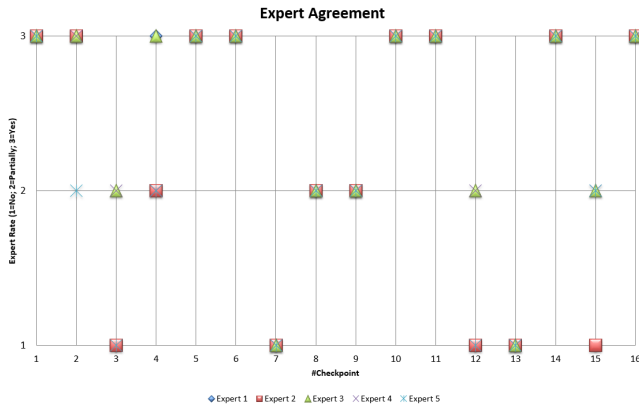


Figure 7: Expert agreement with respect to the 16 checkpoints analyzed

Contrarily, the experts agreed that some requirements related to permitting changes in box sizes are either not included or only partially included. Moreover, the experts observed that the tool does not fully comply with some of the requirements. One example of this is the fact that users are not given information as to which sizes and formats of external pictures can be used.

Additionally, users are not forewarned that the pictures and captions introduced should be easy to understand. What is more, users are not allowed to select and adjust the volume within the application itself and it can only be adjusted through the volume settings of the device. The experts observed only partial compliance with other accessibility requirements with regards to the size and editing of messages, which can be moved within the grid but the size cannot be changed. Furthermore, while access via assistive technology is allowed using the magnifier, the voice assistant is not well supported.

Compliance with the remaining requirements has been observed in the tool, according to expert criteria. ECO permits access via haptic interactions and, moreover, enough space is provided to allow for the movements needed to reach all boxes. Finally, a help menu with comprehensive information is offered.

We also measured efficiency values according to the average time on usage scenarios during the walkthrough sessions with experts (see Table 3). As shown, Scenario 3 took the highest average time, while Scenario 2 took the lowest. In general, Scenario 2 was achieved by all experts presenting no specific problems. It consisted in configuring the tool according to the new user created in the previous scenario. As for Scenario 3, users spent some time identifying how categories and messages have to be created. This took more time than the rest of tasks, as experts realized that categories should be created before messages, in contrast to the order specified in the scenario statement. As for Scenario 1, it involved initial tasks concerning creation, exportation and sharing of a new user. It is worth mentioning that experts found difficulties in finding the sharing option, which are executed together when the user is exported and saved in a folder of the tablet, needing some additional time to correctly identify the task and carry it out. As for strengths identified in each scenario, experts highlighted the intuitive and easy creation of users, together with the help mechanism that provides the corresponding support to carry out the task successfully. In addition, all experts appreciated the mechanism to configure the tool's settings according to the new user created, where the tool provides visual help and support to carry out the task easily. As for functionality affecting messages and categories, all experts agreed that both messages and categories are well structured, providing visual feedback to complete the tasks.

Table 3. Statistics corresponding to efficiency in seconds for each scenario analyzed

Measure	Scenario 1	Scenario 2	Scenario 3
Mean	199.60	80.60	314.60
Min	153.00	56.00	231.00
Max	246.00	102.00	390.00
SD	40.61	19.84	63.75

With respect to improvements, experts identified that the user management should be improved in order to provide visual feedback accordingly, as a new user has to be created from an existing one, which may result confusing as all user options appear together. On the other hand, one expert identified that the editor does not correctly interact with the Android Voice

Assistant accessibility option, presenting problems for blind parents and teachers. In addition, experts identified another improvement related to messages and categories. This way, visual feedback should be improved to distinguish options affecting all categories or just only one. Besides, options related to message configuration should be improved in order to correctly identify how to remove messages and the relationship among the different options provided for it, which should appear clearly enough. In addition, menu options affecting categories and messages should be restructured in order to better identify the creation sequence and split up help and management options in a much clearer way. All these concerns will be considered in the next improvement round to refine and include new requirements. All in all, ECO provides evidences of initially being a usable and accessible communication tool according to the expert criteria. This helps answer research question RQ1 and RQ2, concluding that ECO can be considered usable, fitting also the most important AAC accessibility requirements according to expert criteria, respectively.

## 5 Conclusions

While current technology provides new challenges to facilitate communications, new applications intended for people with special needs must follow a UCD approach in order to feature usability and alignment to the most important accessibility requirements.

In this work, a mobile AAC tool that facilitates functional communication to people with complex communication needs has been presented. Namely ECO has been conceived under a UCD approach, providing functionalities for both final users and experts/educators. As part of the UCD approach, we have carried out a formative evaluation with experts to provide usability and accessibility clues based on the Communication Manager module included in the ECO tool. More precisely, we have enumerated research questions focused on finding out usability and accessibility clues according to expert criteria.

Results obtained provided evidence of perceived usability and achievement of the most important accessibility requirements, providing also an answer to the stated research questions. Also, results provided relevant clues to improve the application and refine requirements. All these findings together with the results of an oncoming summative evaluation with real users will product in a new release of the tool.

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