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# A VOICE-ASSISTED VISUAL LEARNING INTERFACE FOR LOW-LITERATE ADULTS: DESIGN AND USABILITY EVALUATION

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**Abstract**
*Low-literate adults are likely to struggle with traditional mobile learning systems, which often require reading and following instructions, navigating through multiple screens and layers, and participating in text-heavy feedback. This paper describes the design and usability study of the Voice-assisted Visual Learning Application for foundation literacy and numeracy learning of adults with limited reading and writing ability. The developed application is based on an Android prototype educational application and adapted to adult learners by adopting a text-light approach, Urdu audio instructions, familiar visual objects, large buttons, simple navigation, repayable voice instructions and immediate positive or corrective feedback. Four basic learning modules were employed in the system: alphabet recognition, numeracy learning, shape recognition and color recognition. 20 adult participants with low literacy skills participated in a task-based usability evaluation. They evaluated the percentage of tasks completed, time spent on task, error rate, assistance required, perceived usability, and qualitative user feedback by observing the subjects, conducting an orally administered usability questionnaire, and performing brief post-task interviews. The results showed the application to have a low mean error rate, 0.51 errors per task, a mean usability score of 83.4 out of 100, and a limited amount of assistance required, 10.6% and a mean task completion rate of 93.75%. The participants did well at the Audio Replay, Color Identification, and Shape Recognition tasks and needed more time and assistance in Arithmetic tasks. The results indicate that the voice-assisted, visual and text-light mobile learning interfaces can create a usable and acceptable learning environment for adults with low literacy skills. Future work should involve a larger field study to validate learning outcomes in the application, which should also include more adult-centered functional literacy activities.*

## INTRODUCTION

Smartphones have made mobile learning more accessible, but many educational applications still depend on written menus, instructions, and feedback. This creates barriers for adults with low

literacy skills, who may need audio instructions, familiar images, simple navigation, and immediate feedback to use learning applications independently [1]. Unlike children or fully literate adults, this user group requires respectful adult-centered content, culturally familiar visuals, and interfaces that support first-time use with minimal assistance as shown in Table 1.

Human-computer interaction research shows that text-free, visual, speech-supported, and multimodal interfaces can improve access for users with limited literacy [2]. Based on these principles, this study presents the design and usability evaluation of a voice-assisted visual learning application for adults with low literacy skills [3]. The application was adapted from an Android-based educational prototype with alphabet, mathematics, shape, and color modules, each supported by learning and testing sections, Urdu audio instructions, images, sound effects, and visual feedback [4].

The application was redesigned for adult users by emphasizing dignity, simplicity, and daily-life relevance [5]. Alphabet learning was linked with common words, numeracy with counting, addition, subtraction, and money-related examples, while shape and color learning were connected with familiar objects, signs, and labels [6]. The interface used large buttons, limited choices, replayable Urdu audio, simple navigation, and immediate corrective or positive feedback [7].

A task-based usability evaluation was conducted with 20 adults with low literacy skills. The study measured task completion rate, time on task, error rate, assistance required, and perceived usability, while feedback was collected through an orally administered questionnaire and short interviews [8]. Results showed a 93.75% task completion rate, usability score of 83.4/100, mean error rate of 0.51 errors per task, and assistance requirement of 10.6%. Stronger performance in audio replay, color identification, and shape recognition supports the value of voice-assisted, visual, and text-light learning, while arithmetic tasks require slower narration and step-by-step adult-centered examples [9].

**Table 1: Positioning of The Proposed Study Within Existing Research**

| Research Direction | Existing Focus | Link to Present Study | Present Contribution |
|---|---|---|---|
| Text-free interfaces | Images, speech, and non-textual cues | Supports visual objects and Urdu audio | Applies text-light interaction to adult learning |
| Novice mobile users | Simple navigation and spoken support | Supports large buttons and replayable audio | Evaluates first-time use by low-literate adults |
| Adult literacy apps | Mobile support for literacy practice | Supports adult-focused design | Extends learning to numeracy, shapes, and colors |
| Low-literacy UI guidelines | Multimodal and culturally relevant design | Supports local-language visual interface | Provides task-based usability evidence |
| Mobile learning usability | Ease of use, learnability, and satisfaction | Supports completion, errors, time, and usability score | Combines metrics, oral questionnaire, and interviews |
| Usability evaluation | Effectiveness, efficiency, and satisfaction | Supports task-based assessment | Adapts evaluation for low-literacy adults |

The main objective of this paper is to evaluate whether a voice-assisted visual learning application can provide a usable and acceptable learning environment for adults with low literacy skills. The specific objectives are:

1.To design a text-light Android learning interface supported by Urdu audio instructions and familiar visual objects.
2.To evaluate task completion, time on task, error rate, assistance required, and perceived usability among adult low-literacy users.
3.To identify which learning tasks are easier or more difficult for the target users.
4.To collect user feedback for improving adult-centered literacy and numeracy learning applications.

The main contributions of this paper are as follows:

1.It presents an adult-centered adaptation of a visual and audio-supported Android learning application.
2.It provides a task-based usability evaluation with 20 adult participants having limited literacy skills.
3.It reports usability evidence through task completion rate, error rate, time on task, assistance required, and oral usability scoring.
4.It identifies design improvements required for arithmetic and other cognitively demanding learning tasks.
5.It contributes practical guidance for developing respectful, culturally relevant, and accessible mobile learning applications for adults with low literacy skills.

The remaining sections of this paper are organized as follows. Section 2 reviews related work on low-literacy interfaces, mobile learning applications, adult literacy systems, and usability evaluation. Section 3 describes the application design and interface features. Section 4 presents the research methodology, participants, tasks, instruments, and data analysis process. Section 5 reports the usability evaluation results. Section 6 discusses the findings in relation to interface design and adult low-literacy learning. Section 7 presents limitations and future work. Section 8 concludes the paper.

## 2. Related Work

Mobile learning applications are widely used for education because smartphones are portable, accessible, and familiar to many users. However, most applications still depend on written labels, instructions, and responses, which creates barriers for adults with low literacy skills [10]. For this group, usability evaluation must consider not only learning content but also interaction design, audio support, visual clarity, simple navigation, and user confidence [11].

Low-literacy interface design has been widely studied in human-computer interaction, showed that text-free interfaces using images, speech, and non-textual cues can help illiterate and semi-literate users complete tasks without depending on written instructions [12]. Further work also found that graphical and spoken interfaces can improve usability for novice and low-literacy mobile users[13]. These findings support the present study, which uses visual objects, Urdu audio guidance, large buttons, and immediate feedback to reduce text dependence.

Adult literacy applications require different design considerations from children's learning applications. Hill and Simha developed CAPITAL Words, an Android literacy application for adults, and emphasized simple navigation, iconography, consistency, visibility, and guided interaction [14]. Similarly, Srivastava et al. proposed smartphone UI guidelines for low-literate users, highlighting multimodal interaction, simplified navigation, audio support, visual cues, cultural relevance, and early user assistance [15]. The present study follows these principles by combining audio, images, color feedback, and simplified screen flows in an adult-focused learning prototype[16].

Previous reviews and mobile learning studies further support the need for inclusive interface design. Islam et al. noted that text-heavy systems increase digital exclusion for illiterate, semi-literate, and digitally inexperienced users [17]. Ali et al. identified ease of use, satisfaction, attractiveness, and learnability as key usability dimensions for mobile learning applications [18]. These dimensions are reflected in the present study through task completion rate, time on task, error rate, assistance required, and perceived usability.

The System Usability Scale is commonly used to measure perceived usability [19], but written questionnaires may not be suitable for adults

with low literacy skills. Therefore, this study used an orally administered usability questionnaire, allowing participants to share their experience without relying on reading ability. Usability is generally defined through effectiveness, efficiency, and satisfaction within a specific context of use [20]. Accordingly, this study evaluates effectiveness through task completion, efficiency through time and assistance, and satisfaction through oral questionnaire responses and interview feedback [21]. Table 2 summarizes key related studies and highlights the research gap addressed by the present study.

**Table 2. Summary of Related Studies and Research Gap**

| Study | Focus | Key Contribution | Gap Addressed |
|---|---|---|---|
| Text-free interface study | Text-free interfaces | Used images, speech, and non-textual cues for low-literate users | Applied here to adult learning modules |
| Novice mobile user study | Novice mobile users | Showed graphical and spoken interfaces improve usability | Extended here to literacy, numeracy, shapes, and colors |
| Adult literacy app study | Adult literacy app | Used simple navigation, icons, and guided interaction | Present study evaluates multiple learning modules |
| Low-literacy UI guideline study | Low-literacy UI guidelines | Proposed multimodal, simple, and culturally relevant UI design | Applied here in a working prototype |
| Interface review study | Interface review | Highlighted exclusion caused by text-heavy systems | Present study provides practical usability evaluation |
| Mobile learning usability study | Mobile learning usability | Emphasized ease of use, satisfaction, and learnability | Adapted here for low-literacy adults |
| Usability scale study | Perceived usability | Provided a standard usability measurement approach | Used here through oral administration |
| Usability concept study | Usability measurement | Defined usability through effectiveness, efficiency, and satisfaction | Applied here in adult low-literacy context |

The reviewed literature indicates that low-literacy interface design should include multimodal interaction, simple navigation, visual cues, local-language support, and immediate feedback [22]. However, most prior studies focus on general digital access, mobile money, health information, or single-skill literacy tools. Fewer studies evaluate a voice-assisted educational application that combines alphabets, numeracy, shapes, and colors for adults with low literacy skills[23]. This study addresses that gap by evaluating a text-light Android learning application with 20 adult participants using task completion rate, time on task, error rate, assistance required, perceived usability, and qualitative feedback [24].

The related work also supports the design choices used in the proposed application. Urdu audio instructions, familiar images, large buttons, simple task flow, and oral usability evaluation are consistent with prior recommendations for low-literate users [25]. Thus, the study contributes to HCI and mobile learning research by combining inclusive interface design with a structured usability evaluation method for adults with low literacy skills.

## 3. Application Design

### 3.1. Design Rationale

The initial Android prototype was intended to teach basic alphabets, numbers, shapes and colors with graphics, sound and basic testing. They can also be adapted to adult foundational education with examples relevant to the adult population. For instance, when working on numeracy, it can

be related to shopping, money counting, mobile number etc. as well as making calculations in everyday life. Alphabet learning and linking to names, signs, medicine labels and simple words. Shapes and colors can relate to traffic signs, product labels, safety symbols and household objects[26].

The adult-focused version of the application follows five design principles:

1. **Text-light interaction:** Written text is minimized and supported with audio.
2. **Voice-first guidance:** Instructions are provided in Urdu or the learner's native language.
3. **Familiar visual objects:** Icons and images are selected from everyday adult life.
4. **Immediate feedback:** Correct and incorrect responses are shown using color, sound, and simple confirmation messages.
5. **Respectful adult presentation:** Graphics, voice tone, and examples avoid childish language and preserve learner dignity.

### 3.2. System Modules

The proposed application contains four major modules. Each module includes a learning mode and a practice/testing mode as shown in Table 3.

**Table 3: System Modules**

| Module | Learning Purpose | Interface Support | Adult-Relevant Example |
|---|---|---|---|
| Alphabet Learning | Recognize letters and sounds | Large letters, object images, Urdu audio | Names, shop signs, medicine labels |
| Numeracy Learning | Learn numbers and basic arithmetic | Object counting, audio explanation, visual examples | Money counting, buying items, mobile numbers |
| Shape Recognition | Identify common shapes | Real-life object images and voice guidance | Road signs, doors, mobile screens, coins |
| Color Recognition | Recognize basic colors | Color blocks, object examples, audio replay | Product labels, traffic lights, clothing |



### 3.3. Interface Features

Large buttons, limited selections per screen, easily recognizable icons, audio replay buttons, and consistent navigation are all part of the interface. One learning concept is presented on each of the screens. A learner can click on a picture or speaker icon to listen to the pronunciation or instructions read out again. The application, when in testing mode, displays a variety of visual options and prompts the learner to select the appropriate option. Questions with correct answers are displayed in GREEN and positive sound effects are given to reinforce the correct answer. Wrong answers are marked in red and a polite 'corrective' sound is played.

Back, next, replay and home buttons make navigation easy. An icon is used on each button, and can be accompanied by audio description. The design is not to have long menus, and is not to ask users to type long answers. This is important as many low-literate adult users may also be low-literate in terms of their digital literacy as illustrated in figure 1.

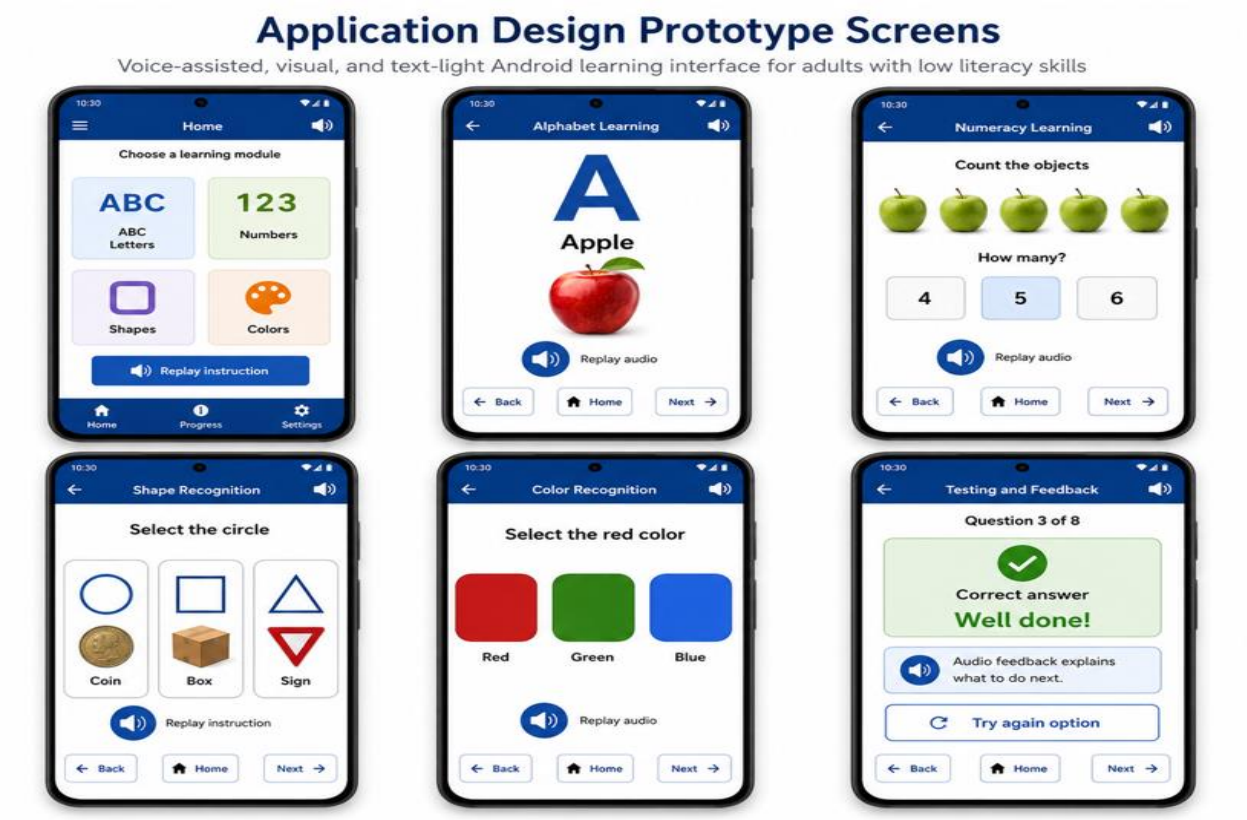


**Figure 1:Prototype Screens of the voice assisted learning application**

### 3.4. Development Environment

Developing of the prototype of the thesis was carried out in the Android platform through the use of Eclipse, Adobe Photoshop, sound recording and audio conversion applications. The same idea could be updated with Android Studio, Kotlin or Java, vector icons, compressed audio files, local storage for progress tracking etc., in case of an existing implementation. A modern version might also be able to be used offline, making it more useful in regions where internet connections are scant.

## 4. Methodology

### 4.1. Research Design

The purpose of this study was to investigate the effectiveness, ease of use and acceptability of a voice-assisted visual learning application for adults with low literacy skills using the task-based usability evaluation approach. A mixed-method design was chosen as usability evaluation needs measurable performance data and feedback on the user experience [27]. Task completion rate, time on task, error rate, amount of assistance required, and usability score were all utilized to gather quantitative data. Observations and short post-task interviews were used to capture qualitative data [28].

The evaluation was based on how much the adult users, who are not very good at reading and writing, can use the application without depending on others with the help of visual content, Urdu sound prompt, big buttons, easy navigation and prompt feedback [29]. The methodology was designed to reduce instructions, which have to be written and read by the users, and to provide oral explanation during the evaluation process as indicated in Figure 2.

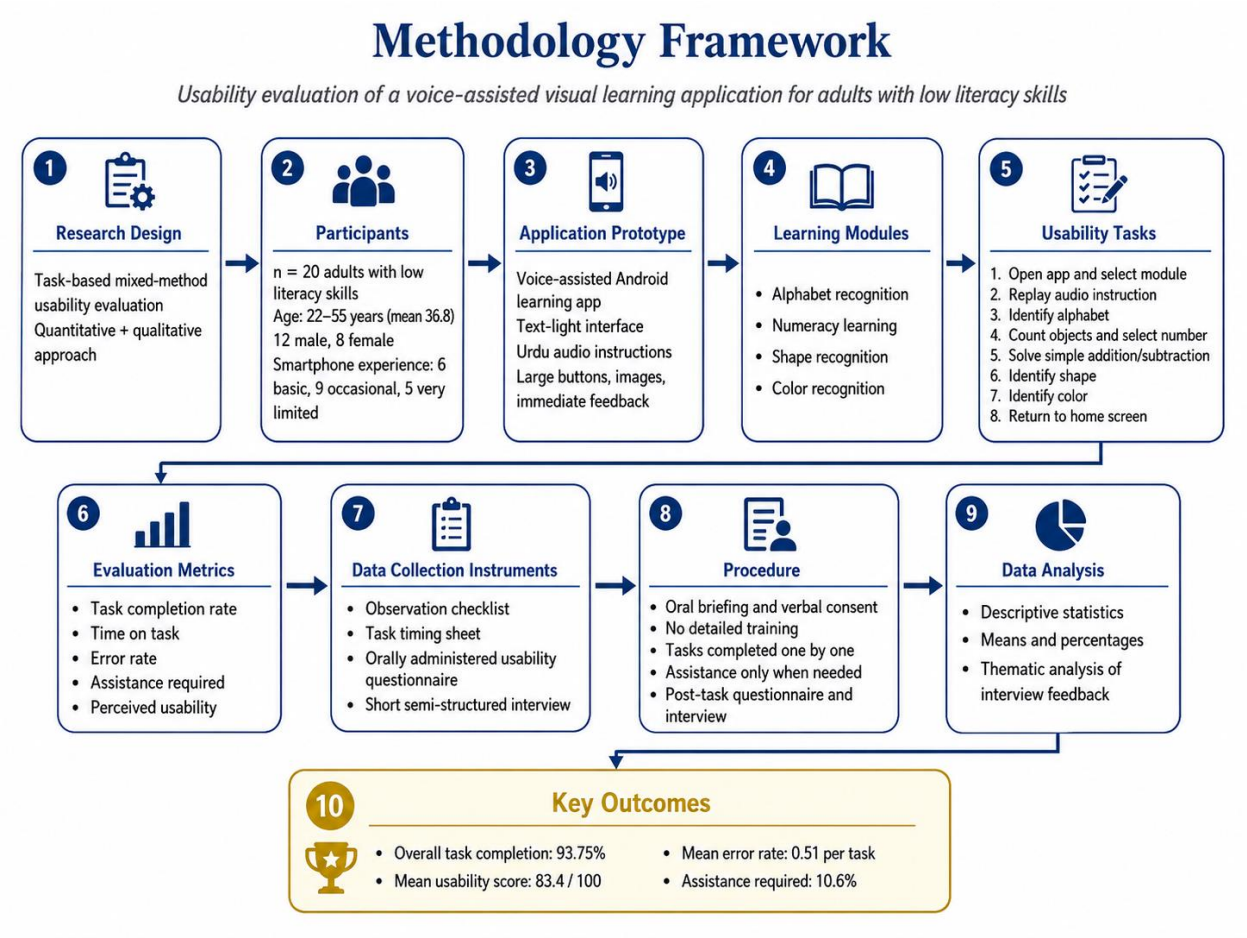


**Figure 2. Methodology framework for the usability evaluation of the voice-assisted visual learning application for adults with low literacy skills.**

### 4.2. Participants

There were 20 adult participants in the usability assessment. All the participants were chosen as they had limited reading and writing capability and were the target users of the proposed application. Participants' age was between 22 and 55 years (mean age 36.8 years). There were 12 male and 8 female subjects.

There was a range of smartphone experience among the participants as well. Six participants described basic use of the smartphone, nine participants described occasional use of the smartphone, and five participants described very limited use of the smartphone. No one had experience with the proposed application prior to the evaluation. This was useful to gauge the learnability and first time usability of the interface.

The inclusion criteria were as follows:

1. Adults aged 18 years or above.
2. Participants with limited reading and writing ability.
3. Participants able to understand spoken Urdu instructions.
4. Participants with basic ability to touch and interact with a smartphone screen.
5. Participants willing to take part voluntarily.

Participants with severe visual, hearing, or motor impairments that prevented basic smartphone interaction were excluded unless assistance was available. This criterion was used to ensure that usability issues were related mainly to interface

design and low literacy rather than unrelated physical limitations.

### 4.3. Application Prototype

The prototype assessed was an Android learning application for adults with low literacy skills, which is voice-assisted. The application employed a text-light approach with the assistance of pictures, very large sized buttons, Urdu audio instructions, learning activities, testing activities, and immediate feedback. Four learning modules were included in the application namely alphabet recognition, numeracy learning, shape recognition and color recognition.

There were two main parts in each module. The first was the learning part, it was to listen to instructions, look at pictures and to get the idea. The second section was the testing section which comprised of visual options where the participant had to select the correct answer. Positive feedback was given to highlight the correct answers, and corrective feedback was given to the incorrect answers. Audio replay enabled the user to replay the instruction if necessary.

### 4.4. Usability Tasks

Participants were asked to complete eight representative tasks covering the main functions of the application. The tasks were selected to evaluate navigation, audio support, visual recognition, numeracy learning, and return navigation [30].

The usability tasks were:

1. Open the application and select a learning module.
2. Replay an audio instruction.
3. Identify an alphabet or letter from visual options.
4. Count objects and select the correct number.
5. Solve a simple addition or subtraction question.
6. Identify a shape from real-life object images.
7. Identify a color after listening to the audio prompt.

**8. Return to the home screen.**

These tasks were directly linked with the learning and testing features of the application. The tasks were arranged from simple navigation to more cognitively demanding activities such as arithmetic. This helped evaluate both basic usability and learning-related interaction.

### 4.5. Evaluation Metrics

The usability evaluation used five main performance metrics. These metrics were selected because they are suitable for measuring usability among users who may not be able to complete written questionnaires independently as shown in Table 4.

**Table 4: Evaluation Metrics**

| Metric | Description | Measurement Method |
|---|---|---|
| Task Completion Rate | Percentage of participants who completed each task successfully | Observation checklist |
| Time on Task | Time taken to complete each task | Stopwatch or screen recording |
| Error Rate | Number of wrong taps, wrong selections, or failed attempts | Researcher observation |
| Assistance Required | Whether the participant needed help during the task | Observation checklist |
| Perceived Usability | User satisfaction and ease-of-use rating | Orally administered questionnaire |

Task completion rate was used as the primary usability measure. Time on task was used to understand how quickly participants completed each activity. Error rate was used to identify confusing screens or interaction problems. Assistance required was recorded to assess user independence. Perceived usability was measured after task completion through an oral questionnaire[31].

### 4.6. Data Collection Instruments

Data collection was done using three instruments. To begin with, an observation checklist was utilized to document success, errors, assistance needed, and hesitation observed. Second, a task timing sheet was used to record the time taken for each task. Third, a self-administered, oral usability questionnaire was employed to assess participants' satisfaction and perceived ease of use[32].

A five-point response scale with simple oral statements was used in the usability questionnaire. The researcher read each statement in Urdu, as target participants were not that much educated, and explained the response options verbally[33]. Ease of use, voice instructions clarity, pictures understandability, buttons recognition, and using the application with little help were measured by the questionnaire, as well as willingness to use the application again.

A brief semi-structured interview was also carried out following the usability tasks. Interview questions concerned the most straightforward aspect of the application, the most challenging aspect, usefulness of audio instructions, clarity of images, and suggestions for improvement.

### 4.7. Evaluation Procedure

Each participant received a simple verbal explanation of the purpose of the evaluation prior to beginning the evaluation. Participants were informed that they were not being tested, but the application. This was carried out to relieve pressure and to make the participants comfortable. The participants informed their verbal consent before participating. Then each one of them received a smart phone with this app. The researcher briefly explained that the participant was able to tap buttons and listen for voice instructions, and select answers. No detailed training was given since the aim was to test the first time usability [34]. Participants did one task at a time, out of the 8 assigned. In every task, the researcher observed the participant and noted whether the task was finished and how much time it took to complete, as well as the number of errors and amount of help needed. Assistance was only given when the participant was unable to proceed independently. The participant filled out the oral usability questionnaire and took a brief interview after the completion of all the tasks.

### 4.8. Data Analysis

Data collected were quantitative in form and were analyzed by descriptive statistics. The task completion rate was measured in terms of percentage of participants who successfully completed each task. Time was measured for each task and mean time was used to determine which tasks required more time[35]. Mean error rate was used to determine which activities were more difficult to do. Assistance required was determined as the percent of attempts that the researcher had to assist with the task.

The mean scores were used to summarize the results from the usability questionnaire. Overall usability score was then translated to a score out of 100 to aid interpretation. The higher scores represented better perceived usability. The qualitative interview responses were analyzed using thematic analysis of repeated comments on audio guidance, visualization of clarity, button design, difficulty of the tasks and suggestions for improvements.

The analysis was structured to match the primary usability measures reported in the Results section, such as overall rate of task completion, mean score for the usability scale, mean score for the errors, and the assistance required[36].

### 4.9. Ethical Considerations

Basic ethical principles of voluntary participation, informed consent, privacy and respect for participant dignity were followed. It was

explained to the participants that the evaluation could be discontinued at any time at their request. The study did not report any personal identifying information. Negative or stigmatizing language was avoided by using the term 'adults with low literacy skills'.

Special efforts were made to ensure that participants were not embarrassed in the evaluation. The participants were told that the aim of the study is to improve the application design and not to test their intelligence nor their capacity. Due to the participants' low level of literacy, all instructions, explanations of consent, and items in the questionnaire were given verbally and in simple language.

## 5. Results

This section reports the results of the usability evaluation of the voice supported visual learning media that had been created for adults who have low literacy skills. Evaluation was done by 20 adult participants and measured in terms of task completion rate, time on task, error rate, assistance required, perceived usability, and qualitative feedback. The results are broken down into participant profile, task completion performance, time on task, error rate and assistance, perceived usability, qualitative feedback, and overall findings.

### 5.1. Participant Profile

20 adult users participated in the Usability Evaluation. All participants were limited in their reading and writing skills, and had been chosen because they were representative of the proposed application's user group. The age of the participants ranged from 22 to 55 years with the mean age of 36.8 years. Of these, 12 were males and 8 were females. Mobile phone: 6 basic, 9 occasional and 5 very limited experiences. All the participants had no experience with the proposed learning application.

### 5.2. Task Completion Performance

The completion rates of the overall tasks were high for all the core modules of the application. The participants did best when good audio instructions were provided and with familiar visual objects[37]. As seen in Table 5, the tasks that were completed in the least amount of time and with the least amount of help were the color identification and shape recognition tasks.

| Task | Completion Rate | Mean Time | Mean Errors | Assistance Required |
|---|---|---|---|---|
| Open application and select module | 95% | 18.4 sec | 0.35 | 10% |
| Replay audio instruction | 100% | 9.8 sec | 0.10 | 0% |
| Identify alphabet/letter | 90% | 25.6 sec | 0.75 | 15% |
| Count objects and select number | 90% | 28.2 sec | 0.80 | 20% |
| Solve simple addition/subtraction | 85% | 36.7 sec | 1.10 | 25% |
| Identify shape | 95% | 21.5 sec | 0.45 | 10% |
| Identify color | 100% | 16.9 sec | 0.20 | 0% |
| Return to home screen | 95% | 14.3 sec | 0.30 | 5% |

**Table 5: Task Success Rates**

The mean task completion rate across all tasks was 93.75%. This indicates that most participants were able to complete the learning and testing activities with minimum assistance. The replay audio task achieved a 100% completion rate, showing that participants understood and used the voice-support function effectively. The arithmetic task showed the lowest completion rate at 85%, which suggests that numeracy-based activities may require additional visual examples and slower audio guidance.

### 5.3. Time on Task

Average time to perform the tasks was between 9.8 seconds and 36.7 seconds. Simple navigation and audio replay tasks were quicker than recognition or calculation learning tasks. Longest mean completion time was reported for the addition/subtraction task as participants had to listen to the verbal instructions, view the visual objects, comprehend the question and then pick the correct answer. The time-on-task results indicate that the interface could be used with adults who had low literacy skills, particularly when the task had one clear instruction, one visual concept and limited answer choices[38]. The results also indicate that mathematical tasks should be broken down further by adjusting the size of the images, the pace of narration and the visual step-by-step guidance.

### 5.4. Error Rate and Assistance

The overall mean error rate was 0.51 errors per task. The majority of mistakes were made by participants clicking on a different option when asked to recognize the alphabet or to count during the arithmetic tasks. Errors were minimized in color and shape tasks as these could easily be matched to familiar visual examples with the audio instructions.

There was a need for assistance for 10.6% of all tasks attempted. The most frequently provided assistance was explaining the purpose of the first screen, directing participants to replay audio, or helping participants to understand the arithmetic task. Following the two tasks, there was an increase in confidence and in the number of participants needing less assistance. This suggests that first-time adult users experienced good learnability in the application[39].

### 5.5. Perceived Usability

Once the tasks were finished, the participants answered an orally administered usability questionnaire. The result of the mean usability score, as shown in Table 6, was 83.4 out of 100 which showed a positive user experience[40]. The audio guidance, large visual buttons, easy navigation and instant feedback were well received by the participants. Arithmetic questions were given a lower rating as some participants felt that the calculation questions needed more examples.

**Table 6: Usability Score**

| Usability Item | Mean Score |
|---|---|
| The application was easy to use | 4.35 / 5 |
| The voice instructions were clear | 4.60 / 5 |
| The pictures were easy to understand | 4.45 / 5 |
| The buttons were easy to identify | 4.30 / 5 |
| I could use the application with little help | 4.10 / 5 |
| I would like to use this application again | 4.40 / 5 |

The results show that participants responded positively to the voice-assisted and visual interface. The high rating for voice instructions confirms that audio support is an important design feature for adults with low literacy skills. The positive response to pictures and buttons also shows that visual design can reduce dependence on written text.


**Figure 3. Composite visualization of participant profile, task-level performance, assistance, errors, and perceived usability scores.**

Figure 3 summarizes the main usability results, including smartphone experience, task completion, time, errors, assistance, and usability scores. The results show strong overall performance, with audio replay, color identification, and shape recognition performing best, while arithmetic tasks required more time, errors, and assistance.

### 5.6. Qualitative Feedback

The quantitative results were supplemented by participant feedback. Most of the participants said that the application was easy to understand as instructions were given to them using the voice. Some participants indicated that the images facilitated their identification of letters, numbers, shapes and colors, but did not require them to read lengthy texts. In addition, participants valued the instant feedback as this allowed them to know whether they have given a correct or incorrect answer [41].

More examples of everyday life were suggested to be added to the application, for example reading a mobile number, medicine labels, shop signs, road signs and money counting. Some of the participants also proposed voice commands of a slower speed for the math-related activities. From these comments, it can be said that practical applications are needed in adult learning applications with examples that are in line with the needs of adult learners[42].

### 5.7. Summary of Findings

The usability evaluation revealed that there was generally little difficulty for the adults with low literacy skills using the proposed application. The results of task completion rate, error rate, level of assistance and positive usability score indicate that a voice-assisted and visual learning interface can support the independence of low-literate adult users in the learning process. The results also demonstrate that the following features are important in the design for this group of users: audio guidance information, familiar images, large buttons, and feedback information. But there is still more to be done for the arithmetic based tasks, step-by-step explanations and more practical adult-centered examples.

## 6. Discussion

The results for the usability indicated that the application was usable and acceptable for adults with low literacy skills, with a task completion rate of 93.75%, and a mean score of 83.4/100, a mean number of errors per task of 0.51 and a mean % of assistance required of 10.6%. It was seen that Urdu audio guidance, familiar images, large buttons and simple navigation minimized reliance on written instructions as evidenced by good performance across the audio replay, colour identification and shape recognition tasks.

The fraction of tasks that were completed was higher for recognition tasks than arithmetic tasks, with the lowest completion rate of 85% for addition and subtraction. Focus for future improvement should be on slower narration, step-by-step numeracy examples, adaptive difficulty, and content related to real-life such as money counting, mobile numbers, medicine labels, road signs and shop signs.

## 7. Limitations and Future Work

This study has limitations in that the prototype was developed for the children and needs to be validated for adult low-literacy learners. Future work should be conducted with a larger and more varied sample and in conjunction with comparison to other literacy instruments and learning improvement with pre-test and post-test.

Future releases will include local dialects, offline, functional literacy features like reading signs, reading medicine labels, instructions for making mobile payments, and basic financial information, as well as progress tracking and personalized learning.

## 8. Conclusion

The design and usability testing of a voice assisted visual learning application for adults with low literacy skills was presented in this paper. The approach of the application was text-light, and included large visuals, Urdu audio instructions, familiar images, simple navigation, learning and testing modules, and immediate feedback. The Usability Evaluation Results were positive and the overall mean task completion rate was 93.75%. Voice assistance for 100% completion and visual identification of familiar objects for 100% completion and shape identification for 95% completion demonstrated that voice guidance and familiar, visually presented objects can be effective means of supporting interaction for adults who struggle to use text-heavy educational applications.

The mean usability score of 83.4 out of 100, the low mean error rates of 0.51 errors per task, and the limited assistance required of 10.6 % suggest that the participants found the application easy, clear, acceptable, and learnable after limited exposure. The completion rate was less successful with arithmetic based tasks however, with addition and subtraction being the least successful at 85%.

This means that in the future, it is believed that there is a need to enhance the learning of numeracy by slowing down the narration speed, showing step by step explanation using pictures, providing repeated examples, and performing real-life activities with adults, like counting money, reading mobile numbers, and doing calculations when shopping. The study overall suggests that a mobile learning system which is voice assisted and designed to be both visual and text-light, can offer a usable and respectful learning environment for adults with low literacy skills. Future research is suggested to be done with a larger number of participants, with pre and post tests for learning assessment and extend the use of the system to functional literacy like reading signs, medicine labels, public instructions and basic financial information.

## Declaration

### Author Contributions

The authors confirm their contributions to the paper as follows: Conceptualization, methodology, and original draft preparation: **Sadeeq jan**; data curation, formal analysis, and validation: **Imran Maqsood**; investigation, resources, visualization, and review and editing: **Mareena Karim**. All authors reviewed and approved the final version of the manuscript.

### Data Availability

All relevant data and supporting material used in this study are in the manuscript.

### Conflict of Interest

The authors state that none of the work described in this study could have been influenced by any known competing financial interests or personal relationships.

### Ethics Approval

The study was conducted following standard ethical guidelines. Approval was obtained from the relevant institutional review board, and all participants provided informed consent.

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