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# Mapping HCI Principals to Evaluate the Usability of Learning Applications for CCI User

Manal Umar<sup>1</sup>, Muhammad Umar Bakhat<sup>2</sup>, Masood Hassan<sup>3</sup>

<sup>1,2,3</sup>Department of Computer Science, Bahria University, Lahore-Pakistan

**Abstract**— Heuristic evaluation has turned into a broadly acknowledged technique for usability evaluation in software development. The paper portrays issues with the utilization of the method with software designed intended for Child Computer Interaction (CCI) community. CCI community includes children from age 4-15 years. The user testing technique was selected to collect the requirements from CCI user about the mobile phone software interface. The results indicated that CCI Usability Heuristic (CCIUH) is best suited for evaluating child usability. The result of this study will give advancement in the field of CCI for designing learning mobile application.

**Index Terms**— Usability Evaluation, E-Learning, Child Computer Interaction (CCI) and HCI

## I. INTRODUCTION

TECHNOLOGY is changing the living styles of every field of life in the modern world. The technique of learning has changed with the developments in technology. Electronic learning (E-learning) is becoming mainstream for instructing and learning [1], [2]. In the contemporary world, E-learning applications have grown into a rapidly expanding domain in the software design business. From the viewpoint of traditional marketing culture, the practicability of an application needs to be examined properly to make productive, resourceful products. In this particular industry, the key trial is to create an E-learning application that is both educational as well as interactive for the students.

### A) E-learning

Basically, it is a computer-based instructive framework for learning. It combines learning with fun and creative games. It is a cost-effective method of learning. Distant learning is becoming easier with the development of E-learning applications. People from distant locations can access and learn by using E-learning applications. A significant figure of web-based and mobile learning applications is available. The adaptation and admiration of E-learning applications is increasing world-wide.

### B) User Interface

User Interface (UI) design in fact describes the graphic layout of the basics of an application that a user directly interacts with in an application or technological invention. This interface can be the control buttons that make television or radio work. It could also be the graphical design of an application. A mobile user interface (mobile UI) is the visual design of an application that is accessible by the user. This visual design is graphic and touch-sensitive in nature and has become a trend, with the invention and popularity of touch screens.

### C) Usability

‘Usability’ is basically a method of determining the way individuals can create or invent objects that are more productive and useful for instance computer-interfaces or web pages for their planned objective.

A usable interface should contain following three key aspects:

1. A user should be able to access, comprehend and use the interface with familiarity. Therefore, the user interface should be straightforward to operate even during the first contact with the application.
2. The objective for which the application has been created should be easily achievable.
3. It should be effortless to remember the user interface and its usage on later visits.

There are numerous methods to examine the usability evaluation of learning applications; for example, testing its usability (e.g., user testing); or inspecting it (e.g., heuristic evaluation/ ‘expert evaluation’) and initiating inquiry or investigation regarding its usability (e.g., questionnaires)

### D) CCI Community

CCI is the new term introduced in the HCI. This term means Child Computer Interaction. This term is used for the community of children those are familiar with computer and using computer technologies [1]. The community of CCI includes children age 4-15 years [13]. The needs and requirements of the CCI community are different from other

users. Their emotional and educational requirements are different. Usability requirements for any interface are different for the CCI community [1]. This can expand the limit between the interaction of learning applications and users. The interface is of no utilization if it is trouble for the user. [14], [15]. The good interface is directly proportional to the good learning because attention will be only on the learning not on the understanding of the interface of the application [16]. Fig. 1 explains the relationship between interface and learning. The interface is directly proportional to the learning.

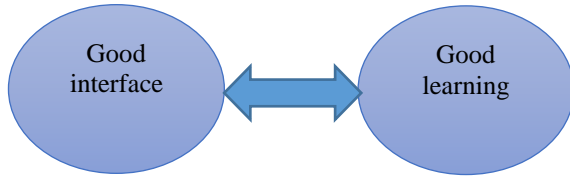


Fig.1: Interface interaction with learning

## II. RELATED WORK

Heuristic evaluation (HE) is a systematic assessment of a user interface layout for usability. The objective of heuristic evaluation is to discover the usability challenges in a user interface design. It is the extremely frequent utilized assessment procedure; it is cheap compared to other assessment procedures. It is insightful and effortless to persuade prospective assessors to utilize it whilst superior planning is not needed. HE has been widely utilized in the e-learning, however, not much has been done practically to methodically tackle the above-mentioned research challenges in an e-learning perspective. Corresponding research attempts in e-learning studies are rare. The efficiency of this approach for applications is uncertain in numerous studies; as only some attempts have been accomplished to examine such matters (efficiency, practicability, etc.) and the majority of the researchers and experts solely operate such approaches and heuristics from out-dated usability research to examine and assess e-learning settings.

## III. EXPANDED HEURISTIC EVALUATION

For the evaluation of child e-learning programs the traditional heuristics developed by Neilson are not applicable. Therefore, we mould traditional Neilson Heuristics for the CCI users learning applications. For this the researcher introduced Child Computer Interaction Usability Heuristics (CCIHU). CCIUH will more closely focus on the child elearning applications and overcome the shortcomings.

## IV. CCIUH WITH EXPLANATION

The CCI users have their own needs and demand. The usability of the interface is different from other users. The heuristics for the CCI user usability are given. A comprehensive explanation of each heuristics has been

combined to improve usability evaluator and to clearly use the heuristics while assessing the e-learning program.

### *CCIUH 1-Design an attractive layout*

The interface made for the CCI user is made attractive by the efficient use of the animations or clipart. The colourful interface attracts the CCI user. The screen design for the CCI user appears to be an attractive layout if it is simple, i.e., uncluttered, readable, and memorable. The font choice, colours and sizes are consistent with good child screen design.

### *CCIUH 2- Buttons and icons visible easily*

The interface made for CCI user is efficient if the user can easily use it. The usability of the interface is enhanced for the CCI user if every button on the screen is easy to understand. The buttons must be much visible that CCI user find it easily. The button of small size and located in inappropriate place make the usability of the interface poor.

### *CCIUH 3 – less steps and less screens*

The application interface made for the CCI user is attractive for the user if its design has less steps to reach to required field. The interface with less screens is liked by the CCI users. The CCI user is a dabbler user so more the number of screens more is the trouble for the user.

### *CCIUH 4- No scroll design*

The interface made for the CCI user must be simple. The CCI users are not expert users. The users get confuse with complex design of the interface. The interface can be made simple and easy to use by avoiding the scrolling design. The scrolling of the application for choosing any option make the user in difficulty.

### *CCIUH 5- Avoid Header*

The simple design is easy to use by the CCI user. The interface is more usable if the design is more simple. The main things of the application must be on the top. The CCI user gets confused to see the less important things on the header as the first attention of the user goes to the header. The interface can be made attractive for the CCI user by avoiding header or using small header.

## V. CASE STUDY

Millions of the learning applications available on the play store. It is very difficult to select the application from such a vast range of applications. The researcher selected the applications for testing those are high rated applications. The research is conducted in Pakistan, so the most common applications used by CCI users in Pakistan are selected. The Khan Academy application was selected.

### *A) Khan Academy*

All of the code in the Khan Academy is composed of utilizing JavaScript and Processing.js. Khan Academy is one such free asset that has its foundations in mathematics yet has extended to cover areas of science, history, and economics. Different exercises, videos relevant to the topic are available

on the application. The application contains brief lectures in the shape of videos. Its application also involves additional training drills and tools for teachers. Khan Academy is viewed by many as an incredible platform where children and adults can go to learn about subjects and topics at their own pace CCI users training at their own speed, first fixing the holes in their knowledge and then speeding up their understanding. With Khan Academy, educators can pinpoint differences in their CCI users’ grasp, tailor education, and fulfil the demands of all CCI users. In current times, Khan Academy has developed to be the most renowned innovators amid a new group of digital education organizations in K-12 education. They have become so popular that about 10 million distinctive users per month as of February 2014 joined its platform whereas 65% of users are in the United States.

**B) Selection of Participants**

In the usability evaluation, the aggregate of thirty CCI users was chosen who were at various levels. All users were CCI users of LGS and were chosen from different grades. For better comprehension of the usability test, it is significant that members should realize that what the task is about. For this, the language utilized during the test has a significant job. The English language is a mode of communication and all CCI users can convey in English. Since CCI users are studying in English medium so the language chosen for the test was —ENGLISH. The language utilized in the task is extremely basic and effectively understandable as the CCI users are young and not experienced and it will be difficult for them to understand difficult words.

Prior to the leading task, specifics of every member were taken which include, their names, gender, grade they are studying.

**C) Details of users for User testing**

The details of the participants who take part in the experiments are given in the Table 1. The total number of participants is thirty. The numbers of females are eleven and number of males is nineteen.

Table I: Number of CCI users participated

Gender	No.
Female	11
Male	19
<i>Total</i>	<i>30</i>

The detail of the grade the user study is given in the Table II. The user participated in the experiment are from grade 1 to grade 6. The number of users from grade 1 are two. The number of users from grade 2 are five. The number of users from grade 3 are ten. The users from grade 4 are ten. One user from grade 5 and two CCI users from grade 6 participate in the experiment.

The Table III shows the frequency of the user’s age. The age of the user in experiment is from 7 years to 12 years. The age of the CCI user is from 4-13 years so all the users in experiment belong to the group of CCI users.

Table II: CCI users and grades they study

Grade1	2
Grade2	5
Grade3	10
Grade 4	10
Grade 5	1
Grade6	2
<i>Total</i>	<i>30</i>

Table III: CCI user’s age

7 years	2
8 years	5
9 years	10
10 years	10
11 years	1
12 years	2
<i>Total</i>	<i>30</i>

**D) Results**

During the user testing the researcher observe the task. The results of the observations for the Khan Academy is given in Fig 2.

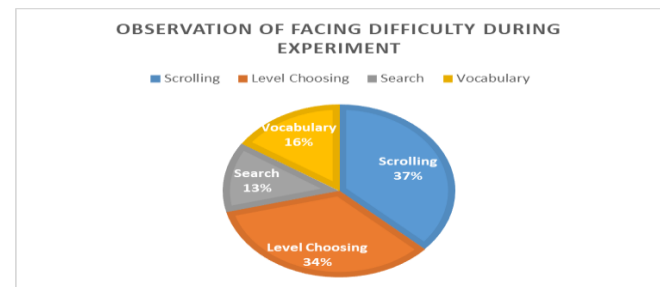


Fig. 1: Results of Observations

The users also fill the questionnaire after performing the tasks relevant to the Khan Academey. The results of the Questionnaire is given in Fig. 3.

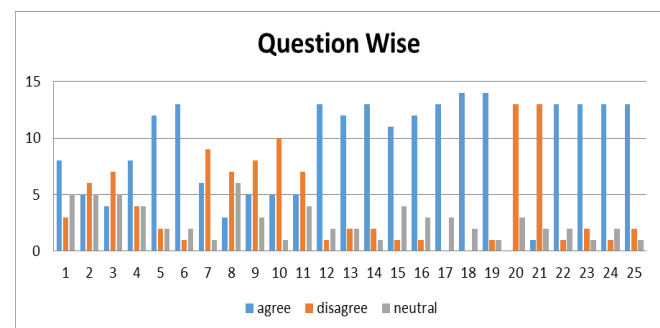


Fig 2: Result of Questionnaire

### E) Heuristic Evaluation

Heuristic evaluation (HE) is a systematic assessment of a user interface layout for usability. The objective of heuristic evaluation is to discover the usability challenges in a user interface design. It is the extremely frequent utilized assessment procedure; it is cheap compared to other assessment procedures. It is insightful and effortless to persuade prospective assessors to utilize it whilst superior planning is not needed. HE has been widely utilized in the e-learning, however, not much has been done practically to methodically tackle the above-mentioned research challenges in an e-learning perspective.

The (Nielsen, 1994) recommended a model strategy that is: the master evaluators assess the focused-on learning applications. The results of the evaluations are collected. After the issues are consolidated, the evaluators ought to agree on the seriousness of every individual issue (Nielsen, 1994). Applying heuristics provide a list of usability problems (Nielsen, 1994). These issues are characterized in various gatherings in which a numerical scale from 0 to 4 is utilized to measure the severity of every issue.

- 0 means “not a usability problem at all”
- 1 means “cosmetic problem that should be fixed if enough time is available”
- 2 means “minor problem with low priority”, 3 means “major problem with high priority”
- 4 means “catastrophic problem that it is imperative to fix”.

### F) Selection of the Experts

The Heuristic Evaluation is the expert base testing. For this first the experts were selected. Four experts were selected from the IT industry. All of the experts are from Pakistan. Three of the participants who are Head of the QA in application and have prior experience with the selected applications. Other expert evaluator is working as a product manager in Application/game development agency. The specifics of the experts are provided in the Table IV.

Table IV: Experts Demographics

Sr#	Gender	Country	Degree	Profession	Experience of experts
1	M	Pakistan	Masters	QA	3 years
2	M	Pakistan	Masters	QA	2 years
3	M	Pakistan	Masters	QA	3 years
4	M	Pakistan	Masters	Product Manager	3 years

### G) Results of Heuristic Evaluation

The scholars established a usability specification for the Khan Academy software and the findings attained from the expert assessments are summarized in Table V, it displays the comprehensive quantitative findings after performing the

heuristics assessment on Khan Academy application by every heuristic.

In this test the heuristics assessment uncovered 42 problems overall, of which 13 were cosmetic glitches, this being 31% of all usability challenges and 14 lesser difficulties were also found (33% of all usability problems). Finally, 15 main problems were detected, producing 36% of all usability issues.

Table V: Heuristic Evaluation Results

	Cosmetic	Minor	Major	Catastrophic	
1. Visibility of system status	3	4	4	0	11
2. Match between system and the real world	2	3	2	0	7
3. User control and freedom	2	2	0	0	4
4. Consistency and Standards	1	0	0	0	1
5. Error Prevention	4	1	1	0	6
6. Recognition rather than recall	1	2	0	0	3
7. Flexibility and efficiency of use	0	0	3	0	3
8. Aesthetic and minimalist design	3	2	0	0	5
9. Helps users recognize	1	0	0	0	1
10. Help and documentation	1	0	0	0	1
	13	14	15	0	42
	30.95%	33.33%	35.71%	0%	

The ‘visibility of system status’ heuristic identified more problems, with 3 cosmetic, 4 minor and 4 major ones. This means that the application was found to be a little attractive. The next heuristic was ‘match between system and real world, with 2 cosmetic, 3 minor and 2 major ones. This indicates that the Khan Academy has fewer matches between system and real world. The next heuristic was ‘user Control and freedom, with 2 cosmetic, 2 minor and 0 major ones. The other heuristic was ‘Consistency and Standards, with 1 cosmetic only. The next heuristic was ‘Error Prevention, with 4 cosmetic, 1 minor and 1 major ones. The next heuristic was ‘Recognition rather than recall, with 1 cosmetic, 2 minor and 0 major ones. The next heuristic was ‘Flexibility and efficiency of use, with 3 major ones. The next heuristic was ‘Aesthetic and minimalist design, with 3 cosmetic, 2 minor and 0 major ones the next heuristic was ‘Helps users recognize, diagnose, and recover from errors, with 1 cosmetic only. The last heuristic was ‘Help and documentation, diagnose, and recover from errors, with 1 cosmetic only.

Nevertheless, some professional assessors emphasized the subsequent complications related to these heuristics: 1) A Few logos are not graphically and theoretically distinctive, and 2) How to reverse procedures is not visibly specified.

In end, the professional assessors established that Khan Academy could be very challenging for beginner users because it was designed for qualified users, but it could turn out to be much simpler and clearer for beginners with time.

### H) Prototype Development

The prototype is built on the basis of the data collected in the above section. The researcher makes the prototype of validate the CCIUH. The link of prototype is given below: (<https://www.figma.com/proto/LvRozcvhk6w9TXVwqh5MKruM/ElearningApp?nodeid=16%3A58&scaling=scale-down&node-id=1%3A3>)

### G) Results of Prototype

Different tasks were given to the users. The users use the prototype and after performing different tasks the users fill the questionnaire. The results of the questionnaire are given in Fig. 5. The results show that the CCIUH are more effective for the CCI users.

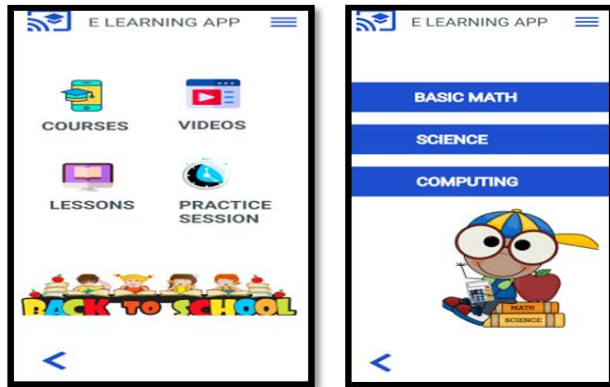


Fig. 3: Prototype Screens

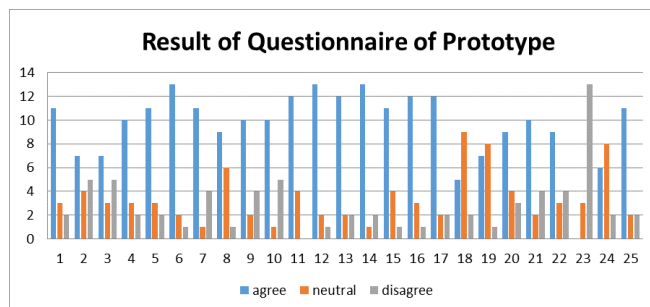


Fig. 4: Results of Prototype Questionnaire

## VI. CONCLUSIONS AND FUTURE WORK

The objective of this research report was to assess the usability and practicability of e-learning application by utilizing proper methods and means. To do that, the largely managed e-learning program of Khan Academy and LingQ application are chosen as case study. To assess the user interface in enhanced method, a well-organized structural approach has been adopted

Various approaches and practices are applied globally to gauge the usability. Every usability assessment method affects different methodologies of teaching and understanding. To receive more precise outcomes, User Testing technique and Questionnaire have been used as the principal devices to uncover the findings.

### Recommendation

The authors have following recommendations that might be helpful in designing the software user interface of mobile phone for CCI user. These recommendations are based on the literature review, findings of questionnaire results, and

observations of CCI user during questionnaires conduction, prototype designing and testing.

### CCI USABILITY HEURISTICS (CCIUH) with the explanations

The CCI users have their own needs and demand. The usability of the interface is different from other users. The heuristics for the CCI user usability are given. A comprehensive explanation of each heuristics has been combined to improve usability evaluator and to clearly use the heuristics while assessing the e-learning program.

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### Conclusion

The major purpose of this study is to discover the necessary demands and desires of CCI users concerning the mobile phone software interface, the usability problems and satisfaction level. To boost the main purpose, broad literature



review is performed to understand the problems of CCI users with mobile phone software interface and services, current software interface layout is offering.

Author realized that there are several problems CCI user face related to the layout of the mobile phone software interface. To clarify and examine usability difficulties in the applications available. The first step that carried out was of literature review in order to gain insight knowledge about the usability evaluation methods and to find related research work. In the second step, the author selected two applications “Khan Academy” and ‘LingQ. User testing was carried out on the same applications by users. User testing was carried out and observations were noticed. It was through the findings from literature review and heuristics evaluation that ultimately helps the author in designing the tasks and questionnaire for user testing participants. The results were gathered helped in making the prototype. With the help of prototype evaluation, the researcher was able to conclude the CCI usability Heuristic for the learning applications.

#### Future Work

The writer considers that the suggestions given in this research might be beneficial in planning and improving the software user interface of mobile phone for aging people with diminishing eyesight. A Few recommendations for future research are described below, built on the conclusions from previous sections of thesis. The learning application can have the social interaction feature. Moreover, the feature of online help by the designer could also be added.

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