Cognition based User Interface Design Framework for E-Learning

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Abstract

User Interface Designs (UIDs) are approaches to teaching and learning based on the use of electronic media and devices. They have various issues where, the cognitive and human factors of the E-Learners that affect the performance of the students are less considered. The objective of this research is to involve the human factors such as Emotional Intelligence, Personality and Intelligent Quotient in designing the UID. Recollection and Retention tests are conducted with the existing UIDs and different Inventory tools are applied to categorize the E-learners based on the human factors. Association rule mining technique is applied to generate rules. Based on the generated rules, suggestions are made to the interface designer for better UID in E-learning. The proposed work focuses on to put forth a framework for UID based on cognitive process of E-learners. This work improves the quality of the UID which in turn increases the students’ performance.

Introduction

Modern Learning methodology has enhanced the traditional pedagogy in its approach. E-learning is an approach to teaching and learning, representing all or part of the educational model applied, that is based on the use of electronic media and devices as tools for improving access to training, communication and interaction and that facilitates the adoption of new ways of understanding and developing learning. Many researches show that E-learning is better than the traditional learning.

The Modern methodology does not have guidelines for its design. There are various factors influencing this design such as the human factors (EQ, Attention, Personality, Stress, IQ, Attitude) and the Cognitive factors (recollection, retention, comprehension and recognition) in the E-Learning process. The relation among the UID parameters and the human, cognitive parameters are investigated to enhance the UID design. The parameters taken into consideration are Personality, Emotional Quotient, Intelligent Quotient.

Personality is the science of describing and understanding persons. It is a dynamic organization, inside the person, of psycho-

physical systems that create the person’s characteristic patterns of behavior, thoughts and feelings. Emotional intelligence (EI) describes the ability, capacity, skill or, in the case of the trait model, a self-perceived grand ability to identify, assesses, manage and control the emotions of one's self, of others, and of groups. Intelligent Quotient is the measure of person’s capacity relative to his or her peers.

In this paper, the correlations between human & cognitive factors of students and their respective recollection & retention ability are observed in an E-learning environment with respect to UID parameters. Finally, AroUID framework is proposed to realize the better E-learning tool.

Background

Cognitive science is the study of the mind. It is an interdisciplinary science that draws upon many fields including neuroscience, psychology, philosophy, computer science, artificial intelligence and linguistics. The purpose of cognitive science is to develop models that help to explain human cognition - perception, thinking, and learning [1].

E-Learning enables users to learn anytime and anywhere. E-Learning demands proper User Interface Design (UID) [2]. UID should be designed by matching the skills, experience and expectations of its users [3]. UID is the design of software applications and websites with the focus on the user’s experience and interaction [4] [5].

The E-learning environment is prominent and it affects the success of individual student’s characteristics [6]. With the rapid development and increasing use of the World Wide Web, learning through the web interfaces has become popular. Web-based learning environment serves as motivational, instructional, modeling, feedback, and assessment tool to the E-learning process. These environments make considerable impact on the cognitive and social behavior of students [7].

The organization of the E-learning materials such as size of text, inclusion of heading, physical layout and size of window are also affecting the E-learning process [8]. Shneiderman [9] cited a number of cognitive aspects (e.g. short and long-term memory, problem solving, decision making, and searching) related to the
user and the task that can have a significant impact on web page design.

With the main objective to produce the university graduates with excellent intellectual skills and creative personality, an experiment was conducted. The findings revealed that such skills can only be achieved if learning was done with process approach within E-learning program, which integrated the elements of motion, audio, color, and image in the learning materials [10].

Stephen R. Gulliver et al. [11] conducted an experiment on Cognitive style and personality. They showed that personality type and user cognitive style affect information assimilation, self-perceived achievements and the level of confidence.

The response of learners varied based on their personality and so personality became an influential indicator of learning performance when learners were taught by various learning materials [12]. Design and implementation of an E-Learning Model considering Learner’s Personality and Emotions analyzed that people with different personalities show different emotions in facing an event [13].

Robin Berenson et al. [14] conducted a research on Emotional Intelligence as a predictor for Success in Online Learning. Their findings revealed that there is a relation between online students’ academic performance and emotional quotient.

In an initiative to explore the relationship between distance education students’ academic performance and emotional quotient, a positive relation among them was discovered [15].

Finally, they found that there is a positive relation between distance education students’ academic performance and emotional quotient.

So, a study is conducted to improve the User Interface Design (UID) based on users’ personality, their EQ and IQ with respect to Recollection & Retention (R&R). Based on the study, a UID Framework has been proposed for E-learners to improve their skills.

AroUID: A Framework for UID

The methodology for AroUID using cognitive processes of E-learners is developed by considering UID and human computer interaction concepts. The UID parameters such as background color, font type are considered to provide a better UID. The human factors such as Personality, Emotional Quotient and Intelligent Quotient are taken in to account in UID based on human interaction. Recollection and Retention are considered as cognitive processes of E-Learners to cull out the characteristic preferences. The methodology incorporates three procedures such as UID based on personality (UIDBP), UID based on IQ (UIDIQ) and UID based on EQ (UIDEQ).

In the methodology of the AroUID framework, two phases are involved. In Phase I, the UIDBP, UIDEQ, and UIDIQ procedures are invoked to explore the respective preferences with R&R tests at two intervals. Test 1 is conducted immediately and Test 2 is conducted with an interval of 24hrs. The results are associated with the UID parameters and the training patterns are found based on Association Rule Mining. Then, the training patterns are stored in the knowledge base for new pattern discovery as shown in Figure 1.

![Phase I – AroUID Framework](image)

Figure 1: Phase I – AroUID Framework

In UIDBP procedure, the students are classified into three categories, namely, Extraversion, Neuroticism and Psychoticism. R&R test is conducted based on the results. The results are analyzed statistically and they are presented to Association Rule Mining technique to yield suggestions for better UID with respect to each personality trait.

The UIDEQ procedure classifies students into five categories, namely, well-being, self-control, emotionality, sociability and global trait EI. R&R test is conducted based on the results. The test results are analyzed statistically and appropriate rules are generated with Association Rule Mining technique for better UID based on Emotional Quotient.

In UIDIQ procedure, students are categorized into three levels, namely, Level I, Level II and Level III. R&R test is conducted to the different levels of students and the results are analyzed with Association Rule Mining technique to generate the rules. Finally, comprising the above methods, the trained patterns for Cognition based User Interface Design Framework is formed.
Procedure

The procedure for the AroUID framework is given below.

Algorithm:
Start

{new_User_Logs_in() /* this method is invoked when a
new student logs in. Then one of
the following tests is conducted*/

UIDBP () /* Personality Test to identify the
Trait*/
{result: Trait of the student is identified
}

OR

UIDEQ () /* EQ Test to identify the Classification*/
{result: The student is classified based
on EQ
}

OR

UIDIQ () /* IQ Test to grade the level*/
{result: IQ level of the student is graded
}

}knowledge_Engine (result) /* the result is sent
to the Knowledge Engine */

{request_Pattern_Recovery() /* request for
trained pattern from the Knowledge Base
is made */

}design_UID
(selected_Pattern, data) /* designer receives
the trained patterns
and data from the
Knowledge Base and Page Base re-
spectively for de-
signing UID */

{output Screen(s) /*(UID Content)
}

Stop

The following lines decipher the above elementary functions of the framework:

(i) new_User_Logs_in () : This method is invoked when a
new student logs in. This function calls one of the methods
(UIDBP, UIDEQ, UIDUQ) based on the choice made by the
student.

(ii) knowledge_Engine (result) : The result acquired from the
test is passed on to the knowledge engine which acquires the
trained patterns using request_Pattern_Recovery().

(iii) design_UID(selected_Pattern, data) : The designer designs
the new UID based on the selected pattern and the data from the
page base.

Framework

In phase II of the AroUID Frame work, the new user in-
puts are analyzed based on the Personality, EQ and IQ. The re-
results are compared with already stored patterns available in the
knowledge base. The knowledge engine discovers the appropriate
patterns based on the decision making process which yields
the trained patterns to the page designer. The page designer de-
signs the UI content with the contents from the page base, based
on the recommendations received from the knowledge engine.
The overall framework is depicted in figure 2.

Figure 2 : Phase II – AroUID Framework
Results and Correlations

The R&R test results are tabulated below, which contain the results of the students’ performance in four tests. The first two columns consist of test results conducted at different time intervals with the existing UID content. The test 3 and test 4 columns are the results obtained after the use of new UID content designed with new patterns. The R&R results for Personality, Emotional & Intelligence Quotient are given respectively in Table 1, 2, 3, where E, W, A refers to Extravert, Wellbeing and Level I respectively.

<table>
<thead>
<tr>
<th>Test 1</th>
<th>Test 2</th>
<th>Personality</th>
<th>Test 3</th>
<th>Test 4</th>
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Personality:
The correlation between Test 1 and Test 2 is 0.911. Test 3 and Test 4 correlation value is 0.932. Thus, it is observed from the results that there is an improvement of 2.01%, which proves that the new user interface design improves the performance of the students.

Emotional Intelligence
The results of Test 1 and Test 2 are correlated and the correlation value is found to be 0.933. From phase II, Test 3 and Test 4 results are correlated to 0.956, which is an improvement of 2.31% in the performance of the students.

Intelligent Quotient
The correlation value for the phase I tests, Test 1 & Test 2 is 0.921 and the phase II tests, Test 3 & Test 4 is 0.942. The results of the correlation values show that there is an improvement of 2.13%, which proves that the new user interface design helps the students to perform better in their academics.

Conclusion

In this paper, the new framework, namely, AroUID is designed incorporating the cognitive and human factors for designing an effective UID. It is observed that the performance of the students has increased with the use of the new UI designed taking into considerations the appealing patterns. There is an average increase of 2.15% in the performance level of the students with the use of new UID. This framework can be made use of while designing effective E-learning materials.

References

Biographies

**Dr. L. AROCKIAM** is working as Associate Professor in the Department of Computer Science, St. Joseph’s College (Autonomous), Tiruchirappalli, Tamil Nadu, India. He has 22 years of experience in teaching and 14 years of experience in research. He has published 107 research articles in the International / National Conferences and Journals. He has also presented 2 research articles in the Software Measurement European Forum in Rome and 1 article in international conference held at Bali, Indonesia. He has chaired many technical sessions and delivered invited talks in National and International Conferences. He has authored books on “Success through Soft Skills” and “Research in Nutshell”. His research interests are: Software Measurement, Cognitive Aspects in Programming, Data Mining, Mobile Networks, and Cloud Computing. He is awarded the “**Best Academic Researcher**” for the academic year 2012-2013 from ASDF Pondicherry. *mail: larockiam@yahoo.co.in. website: www.arockiam.in.*

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