DEAF HCI IN LEARNING AS IMPLEMENTED THROUGH THE DEVELOPMENT OF AN ENGLISH ONLINE COURSEWARE

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ABSTRACT

The growth of technology today has a great impact on the society and because of that, technology are always with everywhere. The internet is becoming the main medium of communication and entertainment for people. The internet is a good use for developing an online courseware that would help the deaf learners in the society especially in the Philippines and local areas. This study discusses the development of an online courseware that would be fitting with the deaf learners to text-based learning materials. It will also tackle some principles in HCI for it is a need for designing the courseware in order to formulate a study that would help the ongoing research on deaf people's learning pattern. Other related works with this proposed project will also be discussed in order to show some comparison between other systems or other application with it. The significance of this study is to create an online courseware for deaf learners in order to study their learning patterns gathered information will be used to help future researchers that are working on designing learning tools for deaf learners. The general focus of this study is to design a learning tool that would fit elementary deaf learners using English subject. The research started from prototyping, which planning and designing the blueprint for the overall research took place. . Pre-test and Post-test testing will be used to gather data for developing new Deaf HCI guidelines. Pre-test and Post-test data will be compared from each other to verify the newly developed Deaf HCI guidelines. The proponent's research found that there is a significant improvement in the children's test scores; indicating that deaf student's improved their learning by using the courseware. According to the data gathered in pre-test and post-test the proponents concluded that had easier time in interacting with the courseware during the post-test when the Deaf HCI guidelines were already applied. In conclusion, the research objectives were achieved and observations suggest future works to try group learning to deaf students.

1. Background of the Study

HCI for Deaf community is an ongoing research and in this research the researchers want to contribute on its growth as the proponents will be using principles of usability and accessibility in HCI as basis for designing this online courseware. There are multiple guidelines in providing better interaction between deaf people and computers; these guidelines will be used as our foundation in developing this research for DHCI. Deaf people who learned sign language since birth will have issues in reading comprehension because the difference of sign language and written language such as English. People that are fully capable doesn't have a hard time in gaining information because they are fully-abled but deaf people are unable to hear and because of that they are having a hard time gaining information that requires audio. In DHCI, captioning will be used in order to provide

accessibility for deaf people in order for them to gain information from videos or audios. Current captioning techniques for the deaf have their own share of issues and hopefully the proponents can derive a better captioning technique especially the more effective use of fonts in designing our webpages. Studies also show that deaf students are having more difficulties in reading comprehension compared to normal students because normal students have access to language since birth and as they grow they also develop their language but for deaf students who are deaf since birth doesn't have immediate access to language during birth because parents need to learn sign language in order to use it to their children. This will play a big part in the deaf student's reading comprehension because they were not able to harness their base language and because of that they will have a hard time to read because they'll have a hard time basing it to their language. This is when ASL appears because in this research ASL will be used in designing our online courseware and at the same time the proponents will record if deaf students will have better reading comprehension when they're reading a written form of ASL. ASL will be the basis of our text in our online courseware and if they show good results then ASL will have a big part in DHCI for text accessibility. In terms of usability, prompting error message when the user commits an error is easily understood by capable users but for deaf people, error messages will not serve well if they can't comprehend what is written on the dialog box and hopefully with DHCI, a deaf-friendly error message will be created that would really serve the deaf user and also improve the site's usability. In accessibility, considering that not all deaf people prefer text and because of this the proponents will device their own assistive technologies that would let deaf users choose from text or sign language all for contributing in the field of DHCI. With all facts stated above, DHCI is really a field of study that needs to improve because there's a vast difference of what capable people and handicap people can or want to do and with this, discrimination towards deaf people will be lessen because hopefully this research will weaken the barrier of communication of deaf and abled people. This research will also be a good way to motivate developers to develop systems, games, applications and other things that will be accessible for the Deaf community. Success on the research could also be used as the basis of developing an effective courseware for deaf students because our research will all be applied on an online courseware for deaf students.

2. TECHNOLOGY APPLICATION CONTEXT

Developing an English online courseware for deaf learners and it was decided to use PHP as the programming language because this will be very helpful to us because this project will be online and PHP is known for designing Web-development for this project to produce dynamic web page. PHP is also very user-friendly that's why programmers love to use this language because of its flexibility. PHP can be easily embedded directly into HTML (HyperText Mark-up Language) which also going to be use along with CSS (Cascading Style Sheets) for this will help to beautify the user interface. This is easy to maintain and develop. It has good accessibility and great way of presenting styles to the users.

This is the very important part of the project that will help communicate to users in a way they can easily understand the lessons that this online courseware offers and this is what we call HCI (Human-Computer Interaction). HCI involves the study of human and computer interaction which means that it's a study that focuses in communication between the user and the computer. This is very crucial in this research because this would be the root of this project in developing an online courseware that would help the deaf learners in the region. With HCI, this project will be able to design a device that would be user-friendly and interesting for children especially for deaf learners, knowing that deaf people mainly use their sight to understand and comprehend things.

There are different principles under HCI but only two principles will be used in our development of DHCI and the courseware. First, usability will be used because it really matters for any type of users that wants to easily do what they want in the site. Usability is closely referred to as being "user-friendly" because it focuses on the improving ease of access for users. Second principle

is accessibility; this principle is used for improving user access or being sensitive towards people that have special cases. Accessibility is the principle that's sensitive to the users status and it will play a big role for deaf learners because they have different capabilities with normal people, thus, making accessibility a must for our proposed project. Usability has different components but the paper will discuss 6 of them, namely: learnability, efficiency, memorability, errors, satisfaction and utility. Learnability is determined by knowing how easy it was for the users during the first time they used the system. Efficiency focuses on how quick the user learns the system after learning it. Memorability is how quick the user regains its proficiency of the system after not using the system for a period of time. Errors are basically referring to how many errors or what type of errors users commit during the use of the system. Satisfaction is the aspect of usability that determines if the user was pleased in using the design. Lastly, utility focuses on the functionalities in the system. If the system provides the user what the user must do in the system then that is the purpose of utility. Utility is providing users functionalities that the users need in using the system. Accessibility has its own of components but accessibility basically refers to the design of the system by evaluating if the system is accessible for different kinds of user. Usability is focused on the system side while accessibility is focused on the user side.

3. OBJECTIVES OF THE STUDY

The general objectives of this research are to develop an English online courseware that would be an effective and efficient learning material for deaf learners in this country. The Online courseware will reflect the implementation of the developed Deaf HCI guidelines from the data gathered in the study.

The specific objectives are:

- To identify guidelines in creating a learning tool for deaf learners.
- To evaluate the reaction of deaf learners of this proposed courseware.
- To design an online courseware that would be effective and efficient for deaf learners by conducting usability and accessibility survey.
- To provide good basis for future researchers on how deaf learners interact with computers.
- To implement our research on DHCI to our user interface in our online courseware.
- To test the usability and accessibility of the developed online courseware and use the data for developing new Deaf HCI guidelines.
- To test newly developed Deaf HCI guidelines to deaf students.

4. SIGNIFICANCE OF THE STUDY

This study is significant for all deaf learners especially to Filipino deaf learners that are having a hard time to comprehend text-based learning material. Through an online courseware for English that is specialized for deaf learners, this project would be able to promote learning by using a balanced integration of ASL and text-based learning materials in English words. It would also give future researchers a basis in designing learning materials for deaf learners or researchers that are researching on HCI that are for deaf people. HCI contributes to the satisfaction of the user and optimize the performance of the deaf and computer together. It also helps to have less unexpected problems that might occur, allows having an easy learning for the deaf and it offer user-controlled interaction. Deaf HCI promotes innovation and at the same time would help deaf learners to interact with computers in a more efficient and effective manner. It will also present new developments for applications that are made specifically for the deaf culture. Deaf HCI is an ongoing research and is not fully developed yet. This will be a good opportunity in contributing to Deaf HCI because it's certain that Deaf HCI will have a huge impact to future technological advancements in the world. It will help IT companies in the world that wants to create new technologies with deaf sensitive design and functionalities.

5. SCOPE AND LIMITATIONS OF THE STUDY

The scope of the study would be specific for grades 4 and 5 deaf students of SPED Bangkal. The courseware will include basic functionalities of an online courseware namely: home page, lessons, scores and quizzes. The courseware also includes features that allow deaf students to create their own accounts for monitoring. Deaf students' account creation will be monitored by their respective advisers for assistance. The scoring system will be used by teachers to monitor and measure the students learning throughout their lessons.

The study's limitations include the sample size of our study which only comprises the students from grades 4 and 5. The courseware is specifically made for deaf students which mean that the courseware only targets students' needs and not the teachers.

6. REVIEW OF RELATED LITERATURE AND TECHNOLOGY APPLICATIONS

In this research, it was encountered that deaf learners prefer using first-hand information than using the information from their interpreter. In videoconferencing, they felt more like normal because teachers are using texted material rather than using ASL. It was also said that videoconferencing was beneficial because of its visual nature. With videoconferencing, deaf learners are able to visit virtual zoo, virtual fieldtrips and virtual museums; learning and having fun at the same time. It was also worth noting that children didn't say that they prefer texted material than using ASL. [9] Another research was made for Malaysian deaf preschool students but it's not online like in this suggested projected. It was stated on that research that for preschool students it was more effective to start in teaching alphabets then teach words for them to understand better. They concluded in their research that with the use of 3D animation they were able to provide effective and efficient courseware for the children because 90% of the students were able to get the correct answer. In conclusion, deaf learners are more into creative learning materials like 3D animations and at the same time they are also comfortable with texted materials especially with videoconferencing as they feel more comfortable having a teacher virtually than the traditional teaching style. [10]

It was stated that like spoken languages, ASL also includes grammatical categories such as noun, pronoun, verb, adjective and adverb. This tells us that with ASL it is really possible to teach English language to deaf learners because its form is somewhat related with ASL considering the categories stated above. It was stated that English language and ASL are very different in terms of grammar. This being stated in the research just shows that learning ASL doesn't mean learning English at the same time because they're totally different when it comes to grammar. This difference tend to be factors in issues about discrimination of people to deaf people and with our project we can enlighten the people that deaf people are also capable of learning English even though they mainly use sign language in communicating to other people. Our online courseware could really help deaf people to learn English language and its basic grammar and hopefully will be able to avoid discrimination towards them by communicating using English language by written form or by understanding a person who's speaking in fluent English. A debate without empirical studies stated that literacy of ASL is unlikely to be transferred into literacy in English. This can be a sign that researchers should also focus on teaching English to students separately because literacy in ASL is different from literacy in English. A paper also stated that knowing ASL does not interfere in reading printed English and in fact it could help deaf children learn to read English. If a deaf person knows ASL then it's really possible for that deaf person to be able to learn and efficiently read English.

HCI involves the study of human and computer interaction which means that it's a study that focuses in communication between the user and the computer. This is very crucial in this research because this would be the root of this project in developing an online courseware that would help the deaf learners in our region. With HCI, the proponents will be able to design a user-friendly and interesting learning management system for children especially for deaf learners, knowing that deaf people mainly use their sight to understand and comprehend things. In this research, it was discovered that there are some guidelines that would really help deaf learners in learning through

reading here in the web. This article discussed to use headings and subheadings and at the same time to write in a journalistic style to make our point and explain it afterwards. The author said that it would be better if to plain language and avoid slangs or jargons to avoid confusion from the readers. It was also stated that it would be better to have one point every paragraph, use bulleted lists and write in an active voice. These things were based on the author's research in helping deaf people to read through the web. The main goal for HCI is to create a pure connection between the user and the computer. It means that the user would be able to fully use the capabilities of a software while the software is aware of the needs of the user thus, creating a pure communication between humans and computers. The first known use of HCI was on 1975 but because of human complexity and the fast growth of computer technology, it's still a work in progress especially for people that are experiencing difficulties in comprehension and understanding. Today, HCI is widely used by professional programmers around the world in designing their user interface for their output. [5]

In Jordan, a research was conducted to understand the problems of the deaf children and teachers are facing. The deaf students are not yet able to learn through an integrated learning in a computer. Teachers can fully able to teach in a computer integrated system and they have a great potential to fully develop the learning skills of the deaf students with the use of an e-learning tool.

Human computer interaction was used in this research. The targets of the researchers are deaf students aged nine years old and their Jordanian teachers. In this research they used mathematics subject. To fully understand mathematics and in order to solve all the problems of the deaf students and Jordanian teachers are facing, semi-structured interviews were undertaken and questionnaires distributed to teachers. The goal at the early stage of research was to explore the current use and status of the e-learning environment and learning management system within the Jordanian schools for the deaf in Jordan. In the later stage, another interviews and questionnaire are conducted to test the effectiveness, usability and readiness of the adopted e-learning environment "Moodle".

Moodle was presented and tested by the Jordanian teachers. It was found out that it is the most suitable e-learning environment for the deaf students from the teacher's requirements. And then Moodle was presented to the children for them to use during the research. [11]

After all the interviews done, the activities of the deaf and their teachers were used and analysed in terms of Human Computer Interaction (HCI) analysis. The analysis includes the readiness, usability, user satisfaction, ease of use, learnability, outcome/future use, content, collaboration & communication tools and functionality.

In this study, HCI is "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" (Hewett et al, 1996). This shows that HCI will be helpful for this research, which will tackle the use and evaluation of e-learning and open source LMS by Jordanian deaf students and their teachers.[6]

HCI is very important in implementing a web-based learning especially for the deaf learners because it is very necessary that the user interface will be suitable for them and it will easily help them understand the lesson. HCI is a great help because it creates a communication between the user and the learning tool.

According to Cox, Cairns, Thimbleby & Webb (2007), HCI is a multidisciplinary subject, shows how the users interact with the system's user interface. Historically, HCI emerged from the two disciplines of psychology and computer science. [2]

HCI also encompasses other fields, like information technology & computing, design & development, business, entertainment, education, library sciences (Giacoppo, 2001).

This research proves that developing an online courseware for deaf is attainable. This can serve as an inspiration in making this project as long as conduct more interviews with Filipino deaf learners and implement proper HCI guidelines. [3]

7. PROJECT METHODOLOGY

1. Prototyping

Acquiring syllabus from the SPED Bangkal for grades four and five. The proponents agreed to use adjectives as our courseware's main lesson to teach specifically the very basic of adjectives and the degrees of comparison as a sub topic for adjectives. Prototyping is the first step in our research. In this stage, planning and distinguishing the main parts of the research was done. During this time, a blueprint was made for our research to guide us throughout.

2. Development

2.1 Design – In designing our online courseware for pre-test, it is only based to what we think is a website's good design and applying some discipline's from usability and accessibility. We tried to use only text for teaching deaf students and observe how they would react to normal text. CSS, Photoshop CS 5 and HTML for the initial design of the courseware was used.

2.2 Coding – In coding, PHP and MySQL was used for our back end that includes storing data into databases. In our client side, JavaScript, jQuery and AJAX was used to try to provide user-friendly client-side. Lastly, CSS, Photoshop CS5 and HTML for designing the courseware's front end was used. These programs/tools was chosen for our courseware because they were already proven and tested by users all over the world.

3. HCI Concepts

3.1 Accessibility

The proponents applied accessibility principles in the courseware for the pre-test by:

- Using colors that are not disturbing for the user's eyes.
- Using fonts that are readable for the users.
- Presenting sufficient on-screen information at a time.

3.2 Usability

The proponents applied usability principles in the courseware for the pre-test by:

- Users don't need to scroll down to view a page.
- Navigation is available most of the time for easier navigation in the courseware.
- Provided warning messages in the test page to avoid unwanted user mistakes.

3.3 Affordance

According to Norman (1988) an affordance is the design aspect of an object which suggests how the object should be used; a visual clue to its function and use. Affordance principles were mainly applied to buttons that are accompanied with graphical representations to suggest or give an idea of their functions.

4. Observing deaf students' interaction in the classroom and towards our online courseware

We visited SPED Bangkal and observed deaf students from grades 4 and 5 and used the as our sample size. First, observing them during class with teachers using traditional teaching

techniques in teaching. Next, observing them while using the courseware to have a basic knowledge on how they interact with the courseware.

5. Pre-test for determining deaf students' learning and courseware's compatibility with deaf learners

On our pre-test usability questions and accessibility questions was used from reliable sources to gather data from deaf students. Pre-test data will be used for analysis that would result to our final output. All the students were gathered from each year level and asked for help to the deaf children's teachers in organizing the children. Every time a student finished using the courseware, their quiz scores was recorded to assess their learning during pre-test. After everyone finished using the courseware, their teachers helped us by interpreting the survey questions into ASL for the students' to understand.

6. Pre-test data analysis for design and learning

The data from pre-test are analyzed and will be used to improve the site's usability and accessibility for deaf students. The gathered data from the pre-test were interpreted using MS Excel's data analyzer add-ins. In this stage, our observations will be used for analysis to have better set of data gathered.

7. DHCI Guidelines

7.1 Deaf students are visual learners and they prefer graphical representations to understand information better.

- The proponents applied this guideline by providing graphical representation in their examples while presenting the lessons in the courseware. Test 1 questions in the test page were accompanied with graphical representations.

7.2 When you create evaluating materials (quizzes, long test and etc...) online, it is better to provide choices because they have hard time spelling words.

- The proponents used combo boxes in providing choices for deaf students' in the test page to avoid misspelled words. According to teachers in SPED Bangkal, they often consider misspelled words as long as it's close to the correct answer.

7.3 There should be alternatives to common audio content included in the website.

- The proponents used graphical representations of supposed to be audio signals for indicating errors or information. In the exercises that was implemented using flash, instead of bleep sound for wrong answers; the proponents added a shaking animation to graphically represent the bleeping sound.

7.4 Instructions in tests should be explained thoroughly by using sign language to translate the instructions.

- The proponents learned from the teachers in SPED Bangkal that instructions are crucial for deaf students when they take tests of different subjects because they usually don't know what to do without proper and

understandable instructions. The proponents provided videos that translate the English instructions into sign language for deaf students to understand.

7.5 Text information presented in the courseware should have Sign language translation for accessibility especially for first time visitors. There should be a good balance between text and graphics.

- The proponents provided sign language translations to English language in the courseware for deaf students to understand the courseware more. In presenting the lessons, they provided sign language translations for every English text for deaf learners to understand the lessons presented in the courseware.

7.6 In presenting information in the screen, as much as possible present compacted information and not in long paragraphs because Deaf learners would easily lose interest. Keep your information compacted in fewer sentences.

- The proponents used 1 sentence in presenting their lessons and that sentence is also accompanied with a video of its sign language translation. They never presented paragraphs with many sentences to avoid confusing deaf students. It was said by the teachers that deaf students have a hard time in processing information and it would be better to present information slowly but surely to deaf students.

8. Applying interpreted data from pre-test (Usability and Accessibility)

The interpreted data will be used as basis of the final output's design. Our data gathered will be reflected on our courseware's design. In this stage, there will be changes in the courseware and the changes will be tested in the post-test and will be the basis of the newly developed Deaf HCI guidelines if it shows good results.

9. Post-test for determining courseware's usability, accessibility and deaf student's learning.

On our post-test the same questions will be use and at the same time there additional new questions that would help evaluate our final courseware. The data will be used for supporting our courseware's usability and accessibility. The post-test procedures will be the same with the procedures in pre-test by gathering the deaf students and letting deaf students' teachers to translate it into ASL for the students to understand. Post-test also includes observing deaf students interaction towards the online courseware to gather additional data.

10. Post-test analysis for developing new DHCI guidelines

The data gathered from post-test will be used as basis of new DHCI guidelines that will be applied to our courseware as our final output. Post-test analysis will be the same with pre-test analysis by using Microsoft Excel's data analyzer add-in that will be used to extract data from our survey. To have significant improvement in post-test results compared to pre-test results because it will help us determine if our findings for DHCI are valid. It will be used to support the credibility of our developed new DHCI guidelines will be expected.