Online Literacy and Mathematics Assessment for Deaf and Hard of Hearing Students

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ABSTRACT
A literate and numerate population is the goal of any modern industrialized society. Literacy and mathematics skills carry the means by which children are equipped for the education processes on which their future will depend. Deaf and hard of hearing students' reading and mathematics skills are lower than that of others due to their inability. Before enhancing their literacy and mathematics skills, their standard of literacy and mathematics skills should first be identified. For this reason, the Malaysian Ministry of Education initiated the Literacy and Numeracy Screening (LINUS) program in 2009. However, problems arose in the assessment method of LINUS screening for these students since the LINUS screening method does not accommodate these students' situation and needs. Therefore, the researchers introduced internet-based Literacy and Mathematics Assessment (iLiMA) prototype that can overcome those problems. In the iLiMA prototype, sign language instruction video is used to standardize the assessment method in order to ensure that non-bias assessment could be established. The methodology used to develop this system is the Evolutionary Process Model - Prototype. The iLiMA prototype usability was assessed with the Computer System Usability Questionnaire (CSUQ) and conducted by using web-based survey method. The results indicate that the iLiMA prototype is usable and teachers are satisfied with it. Finally, the iLiMA prototype which had the potential to accommodate deaf and hard of hearing students to get a standardized and non-bias literacy and mathematics assessment was developed.
Mohd Hanafi Mohd Yasin, Norziah Sahari & Arbi Haza Nasution

ABSTRAK

Populasi yang mahir literasi dan matematik adalah matlamat setiap masyarakat industri moden. Kemahiran literasi dan matematik bertupakan melengkapi pelajar bagi memudahkan proses pelajaran demi masa depan mereka. Pelajar Pekak dan Bermasalah Pendengaran (PPBP) memiliki kemampuan literasi dan matematik yang lebih rendah daripada yang sepatutnya kerana kurang upaya mereka. Sebelum pelajaran asas literasi dan matematik yang mencukupi diberi fokus kepada PPBP, piawai kemahiran asas literasi dan matematik mereka perlu dikenal pasti terlebih dahulu. Oleh itu Kementerian Pelajaran Malaysia telah memulakan program saringan literasi dan numerasi (LINUS) pada tahun 2009. Namun, terdapat beberapa masalah dalam kaedah penilaian melalui saringan LINUS untuk PPBP kerana kaedah saringan LINUS tidak dapat menampung situasi dan keperluan PPBP. Bagi mengatasi masalah tersebut, penyelidik memperkenalkan prototaip Pengujian Literasi dan Matematik Berasaskan Internet (Internet-based Literacy and Mathematics Assessment-iLiMA). Dalam prototaip iLiMA, arahan dalam bentuk video bahasa isyarat diguna untuk memastikan bahawa penilaian yang saksama dapat dilaksana. Metodologi yang digunakan untuk membangunkan sistem ini adalah Model Proses Evolusi - Prototaip. Kepenggunaan prototaip iLiMA diukur dengan Sistem Komputer Soal Selidik Kebolehgunaan (CSUQ) menggunakan kaedah tinjauan berdasarkan web. Hasil kajian menunjukkan bahawa prototaip iLiMA boleh guna dan guru-guru berpuas hati menggunakanannya. Akhirnya, prototaip saringan iLiMA yang boleh guna yang berpotensi untuk menampung keperluan pelajar pekak dan bermasalah pendengaran bagi mendapat penilaian literasi dan matematik yang piawai dan saksama telah dibangunkan.

Keywords: Literacy and numeracy, deaf and hard of hearing students, sign language instruction video

INTRODUCTION

A literate and numerate population is the goal of any modern industrialized society. Literacy and numeracy skills carry the means by which children are equipped for the education processes on which their location in the adult world will depend.

The Malaysian Ministry of Education (2010) defined Literacy as the ability to read, write and understand words, simple sentences and compound sentences with simple conjunctions ‘and’ and apply the
knowledge in education and daily communication. Numeracy is defined as the ability to perform basic operations of mathematics and understanding easy mathematical ideas and apply mathematical knowledge and skills in daily life. In the context of this research, researchers use the term mathematics instead of numeracy.

The increasing emphasis on qualified entry into jobs and further education and training afterwards, has drawn attention to the critical role of the basic skills of literacy and mathematics. Without these building blocks of educational competence, young people's capability for acquiring qualifications is highly restricted and the opportunities for employment are similarly becoming increasingly limited.

Deaf and hard of hearing students' (DHHS's) reading skills are lower than expected due to their inability. In a recent Dutch study, the average reading comprehension score of almost 464 deaf students between 6 and 20 years of age appeared to be at a level equivalent to a hearing child in the first grade (Wauters et al., 2006). 50% of deaf students graduate from secondary school with a fourth grade reading level or less (Traxler, 2000), and 30% leave school functionally illiterate (Marschark, 2002).

Since basic literacy and mathematics skills are crucial for the future of DHHS, it is important for them to learn basic literacy and mathematics skills in the early stage of their life. Based on Mayer (2007) research conclusion, what really matters in the early literacy education of deaf children is that they do learn to read and write.

Before we can focus on providing enough literacy and mathematics education to DHHS, we need to determine first which students have literacy and mathematics skills below the standard. In order to do that, basic literacy and mathematics assessment needs to be all DHHS. There are several researchers doing research on assessment of DHHS. Prezbindowski & Lederberg (2003) have done research on vocabulary assessment of DHHS from infancy through the preschool years. Cawthon & Wurtz (2009) also have researched on alternate assessment use with DHHS with mixed-methods analysis of portfolio, checklists, and out-of-level test formats.

The Malaysian Ministry of Education (KPM) is aware of the importance of literacy and mathematics skill for DHHS in order for them to have a brighter future. The Education Policy and Development Sector, Ministry of Education has been entrusted to oversee, implement and
coordinate the Ministry’s Key Performance Indicators (MPKI) 3.2 KPM which is all students are able to master basic literacy and mathematics except for students with learning problem after three years of primary education by the end of 2012 (Malaysian Ministry of Education, 2010). It means, DHHS are included in this MPKI 3.2 KPM. In other words, DHHS should be able to master basic literacy and mathematics after three years of primary education by the end of 2012.

The MPKI statement demands a mechanism to determine whether MPKI can be achieved or not. In addition, it can also be used as a basis for identifying students who have not achieved the performance standards of literacy and numeracy, so that diagnosis is carried out on what is not mastered, why they are not mastered, and how recovery can be implemented so that eventually all students are able to master basic literacy and mathematics after three years of primary education.

The Malaysia Ministry of Education (2010) recognizes that there are primary school students who have not mastered the basic literacy and numeracy skills. The inability of students to master basic literacy and mathematics skills may be due to their lack of opportunity and exposure to these skills before entering formal education. Therefore, the Ministry of Education planned to resolve the issue through the Literacy and Numeracy Screening (LINUS) program in 2009.

The LINUS screening instruments was developed by the Examination Board in two forms, verbal and written. The Screening instruments and screening instruments operation manual were distributed by the Education Offices in the form of CD-ROMs consist of files in pdf format.

The screening process can be carried out during the process of teaching and learning, but within the time stipulated by the Ministry of Education.

Initially, the LINUS program was not designed for primary school students with special needs like DHHS. The LINUS program was conducted as a paper based examination. Normal students will have no problem in understanding the LINUS material, but students with special needs will have difficulties in understanding the directions / questions in LINUS, let alone answering the questions.
On August 20 2010, LINUS-NKRA No. 13/2010 committee members had a meeting, which was chaired by Mohd Zanal bin Dirin, Deputy Director (Science & Technology), Curriculum Development Division and agreed that the Division of Special Education (BPKhas) is responsible for spearheading this project in collaboration with other departments of the Malaysian Ministry of Education. In that regard, one alternative program designed for primary school students with special needs, is the Literacy and Numeracy Screening (LINUS) NKRA program, Special Education.

PROBLEM STATEMENT

The learning software in the form of CD-ROM in the market today only targets normal users, without regard to special users. These special users, including those with obvious disabilities such as stroke patients, those with Down syndrome, and those with learning disabilities such as dyslexia, and deaf and hard of hearing. These special users should not be forgotten, because they should also benefit from the effects of growth and progress of technology that is now being rapidly accepted (Nor Hasbiah, 2007). Lanyi et al. (2004) also states that in developing educational multimedia software, the target consumers that should be considered are both the ordinary and special users. The Special users referred to by Lanyi et al. (2004) includes those who have problems such as loco-motive difficulties, mental retardation, dyslexia, and deaf and hard of hearing.

There are a number of studies that have been carried out by local and international researchers on the development of courseware for teaching and learning for normal and disability students and children. Based on the research of international researcher, Barker (2003), the CSLU Vocabulary Tutor in Oral-Deaf Education is an effective means of explicitly teaching vocabulary to the deaf children. Marschark M. (2006) has also done research on the benefits of sign language interpreting and text alternatives for deaf students’ classroom learning. There are also some local researchers in this area. Based on research conducted by the Malaysia Examination Board, Ministry of Education (2004) the achievement of the deaf and hard of hearing students in Interactive Computer-based Assessment
(SIBKOM) assessment group is significantly higher than those in the Live Interpretation and the Normal groups. There is also E-Suara Alternative Assessment that has been produced for special education students with learning difficulties in Malaysia (National University of Malaysia, Malaysian Examination Board, 2008). Studies that have been carried out produced software in the Malay language, which benefit the normal and handicapped students.

Today technology plays an important role in everyone’s life. Most of the people’s daily activities depend on technology, including Internet. The Internet is not only for normal people. Everyone, including people with special needs, should be able to benefit from the Internet. The advantage of exploiting the Internet for various uses with the hearing-impaired had been implemented in several ways and areas. These include sign language-based online communication (Fels et al., 2006) and applications in teaching, learning, and education (Belcastro, 2004; Kluwin & Noretsky, 2005). A study that was conducted by Kasiar et al. (2002) demonstrates that the use of a web-based evaluation system in team-taught courses may be a much more efficient way to conduct lecturer evaluations than the traditional paper method. Slike et al. (2008) used Saba Centra software in their research as the online tool for the synchronous presentation of course content, which included PowerPoint lecture material, text chat opportunities, sign language-interpreted video to explore the use of technology to teach online courses to college-age learners who are deaf or hard of hearing. In Jones et al. (2010) research, an interactive Web site was developed that provides users with information in American Sign Language related to smoking cessation. Based on research results of Barak (2008), deaf and hard of hearing adolescents are motivated to use the Internet more than their hearing counterparts and deaf and hard of hearing adolescents use the Internet more intensively than do their hearing counterparts.

Since there are so many researchers who have successfully developed applications / software and some researchers have even exploited the Internet for various uses for DHHS, the idea of developing an application with implementation of Internet in achieving a better way of LINUS screening than the current paper-based LINUS screening caught the researchers’ attention. Since the LINUS program itself is very new in
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Malaysia (started in 2009), there was no previous local research on the development of online assessment for LINUS program for normal student or DHHS. Therefore, the researchers introduced iLiMA (Internet-based Literacy and Mathematics Assessment) prototype that can overcome traditional LINUS implementation problems, especially regarding DHHS.

The traditional LINUS screening process is a paper-based assessment for both normal and DHHS. Problems arise in the assessment method of LINUS screening for DHHS. The LINUS screening method does not accommodate DHHS' situation and needs. In order for DHHS to understand the directions in the assessment paper, one teacher who understands sign language is needed to guide one student. If there is a limitation in the number of teachers who understand sign language, the assessment needs to be done over several days to make sure the number of teachers is equal to the number of students on the assessment day.

The LINUS screening is carried out during the process of teaching and learning, and within the time stipulated by the Ministry of Education with help from teachers who understand sign language to guide the students and explain the questions in the assessment. If the students do not understand the questions, the teachers need to explain again in sign language. This can be bothersome for the teachers and could affect the teachers' sign language accuracy and consistency. Moreover, different teachers could have different sign language accuracy. The iLiMA prototype can overcome these problems by giving a sign language instruction video for each question in the assessment. It will be a standardization of assessment method to ensure that a non-bias assessment could be established. Therefore, a teacher who does not understand sign language can still help DHHS in understanding the questions in the assessment by playing the video. When DHHS still do not understand the questions, the teacher can play the video again and again. By doing this, the teacher will be less tired compared to the traditional way when a teacher who understands sign language has to deliver the questions in sign language over and over again. By implementing the iLiMA prototype, the assessment process can be done anywhere and anytime by anyone who has authorized access. The assessment can be done concurrently in the computer lab with each student accompanied
by a teacher who understands or doesn’t understand sign language. The sign language video will contribute much in iLiMA prototype to help students understand the assessment questions. Previous researchers have also found the advantages of using sign language video for deaf or hard of hearing user. Based on the research of Fajardo (2010), sign language (SL) videos added to text hyperlinks improve Web search efficiency for Deaf Signers.

The screening instruments and operation manual distributed by the District Education Office in the form of CD-ROMs in pdf format will be printed out before the screening is conducted. This is not effective and efficient. With the number of teachers and students that need the LINUS package, the District Education Office needs to provide a lot of CD-ROMs and a lot of deliveries to reach all the teachers and students in the country. Other factors that make it difficult for the teachers and students to get the LINUS package also need to be taken into account, like problem in delivery of the CD-ROMs, defective CD-ROMs, etc. On the other hand, internet-based iLiMA will make it easier and faster for the teachers and students to get access to the assessment. All they need is access to the internet and they can get access to all assessment instruments and operation manual just in a few clicks. DHHS can do the literacy and mathematics assessment at home with a help of their parents. The teachers will be able to get the students’ assessment result right away in the system.

RESEARCH OBJECTIVES

Objectives of this research are:

a. To develop Internet-based Literacy and Mathematics Assessment (iLiMA) prototype for DHHS.

b. To evaluate iLiMA prototype usability for with Computer System Usability Questionnaire (CSUQ).

LITERATURE REVIEW

Literacy and mathematics are the main skills that DHHS must have in order for them to be equipped for the education processes on which their future will depend.
Language literacy is a primary goal of education for deaf and hard of hearing people (Reeves et al., 1995). Many accessible aids have been created in different forms, e.g., a television closed captioning, teletype telephones and speech to text machine translation system, to help the deaf and hard of hearing to succeed in knowledge acquisition. However, all these aids assume that users have strong language literacy skills; therefore, these aids cannot be successfully accessed by the deaf and hard of hearing people.

Based on research conducted by Mayer (2007), for DHHS, the import of this language-early literacy connection can have implications in two ways. First, many deaf and hard of hearing children have delays in their face-to-face language development which can negatively affect literacy learning. Second, deaf and hard of hearing children whose first language is not English (e.g., American Sign Language (ASL) or some other spoken or sign language) are faced with developing literacy in a language they may not have yet acquired.

A number of studies have been carried out by researchers on assessment and the development of courseware for teaching and learning for normal and disability students and children. Prezbindowski & Lederberg (2003) have done research on vocabulary assessment of deaf and hard of hearing children from infancy through the preschool years. Cawthon & Wurtz (2009) have also conducted research on alternate assessment use with DHHS with mixed-methods analysis of portfolio, checklists, and out-of-level test formats. Based on the research of international researcher, Barker (2003), the CSLU Vocabulary Tutor in Oral-Deaf Education is an effective means of explicitly teaching vocabulary to the deaf children. Marschark (2006) also has done research on the benefits of sign language interpreting and text alternatives for deaf students' classroom learning. Findings of a study conducted by Reitsma (2009) have successfully demonstrated that computer-based exercises can contribute in learning to read in profoundly deaf and hard of hearing children.

There are also some local researchers in this area. The MEL software for Pre-School Children produced by Munir (2001) is a software course to motivate literacy among students in pre-school for normal students. Similarly, the MEL-SindDown which was produced by Noraini Muhammad
(2004) is a software course to promote literacy for students, especially for Down Syndrome students. Based on research conducted by Malaysian Examination Board, Ministry of Education (2004) the achievement of the DHHS in the SIBKOM (Interactive Computer-based Assessment) assessment group is significantly higher compared to those in the Live Interpretation and the Normal groups. D-math multimedia courseware to motivate mathematics literacy amongst children with Dyslexia was developed by Nor Hashiah (2007). E-Suara Alternative Assessment has been produced for special education students with learning difficulties in Malaysia (National University of Malaysia, Malaysian Examination Board, 2008). Studies that have been carried out produced software in the Malay language, that benefit the normal and handicapped students.

There are also a number of studies carried out by researchers around the globe on the development of multimedia application for teaching and learning and online assessment for disability students. Loeterman et al. (2002) developed a multimedia curriculum for deaf and hard of hearing children called the cornerstones approach. The goal of the approach is to improve deaf and hard of hearing children’s ability to identify words and to increase vocabulary knowledge and story comprehension. The Signing E-Book (Mueller & Hurtig, 2010) was developed to be a multimedia tool for DHHS that creates (among other applications) electronic books with or without a video of a narrator telling the story in sign language.

All those researchers realized the importance of literacy and mathematics skill for DHHS and tried to find the way to help DHHS to learn and master literacy and mathematics from the early stage of their life. Early assessment of DHHS’s literacy and mathematics skills is important in order to determine their level of literacy and mathematics and provide special training to boost their literacy and mathematics skills if necessary.

METHODOLOGY

Prototype Development Methodology

The methodology used to develop this system is Evolutionary Process Model - Prototype. Prototyping is the process of building an experimental
version of a system (Goldfarb et al. 2004). This trial version is known as a prototype. This model is chosen because the objective had been secured but the detailed input, processing and product requirements are not known. Prototyping provides an opportunity for software developers and consumers to test products, to ensure that these products meet the requirements of the users. Prototyping is an effective approach to replace the old approaches such as Waterfall (Fitzgerald & Linn 2000, Kruse 2005). The use of prototyping may be an effective technique for correcting weaknesses of the traditional "waterfall" software development life cycle by educating the engineers and users (Fitzgerald & Linn 2000: 175). This model is very suitable for the development of new systems/software such as this assessment system. By using this model, the system can be developed quickly. However, there are some disadvantages of using this model, since the development of systems only focus on specific known and available programming language or browser. Inefficient algorithms can be used only to demonstrate the ability of the system.

The sequence of phases involved starts with the communication phase followed by quick modeling design, construction of a prototype, and finally deployment, delivery and feedback phase. Figure 1.1 shows the Evolutionary Process Model - Prototype.

![Evolutionary Process Model - Prototype](Roger Pressman, 2004)
Usability Testing Methodology
The iLiMA prototype usability is assessed with the Computer System Usability Questionnaire (CSUQ) (IBM Corporation 1993). Based on research of IBM Corporation (1993), CSUQ is a stable questionnaire that works well in non-laboratory setting and can be used to assess user satisfaction with system usability.

The CSUQ will be conducted to the teachers by using the web-based survey method. Previous studies found significant difference in response between web-based and paper-based administrations. Kiernan et al. (2005), McCabe (2004), and Sax et al. (2003) found similar results when offering respondents the option to take the survey in either format. People selected the online survey much more often.

Prototype testing, especially for DHHS is often conducted using small sample sizes (Gagne et al. 1992 McKethan & Everhat 2001) to test the effectiveness and usability software in detail before the complete software is developed. McKethan and Everhat (2001) and Nor Azan (2005) used a sample of 13 and 18 students in each group, to test the effectiveness of using multimedia courseware compared to conventional teaching. Munir (2001) used a sample size of 20 students for each experimental group and control group to test the effectiveness of the software in motivating literacy. Wan Fatimah (2004) used bigger simple size (30 and 31 students) to test the effectiveness of mathematics software for teaching geometric visualization skills.

IMPLEMENTATION
The main users of the iLiMA prototype are students and teachers. Both teachers who understand sign language and teachers who don’t understand sign language can use this system and help their students in conducting the online assessment.

Student
One of main users of the iLiMA prototype are primary school students level 1 (grade 1-3) in Malaysia.
a. Home
   The prototype has a user-friendly user interface. The home page looks like this.

b. Registration
   Before you can use the iLiMA prototype, you need to register. You need to have an email address to be registered in this system. If you do not have any email address, you can register your email address at http://mail.yahoo.com or http://mail.google.com or any other email provider.

   If you already have an email address, you can register to this system. The registration form is given below.
This is the validation if you have not filled in all required fields or used wrong format at the field.

<table>
<thead>
<tr>
<th>Registration Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Type: Student</td>
</tr>
<tr>
<td>First Name:</td>
</tr>
<tr>
<td>Last Name:</td>
</tr>
<tr>
<td>Email:</td>
</tr>
<tr>
<td>Password:</td>
</tr>
<tr>
<td>Password Again:</td>
</tr>
<tr>
<td>Gender:</td>
</tr>
<tr>
<td>Age:</td>
</tr>
<tr>
<td>Telephone No:</td>
</tr>
<tr>
<td>School:</td>
</tr>
<tr>
<td>Year of Study:</td>
</tr>
<tr>
<td>Teacher:</td>
</tr>
</tbody>
</table>

The required fields are written in bold and have to be filled in.

This is the alert if your email is already registered in the system.
Email verification will be sent to your email address to verify your email and complete your registration.
After you click that verification link at the picture, you will be redirected to the iLiMA system.

d. **Login**

You need to login and choose student as user type and put your email address and password that you have already registered and click the "Login", button.

This is the validation if you've used the have not filled in required fields or used wrong format at the fields.

This is the validation if you've used the wrong combination of username and password or your email address is not validated.
This is what the iLiMA header looks like after you successfully login to the system. Your name will appear on the right side of the header.

e. User Profile
After you login to the system, you can view and edit your profile at Profile Menu. This is how your profile will be like.

This is what it looks like when you edit your profile.
f. Assessment

There are 4 assessments in the prototype, which are *Literasi Membaca*, *Literasi Menulis*, *Matematik Bertulis*, and *Matematik Lisan*.

This is what it looks like before you start one of the assessments. Before attempting *Literasi Menulis* and *Matematik Bertulis* assessment, you need to print the instrument that will be used during the assessment.

This is what it looks like when you download the instrument.
After you print the instrument, you can start the assessment. Each assessment will be conducted within an hour. To open the sign language video, click the sign language icon.

This is what you can see after time's up or you click the finish button after the last question.

This is the end of Literasi Membaca Assessment.
Teacher

The second main user of the prototype is the teacher. Teachers who understand sign language as well as those who don’t understand sign language can use this system and help their students in conducting the online assessment.

a. Home

The iLiMA prototype has a user-friendly user interface. The home page looks like this.

b. Registration

Before you can use the iLiMA prototype, you need to register. You need to have an email address to register in this system. If you do not have any email address, you can register your email address at http://mail.yahoo.com or http://mail.google.com or any other email provider.
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If you already have an email address, you can register in this system. This is the registration form.

Registration Form

User Type: Teacher
First Name: __________________________
Middle Name: ________________________
Last Name: __________________________
Email: ______________________________
Password: ____________________________
Password Again: ______________________
Gender: ______________________________
Age: _________________________________
ID No: ______________________________
Telephone No: ________________________
School: _____________________________
Specialty: ___________________________
Year of Experience: __________________

The required fields are written in bold and have to be filled in.

Create Account  Cancel

This is the validation if you have not filled in all required fields or used wrong format at the field.

Registration Form

User Type: Teacher
First Name: __________________________
Middle Name: ________________________
Last Name: __________________________
Email: ______________________________
Password: ____________________________
Password Again: ______________________
Gender: ______________________________
Age: _________________________________
ID No: ______________________________
Telephone No: ________________________
School: _____________________________
Specialty: ___________________________
Year of Experience: __________________

The required fields are written in bold and have to be filled in.

Hover to the icon to see the error

85
This is the alert if your email is already registered in the system.

This is the alert after all forms are filled and the user clicks the “Create Account” button and there are no errors anymore.

If email verification has been sent to your email address, this alert will pop out.

c. Email Verification

Email verification will be sent to your email address to verify your email and complete your registration.
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After you click that verification link at the picture, you will be redirected to the iLiMA system.

d. Login

You need to login and choose user type as Student and put your email address and password that you have already registered and click the "Login" button.

This is the validation if you have not filled in the required fields or used wrong format at the fields.

This is the validation if your combination of username and password or your email address is not validated. Please make sure that you have already validated your email address.
Mohd Hanafi Mohd Yasin, Noraidah Sahari & Arbi Haza Nasution

Invalid Username/Password!
or the email is not verified

Login as: Teacher
Email: arb_haza@yahoo.com
Password: ********

Login

This is what the iLiMA header looks like after you successfully login to the system. Your name will appear on the right side of the header.

e. User Profile
After you login to the system, you can view and edit your profile at Profile Menu. This is how your profile will be like.

This is what it looks like when you edit your profile.
f. **Manual**
You can read the manual on the assessment instruments at the Teacher Menu.

g. **Email Notification**
You will get an email notification every time one of your students has finished one of the assessments.
h. Student Report

You can see your students' assessment results at the Teacher Menu.
RESULT

Evaluation of the iLiMA prototype was done in two phases. The first phase was done at SK Pendidikan Khas Kampung Baharu, Kuala Lumpur with six teachers and six DHHS and the second phase at Faculty of Education, National University of Malaysia with 29 fourth year undergraduate students majoring in Special Education.
Results of the First Phase of Evaluation

In the first phase of the evaluation, researchers observe directly the whole process of assessment and give assistance to teachers on how to use the prototype.

Overall, results show that the iLiMA prototype is usable and teachers are satisfied with it. It is proved by the minimum mean 4.33 for 28 items out of 29 items. Another item mean is 3.67.

Teachers and DHHS have a good basic knowledge of computers and sign language. The mean range is between 3.67 to 6 as shown in the table below.

Table 1: Computer and Sign Language Knowledge

<table>
<thead>
<tr>
<th>Item</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I love using computer.</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>1.095</td>
</tr>
<tr>
<td>I know how to use the computer.</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>5.67</td>
<td>1.033</td>
</tr>
<tr>
<td>I know how to use sign language.</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>4.5</td>
<td>0.548</td>
</tr>
<tr>
<td>My students love using the computer.</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>5.33</td>
<td>0.816</td>
</tr>
<tr>
<td>My students know how to use the computer</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>3.67</td>
<td>0.516</td>
</tr>
<tr>
<td>My students know how to use sign language.</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>4.33</td>
<td>0.516</td>
</tr>
<tr>
<td>Sign language helps my students to</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>5.67</td>
<td>1.033</td>
</tr>
<tr>
<td>understand a thing.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results show that the iLiMA prototype is usable. The range of mean is between 4.33 to 5.33 as shown in the table below.

Table 2: Usability the of iLiMA Prototype

<table>
<thead>
<tr>
<th>Item</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall, I am satisfied with how easy it is to use this system.</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>5.00</td>
<td>1.265</td>
</tr>
<tr>
<td>It was simple to use this system.</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>4.83</td>
<td>1.472</td>
</tr>
<tr>
<td>I can effectively guide my students in the assessment using this system.</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>4.83</td>
<td>1.169</td>
</tr>
</tbody>
</table>

cont.
Online Literacy and Mathematics Assessment for Deaf and Hard of Hearing Students

<table>
<thead>
<tr>
<th>Item</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The automatic marking function in this system is easy to use and</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>5.00</td>
<td>1.265</td>
</tr>
<tr>
<td>effective.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The automatic marking function in this system makes me mark</td>
<td>6</td>
<td>3</td>
<td>7</td>
<td>5.33</td>
<td>1.366</td>
</tr>
<tr>
<td>faster and more efficiently.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sign language video in this system makes it easier to explain the</td>
<td>6</td>
<td>3</td>
<td>7</td>
<td>5.00</td>
<td>1.414</td>
</tr>
<tr>
<td>assessment directions to my students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sign language video in this system can be understood by my students.</td>
<td>6</td>
<td>3</td>
<td>7</td>
<td>4.83</td>
<td>1.602</td>
</tr>
<tr>
<td>I feel comfortable using this system.</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>4.88</td>
<td>1.169</td>
</tr>
<tr>
<td>It was easy to learn to use this system.</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>4.83</td>
<td>1.169</td>
</tr>
<tr>
<td>The system gives error messages that clearly tell me how to fix</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>4.00</td>
<td>1.414</td>
</tr>
<tr>
<td>problems.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whenever I make a mistake using the system, I recover easily and</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>4.33</td>
<td>1.633</td>
</tr>
<tr>
<td>quickly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The information (on-screen / pop up messages) provided with this</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>4.83</td>
<td>0.753</td>
</tr>
<tr>
<td>system is clear.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is easy to find the information I need.</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>4.67</td>
<td>1.033</td>
</tr>
<tr>
<td>The information (on-screen / pop up messages) provided in the</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>4.33</td>
<td>1.366</td>
</tr>
<tr>
<td>system is easy to understand.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The information (on-screen / pop up messages) is effective in</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>4.33</td>
<td>1.033</td>
</tr>
<tr>
<td>helping me to guid the students in the assessment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The interface of this system is pleasant.</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>4.33</td>
<td>1.366</td>
</tr>
<tr>
<td>I like using the interface of this system.</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>4.50</td>
<td>1.049</td>
</tr>
</tbody>
</table>

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Mohd Hanafi Mohd Yasin, Noraidah Sahari & Arbi Haza Nasution

<table>
<thead>
<tr>
<th>Item</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>This system has all the functions and capabilities I expect it to have.</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>4.33</td>
<td>1.506</td>
</tr>
<tr>
<td>The system attracts my students' interest to answer the assessment questions.</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>4.67</td>
<td>1.211</td>
</tr>
<tr>
<td>This system can enhance my students' motivation for answering the assessment questions.</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>4.67</td>
<td>1.211</td>
</tr>
<tr>
<td>My students feel comfortable and happy using this system.</td>
<td>6</td>
<td>2</td>
<td>6</td>
<td>4.50</td>
<td>1.517</td>
</tr>
<tr>
<td>Overall, I am satisfied with this system.</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>4.83</td>
<td>0.983</td>
</tr>
</tbody>
</table>

Results in the Second Phase of Evaluation

Based on feedback and results of the first phase of evaluation, the prototype has been revised and improved. In the second phase of the evaluation, the usability of the revised and improved prototype was evaluated. In this second phase of evaluation, 29 4th year undergraduate students of National University of Malaysia majoring in Special Education were involved, but without any DHHS. Those final year students play the role of teachers.

Overall, the results show that the iLiMA prototype is usable and final year students as teachers were satisfied with it. It is proved by the minimum mean 5.34 for 24 items out of 25 items. Another item mean is 3.83.

Final year students as teachers had basic knowledge of computers and sign language. The mean range is between 3.83 to 6.28 as shown in the table below.

Table 3: Computer and Sign Language Knowledge

<table>
<thead>
<tr>
<th>Item</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I love using computers.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>6.28</td>
<td>0.922</td>
</tr>
<tr>
<td>I know how to use computers.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>5.86</td>
<td>0.875</td>
</tr>
<tr>
<td>I know how to use sign language.</td>
<td>29</td>
<td>1</td>
<td>7</td>
<td>3.83</td>
<td>1.891</td>
</tr>
</tbody>
</table>
Results show that the iLiMA prototype is usable. The range of mean is between 5.34 to 6.10 as shown in the table below.

### Table 4: Usability of iLiMA Prototype

<table>
<thead>
<tr>
<th>Item</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall, I am satisfied with how easy it is to use this system.</td>
<td>29</td>
<td>2</td>
<td>7</td>
<td>5.34</td>
<td>1.203</td>
</tr>
<tr>
<td>It was simple to use this system.</td>
<td>29</td>
<td>2</td>
<td>7</td>
<td>5.55</td>
<td>1.242</td>
</tr>
<tr>
<td>I will be able to effectively guide my students in the assessment using this system.</td>
<td>29</td>
<td>2</td>
<td>7</td>
<td>5.62</td>
<td>1.015</td>
</tr>
<tr>
<td>The automatic marking function in this system is easy to use and effective.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>5.90</td>
<td>0.817</td>
</tr>
<tr>
<td>The automatic marking function in this system makes me mark faster and more efficiently.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>6.00</td>
<td>0.926</td>
</tr>
<tr>
<td>Sign language video in this system makes it easier to explain the assessment direction to my students.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>6.03</td>
<td>0.778</td>
</tr>
<tr>
<td>Sign language video in this system will be understood by my students.</td>
<td>29</td>
<td>3</td>
<td>7</td>
<td>5.76</td>
<td>1.057</td>
</tr>
<tr>
<td>I feel comfortable using this system.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>5.79</td>
<td>0.819</td>
</tr>
<tr>
<td>It was easy to learn to use this system.</td>
<td>29</td>
<td>3</td>
<td>7</td>
<td>5.83</td>
<td>1.197</td>
</tr>
<tr>
<td>The system gives error messages that clearly tell me how to fix problems.</td>
<td>29</td>
<td>3</td>
<td>7</td>
<td>5.55</td>
<td>1.213</td>
</tr>
<tr>
<td>Whenever I make a mistake using the system, I recover easily and quickly.</td>
<td>29</td>
<td>3</td>
<td>7</td>
<td>5.66</td>
<td>1.045</td>
</tr>
<tr>
<td>The information (on-screen / pop up messages) provided with this system is clear.</td>
<td>29</td>
<td>3</td>
<td>7</td>
<td>5.76</td>
<td>0.988</td>
</tr>
<tr>
<td>It is easy to find the information I need.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>5.83</td>
<td>0.928</td>
</tr>
<tr>
<td>The information (on-screen / pop up messages) provided in the system is easy to understand.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>5.69</td>
<td>0.930</td>
</tr>
<tr>
<td>The information (on-screen / pop up messages) is effective in helping me to guide the students in the assessment.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>5.93</td>
<td>0.884</td>
</tr>
</tbody>
</table>

cont.
Mohd Hanafi Mohd Yasin, Noraidah Sahari & Arbi Haza Nasution

<table>
<thead>
<tr>
<th>Item</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The interface of this system is pleasant.</td>
<td>29</td>
<td>3</td>
<td>7</td>
<td>5.97</td>
<td>0.906</td>
</tr>
<tr>
<td>I like using the interface of this system.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>5.97</td>
<td>0.778</td>
</tr>
<tr>
<td>This system has all the functions and capabilities I expect it to have.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>5.72</td>
<td>0.882</td>
</tr>
<tr>
<td>The system will attract my students' interest to answer the assessment questions.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>5.93</td>
<td>0.842</td>
</tr>
<tr>
<td>This system will be able to enhance my students' motivation for answering the assessment questions.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>6.03</td>
<td>0.731</td>
</tr>
<tr>
<td>My students feel comfortable and happy using this system.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>5.90</td>
<td>0.860</td>
</tr>
<tr>
<td>Overall, I am satisfied with this system.</td>
<td>29</td>
<td>4</td>
<td>7</td>
<td>6.10</td>
<td>0.860</td>
</tr>
</tbody>
</table>

CONCLUSION

The use of sign language in this screening test was successfully tested to gauge the reading and math skills of DHH students. Based on the results from the first phase of evaluation at SK Pendidikan Khas Kampung Baharu, Kuala Lumpur with six teachers and six DHHS and the second phase at the Faculty of Education, National University of Malaysia with 29 4th year undergraduate students majoring in Special Education, iLiMA prototype was proven to be usable and the teachers were satisfied with it. Finally, the iLiMA prototype has the potential to accommodate DHHS to get a standardized and non-bias literacy and mathematics assessment.

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