Can Ali Pass the Program? An Empirical Study of a Blind ICT Student challenges at Arab Open University

Ali AlSoufi

College of IT, University of Bahrain

AAlSoufi@Uob.Edu.Bh

ABSTRACT

We live in visually oriented society, in which the computer is becoming as commonplace and integral part of every student's educational experience. It plays essential role in transforming the way in which postsecondary programs educate and communicate with their students. Faculty is encouraged, often strongly, to incorporate more computer technology and web-enhanced components in their courses as well as to develop distance education courses and programs. Recently many textbooks include CDs that contain additional course material, course assignments, animated visual aids and tests to support both faculty and the students. Students usually use their computers to write papers, register a course and communicate with faculty and other students. These actions constitute challenges for students that are visually impaired or blind. People with disabilities are often misunderstood and discriminated against when it comes to education and especially when they pursue their higher education. The purpose of study is to explore challenges with respect to the course materials used in the first degree in IT at Arab Open University. To achieve this a blind student, who is the first experience at the university, is used as a case through studying his background and monitoring his progress in the first year of study, while a comprehensive analysis on the course material, that he will be covering in the 4 years of the program, was conducted to predict whether he will able to complete his studies successfully in the IT program. Furthermore the challenges explored would be used to enhance the program delivery for visually impaired students.

Indexing terms/Keywords

ICT blind student; Arab Open University; Assistive tools; Visual impaired students; E-learning .

Academic Discipline And Sub-Disciplines

Information Technology Education and social aspects of IT

SUBJECT CLASSIFICATION

Information Technology, Visual impared personannels

TYPE (METHOD/APPROACH)

Case study, mathematical and statistical analysis, Interview

INTRODUCTION

According to Individuals with Disabilities Educational Act [1], disability is a natural part of the human experience and should in no way diminish the right of individuals to participate in or contribute to society. Improving educational results for children with disabilities should be an essential element of our national policy of ensuring equality of opportunity, full participation, independent living, and economic self-sufficiency for individuals with disabilities.

In general, policies and institutions have sought to define disability. In a report issued by the United Nations, disability is defined as "any restriction or lack (resulting form and impairment) of ability to performance activity in the manner or within the range considered normal for a human being" [3]. Visual impairments are divided into two general categories: blindness and low vision. Individuals with blindness have absolutely no sight, or have so little that learning must take place through other senses. "Only 10-15% of the visually impaired population is totally blind. People with low vision have severe impairments and need special accommodations, but are still able to learn through vision" [3]. In the current information age, the use of computer technology, internet and understanding the ways in which these technologies affect different dimensions of twenty-first century society have become essential part of every student's education. However, in Gulf countries, there is still exists a digital divide between those who use computer technologies and others. Many of the earliest classroom computer advocates saw technology as a great equalizer, a powerful tool that could be deployed effectively by disadvantaged communities and families to close the learning gap. Assuring that technology resources were distributed equitable and used efficaciously has since proved to be quite the challenge for educators and policy makers alike, in part because advances in technology itself mean that new gaps open up as quickly as old ones are bridged [2].

While the economic digital divide has begun to be addressed, another digital divide started that involves the use of computer technology for students with disabilities. This has recently begun to be explored in a more public forum. People with disability who are accessing the internet are only half as those without a disability. And while just under 25% of those without a disability have never used a personal computer, close to 60% without a disability fall into that category. Among those with a disability, people who have impaired vision have even lower rates of internet access and are less likely to use a computer regularly than people with hearing and mobility problems [4].

Challenges of Blind ICT Students

Over the past few years the trend for the number of IT majors at the college level has increased significantly globally. On the other hand, there are very few students with visual disabilities among these large numbers of IT majors – even though IT is currently a popular major choice for high school students with disabilities planning to go to college. This situation is not because students with visual disabilities dislike IT subjects; rather it is because of barriers that exist for these students to study IT in a traditional IT curriculum. For instance, one barrier is simply the way in which most IT courses are taught – a way that makes heavy use of visual images and abstractions [5]. This is the case in the classroom as well as in textbooks. Another barrier is that the science and mathematics courses of an IT curriculum are usually not set up to use assistive technology that is specifically designed for these kinds of classes. The technology exists; it is just not readily available in most universities. A third barrier for students with visual disabilities comes into play in actually learning to write computer programs [3].

Generally, the biggest challenge that visually impaired students face in school\university and in the outside world is the huge mass of printed materials. In addition, the visually impaired student must also deal with the teacher's use of a blackboard, overhead, and audio-visual equipment. Other problem that the Blind institutions/schools are waiving math course that requirements of students with disabilities in high school. Therefore, any student who wishes to major in IT, and who has the aptitude for studying computer science, should have the necessary high school background to start the program [6]

Different aspects of college and the IT curriculum are more or less challenging for particular students, depending on their disability. For students with visual disabilities, studying mathematics with symbols and formulas, and navigating a programming environment present two unique challenges [5]. On the other hand there are also technical challenges related to the use of computers. Fist, blind people cannot perceive images. Second, they cannot use a mouse as they do not have the necessary coordination between hands and eyes. Third, text passages are frequently integrated as images. Such text images can be imagined as photos of texts. This often happens on the Internet (Java, JavaScript, HTML), in PDF files and in multimedia applications. Finally, blind people do not have an overview of the entire screen layout and content when they start a new program or open a new website. To do this they must read through the screen content or the active window in sequence, line by line, from top left to bottom right [6].

Objectives of the Study

Arab Open University (AOU) was established in 2003 by prince Talal Bin Abdul-Aziz of Kingdom of Saudi Arabia (KSA). Currently the university accommodates more than 25 thousand students spread across 7 countries in the Middle East namely (Kuwait, KSA, Bahrain, Oman, Jordan, Lebanon and Egypt). One of the key objectives of the AOU is education for all, regardless of nationality, race, gender, age or disability. Unlike classical universities, AOU mode of teaching is dependent more on self study with only 25% students/lecturer contact hours or class attendance. This would enable and encourage remote students, working students and mothers at home to pursue their studies.

As a result AOU has put lots of emphasis in developing comprehensive course materials to support such mode of operations. Additionally, technology is put into work, especially ICT and eLearning environments such as Moodle and various video conferencing methods and tools, to deliver such materials easily to the remote students, who spend most of

their time away from the university campus. Such comprehensive self reliant course materials, but also available electronically in various formats, would bring great opportunities for blind students, if they are put into considerations some of the limitations that such students posses.

The objective of this paper is to explore such challenges with respect to the course materials used in the first degree in IT at Arab Open University. To achieve this

- A blind IT student (Ali), who is the first experience at the university, is used as a case through studying his background and monitoring his progress in the foundation and first years of study.
- A comprehensive analysis on the course material, that he will be covering in the coming 4 years, will be conducted to predict whether he will be able to complete his studies successfully or not.

Limitations of the Study

This is research is limited to studying the case of a blind student with respect to his ability to grasp the course material of a IT undergraduate program in AOU. Aspects such as social background of the student, learning environment and blind assistive tools are not the focus of the study, although they may be referred to superficially throughout the paper.

LITERATURE REVIEW

Blind Programmers: Existing Cases

Like any other jobs, experience shows that programming is not limited to sighted people, but blind people could be programmer if the right environment exists. Starting in the mid-1960s the University of Manitoba ran a program for many years in which they trained blind students as programmers [6]. In this section, real cases of visually impaired programmers will be highlighted. It covers cases from different continents including Arab countries. Additionally, the background of the blind case of this research (Ali) is also discussed at the end of the section.

1. **Peter Lundbland:** He is a leading contributor to the subversion of open source code project, which has produced a widely implemented code management system. He was among five leaders of open source code recognized at the O'Reilly Open Source Conference. Unlike the others, Lundblad is blind, a fact that didn't bother Google, his new employer [7].

2. **Chris Hofstader**: He worked at Freedom Scientific as Vice President of Software Engineering, which launched the world's famous screen reader JAWS. "The greatest thing for me was the freedom to invent my future. I was building technology that the next day I could use myself," he told E-Access Bulletin. He left Freedom Scientific to start an open source software company. He is aiming to work on creating his own accessible software company as well as launching a website for blind and sighted programmers to share their knowledge about accessibility. He thinks that the assistive technology industry's downfall because of "not listening to science" and believes that they should have much more contact with universities, something he is putting into practice himself through his own recently-launched accessible software company Ad Lib Technology. The company's aim is to design software, and possibly hardware in future, based on the principles of universal design [8].

3. **Sangyun Hahn:** In his article about himself, titled "experiences of a blind computer scientist", he described how he was introduced to the IT world [9]. He heard that a basic screen reading software for Korean running on DOS was developed, so he started learning how to use it and a word processor program. He learned C programming language and used it write a program to clean up and format scanned text for Braille translation. He enjoyed the logical process of writing a program and took a couple of computer science classes such as data structures and introduction to computer science. He did well in these courses, and with all his computer knowledge, he could help his sighted colleagues to solve their computer problems. He got a scholarship, and had the honor of becoming the first blind computer science student in Korea. The most difficult part was to obtain books in an accessible format. Most computer science books have important math equations and figures. It was a lot harder to find volunteers who could read math equations. So he often had to meet other students and teach them how to read equations and figures. The figures were mostly described verbally, but complex diagrams like computer architecture diagrams were hard to understand, which he had to spend a long time in understanding them. He got interested in artificial intelligence and machine learning, and decided to continue his studies in graduate school [9].

4. **Mohammad Al-Shar':** He is a Jordanian programmer who is a specialized in adaptive technology. Mohamed, who was born blind, has exceeded the expectations of his community and today he does what most of his peers with sight might find difficult. Currently, he is working as a technical support and training executive for Nattiq technologies, an international firm that specializes in assistive technologies [10], to help blind and disabled people access the Internet. He has learnt to touch-type, and the computer reads the letters back to him as he does so. With this technology, Mohammad can surf the web, chat, read e-mail or e-books and even design websites. Developing screen reading technology is Mohammad's job, but it's also much more; a gateway to a world of possibilities he might never otherwise have known, from web design to blogging [11]. His job at Nattiq includes technical support, software development, maintaining web site, and training. One of the biggest projects he ever undertook during his work at Nattiq was building their website, which is now the biggest portal for assistive technology for Arabs. He gave training courses on using screen readers such as Jaws for Windows, Hal and Supernova, Ibsar, Vergo, Window-Eyes. He has either built or participated in building of number of web sites such as AT Explorer, Friendship Association for the

blind, the Saudi center for the training of blind girls, the youth association of the blind in Lebanon and Ride to Stars - a personal website for his friend Sumaia Al khalidi [12].

Ali: The Case of this Study

The author got to know Ali Oliwi, the case of this study, when he first visited his office as a head of IT and Computing (ITC) department at AOU. Ali's request was an acceptance to ITC program. This was not only the first experience in AOU, but also in kingdom of Bahrain to have a blind student who is interested in IT as career. Knowing the difficulty of ITC program for such visual impaired person, the author first tried to convince him to join the business program instead. However, with Ali's insistence and enthusiasm, but also by proving his background and IT skills he had acquired in the past few years, his request was approved. Since this was the first experience in Bahrain, the author decided to put Ali under close supervision and provide him all the necessary support to make him succeed in the program, including an investigation/research on similar cases around the world and Arab work specifically to understand and predict areas of challenge of such kind of students in IT programs.

Ali's Background

Ali is a smart, confident and independent young guy, who was born blind in a small village in Kingdom of Bahrain. Ali got his primary and intermediate education at the Saudi Bahraini Institute for Blind in Bahrain, where he learned Braille language, typed by typewriter; before the computer entered the institute, in addition to the other usual subjects. He then joined a regular secondary school with Art major. Three years later he received his musical diploma in violet instrument form Bahrain Musical Institute.

His first contact with a computer was in 2002, when he bought a computer and screen reader software. It was a desktop PC, but without any special features for blinds; except the screen reader that it supported. Currently, Ali uses JAWS, Virgo, Cobra screen readers [15] [16]. It took many years of hard work and patience with trial and error before he became skilled in using computers and various kinds of applications. His family and friends also had major and a positive role in supporting and encouraging him to move forward. He is now capable of writing using word processor, installing various application programs, organizing the computer and trouble shoot it in many cases. When he was asked about the changes that the computer has made to his life, Ali replied "I have become more independent. It helps me communicating with more people efficiently, reading newspaper and establishing my musical website club. Basically it is all my life."

He has recently developed, in coordination with other Arab blind developers the first Apple website for Arab blinds, www.i4blind.com, to support those using Apple products such as iPhone, iPad and iPod. The announcement about it is published on the Arab technology gateway http://www.aitnews.com/news/15168.html.

Ali's capabilities and potentials in using computers made some of the friends and associates at the Friendship Association for the Blind to encourage him to pursue his studies in IT. As mentioned earlier, unlike other classical universities, AOU has an advantage in their programs and educational model that makes the life easier for visually impaired people to study.
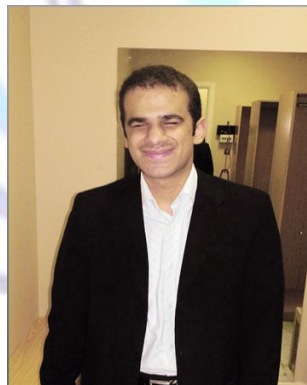

Figure 3: Ali Al Oliwi

RESEARCH METHODOLOGY

As mentioned earlier, the objective of this research is to predict whether Ali (the blind student of our case study) could pass the IT program at AOU. From the previous sections it is clear that Ali has the capabilities (the prerequisite) to enter the IT program at AOU. He showed his IT skills and technical capabilities to handle computer applications, especially with the blind assistive tools mentioned earlier. On the other hand he understands various IT jargons, terms and concepts that would be needed in the 1st year of study. Such characteristics will satisfy one of the key requirements of the research model shown in Figure 2, the "IT Background".
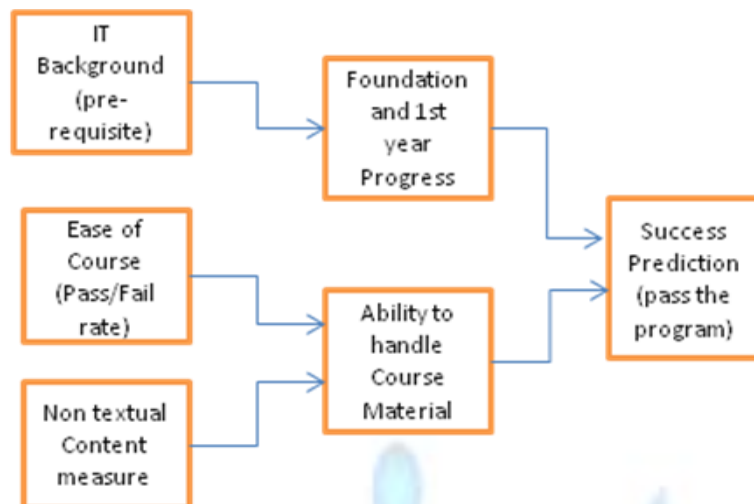
Figure 2: The Research Model

To predict whether Ali will successfully pass the IT program or not, further actions are taken, as shown in the model (figure 2):

1. Monitor his progress in the foundation and first year of the program. This will help in testing his capabilities to handle university environment (both social and academic), to explore the difficulties that he may face during this period in order that they may be overcome in the following years. Second, monitor his performance with regards to the grades he will score for studying along with sighted students.

2. Study the core courses of the IT program, that will be covered in the subsequent years, and analyze their content as follows:

   Method One: The courses are evaluated in terms if their difficulty to be passed by the students. They are tested whether there is a significant difference between the expected values (the highest rate in all courses that he is expected to outperform) and the observed values (the rate which we give him in each course). To achieve this Chi-square test is used in case of one variable (the course) with several tiers (the 13 courses of AOU's IT program).

   Method Two: Calculate the probability of Ali's success in his study by measuring two variables: 1. the weight of Ali's understanding of the four domains; Mathematical, Logical, Graphical and Textual, and 2. the percentage of each domain repeated in the content of each course. These will be further elaborated in the coming sections.

The above two methods will test the null hypothesis (H_0): Ali will succeed and the alternative hypothesis (H_1): Ali will not succeed.

RESEARCH ANALYSIS AND DISCUSSIONS

First Year Progress

Since AOU does not have a special program that is catered for visually impaired students, additionally it does not a have written bylaws for managing and supporting disabled students, Ali had to enroll as a normal student joining other sighted colleagues in the program. However, the university does support the disabled and those with special needs based on the student's request. In case of Ali, as a blind student, he is usually provided with an assistance who will read the hardcopy exam paper so that he can answer verbally or write the answers directly into a PC. Some courses have online exams, here, Ali would be given some guidelines where he would answer directly online.

In the foundation semester, Ali passed two courses satisfactorily; EL100 – English for Orientation, and GR101 – Independent Study Skills. In the first year of the program he registered four courses: EL111 – English Communication Skills I, AR111 – Arabic Communication Skills I, GR111 – Arab Islamic Civilization, and TU170 – Learning On-Line. And the last one TU170, it is an IT course, which will be used to study his performance. His result were quiet good, as he scored "D", "C+", "A" and withdrew from AR111. Not surprising, his score was the highest in TU170, which is a basic IT course. By monitoring Ali's progress in this period, the following were observed:

1. Many of the courses materials at AOU are provided in an electronic format. Additionally, Moodle, the official open source e-Learning management system of AOU, is used heavily in most of the core courses in the university. In these cases Ali did not have any issue in acquiring the knowledge and pass the exams. The challenge is always with those courses that are in hardcopy or just the lecture presentation slides are provided electronically. In this case either someone has to read the material to him or he had to translate the hardcopy lectures into Braille format to be useful.

Additionally, he had to put more efforts searching for other references on the web to get the correct materials to complete his course assignments, which are usually very heavy at AOU and carry high marks.

2. As for the midterm tests and final exam, which are in most cases are in hardcopy, as mentioned earlier, Ali was given an assistance to read the questions for him answer either through the assistant or typed directly into a PC.

3. In case of group discussions or assignments, in the class or at home, Ali did not have an issue, as he was pretty competent in using online systems to brows and interact with websites and e-Learning systems. The only barrier was his sensitivity and shyness to make more friends and in few cases the feeling of being a disabled student.

His 1st year performance was also compared to the performance of another blind student (Zahra Ali) in Business program, especially with courses that are more textually based than symbolic, graphical or logical based. Zahra, is now in her third year business program at AOU and she is doing very well in her studies. She is above the average student in performance, putting in mind that she is competing in class room with normal students and without any disability privileges.

From above and after overcoming the observed issues and challenges, we could come to a conclusion that Ali possesses the capabilities to pursue his study but with little more efforts than the sighted students. The "A" grade in course TU170, in addition to his previous IT skills is the first trump card in his hand to prove his capability. However, unlike programs such as Business or Literature, where the majority of courses' contents are textually based, IT programs are different in nature. One of the difficulties that a blind student faces is their ability to understand graphs and diagrams as they can see it. For instance networking or computer architecture courses depend mostly on graphs and diagrams to deliver the concept. On the other hand programming languages and mathematical courses depend on logic and symbols. From the experience with Ali, in many of the cases he could not solve the assignments or some of the exam questions that are graphical in nature. To support him, many of his tutors had to either skip the question or give him an alternative one.

Therefore, in order that we could more accurately predict Ali's success in the program, further tests were done by studying and analyzing the contents of each IT course that he will have to complete in the subsequent years, and the difficulty of these courses for such students, as described in the following two methods:

Method One

Ali was evaluated according to the hardest course he would take during the 4 years program. This would help to advise the university to relief Ali from certain parts of the courses that contains graphical, symbolic and logical statements.

In Table 1, the actual courses of IT program are shown along with the observed rating of each course ranging from 1 to 5 (1 being the hardest and 5 being the easiest). The ratings are based on feedbacks from IT department instructors that delivered these courses for several years. These rates have been adjusted by additional factor of Ali's visual difficulty of graphical and symbolic figures, such as flow chart, process models, logical and mathematical statements; in cases such as programming languages.

Finally, the rates in Table 1 have been tuned by studying Ali's capabilities and characters. Since Ali is expected to be superior and aiming to achieve the highest scores in all courses, we will test whether there is a significant difference between the expected values and the observed values. To achieve this Chi-square test is used, in case of one variable which is the "course" of several tiers, "there are 13 courses of the ITC program taken by the case". The formula of Chi-square test is shown as follows:

$$\chi^2 = \sum ((O_i - E_i)^2 / E_i);$$

Where i = 1… n, O_i: Observed value, and E_i: Expected value [17].

In our case, n= 13, the observed values that are in the Table 1, the expected values are equal to 5, the highest score as aimed by Ali to achieve.

Therefore, $\chi^2_{(calculated)}$ = [(5-5)^2/5] + [(3-5)^2/5] + [(2-5)^2/5] + [(2-5)^2/5] + [(1-5)^2/5] + [(3-5)^2/5] + [(1-5)^2/5] + [(5-5)^2/5] + [(2-5)^2/5] + [(3-5)^2/5] + [(3-5)^2/5] + [(2-5)^2/5] + [(3-5)^2/5]

= 0 + 0.8 + 1.8 + 1.8 + 3.2 + 0.8 + 3.2 + 0 + 1.8 + 0.8 + 0.8 + 1.8 + 0.8 = 17.6

Now, we must compare it with χ^2 from Chi-square distribution table [17], at significance level: 0.05 & 0.01, and degree of freedom equals to

n-1 = 13-1 =12

$\chi^2_{(0.05, 12)}$ = 21.026, since $\chi^2_{(calculated)}$ < $\chi^2_{(table)}$, we accept H$_0$.

$\chi^2_{(0.01, 12)}$ = 26.217, since $\chi^2_{(calculated)}$ < $\chi^2_{(table)}$, we accept H$_0$.

P-value: Thereafter, P-value is calculated. The p-value is the probability of obtaining a test statistic at least as extreme as the one that was actually observed, assuming that the null hypothesis (H$_0$) is true. The *lower* the p-value, the *less* likely the result is if the null hypothesis is true, and consequently the *more* "significant" the result is, in the sense of statistical significance. One often accepts the alternative hypothesis, (i.e. rejects a null hypothesis) if the p-value is less than 0.05 or 0.01, corresponding to a 5% or 1% chance respectively of rejecting the null hypothesis when it is true [14].

P (x≥17.6) = 0.1733 [13].

Since p-value >0.05, it is not statistically significant, therefore we accept H₀. Therefore, we can conclude that Ali can succeed according to the research model used.

Table 1: IT Program Courses and their Rates

	Course Title	Rate: 1-5 (Observed Values)
TU170	Learning On-Line	5
T175	Networked living: exploring information and communication technologies	3
M150	Data, computing and information (with Java Script)	2
T209	Information and communication technologies, people and interactions	2
MT262	Putting Computer System to Work (C++)	1
M255	Object Oriented Programming with Java	3
M257	Putting Java to Work (Java Programming)	1
M253	Team Working in Distributed Systems	5
M256	Software development with Java (Java Application Development)	2
M363	Software engineering with objects	3
M359	Relational data base theory and practice	3
T324	Keeping ahead in ICT	2
CS490	Selected Topics in Computer Science	3

Method Two

In this test the probability of Ali's success in his IT program is calculated by measuring two variables: 1. the weight of understanding the four difficulty domains (Mathematical, Logical, Graphical and Textual) and 2. the percentage of existence of these domains' within the content of each course in the IT program. These tests are done on the same set of courses used in Method one, as shown in table 2.

From studying Ali's case and few other blind cases, we could calculate an approximate value of the weight as percentage of how much from each domain they can understand and grasp. The two extremes were obviously the textual of 100% (fully understandable) and graphical as 0% (as none). On the other hand, on average they could handle simple mathematical statements and operations; hence it was given a weight of 25%, and 20% for the logical statements that is more challenging and usually exists in a programming languages or flowcharts, for instant.

The other factor, as shown in Table 2 is determining the percentage of these domains existence in each course material. This was achieved by physically inspecting the content of each course to calculate the percentage of each domain repeated.

Therefore, the probability is calculated by multiplying the rate of understanding of each domain by the weight of repetition of these domains in the course content, as shown in the following example:

Let us take "MT262- Putting Computer System to Work" course, then

$$P (MT262) = (25\%*30\%) + (20\%*40\%) + (0\%*10\%) + (100\%*20\%) = 0.075 + 0.08 + 0 + 0.2 = 0.355$$

As shown in Table 2, the average probability equals to **0.550**, which is closer to 1. Hence our null hypothesis (H₀) is likely to occur strongly. So we can comfortably say Ali can succeed in his studies.

Table 2: Courses and Probabilities

Courses	Math (Weight=25)	Logic (Weight=20)	Graphic (Weight = 0)	Text (Weight=100)	Probability
TU170	0%	10%	20%	70%	**0.720**
T175	20%	0%	30%	50%	**0.550**
M150	0%	20%	15%	65%	**0.690**
T209	30%	0%	30%	55%	**0.625**
MT262	30%	40%	10%	20%	**0.355**
M255	10%	30%	20%	40%	**0.485**
M253	0%	0%	25%	75%	**0.750**
M256	10%	30%	20%	40%	**0.485**
M363	10%	10%	30%	50%	**0.545**
M257	30%	40%	10%	20%	**0.355**
M359	10%	20%	10%	60%	**0.645**
T324	10%	10%	30%	50%	**0545**
CS490	10%	40%	20%	30%	**0.405**
Average Probability					**0.550**

CONCLUSION

Blind students all over the world face great challenges when pursuing their higher studies. Unlike western countries where there exists many laws and legislations that protect and support visual impaired people, students in the developing countries, that includes Arab world, face greater challenges with the lack of such laws. Another layer of complexity is added to the challenges of students who desire to explore the IT world in the Internet era. Numbers of these challenges have been highlighted in this research.

The aim of this case study was to find out if a blind student who has joined the IT program at Arab Open University could manage to pass the program successfully. A model was followed that is based on three activities. First monitor the progress of the student (the case of the study) in his 1st year of study; with respects to his performance and technical capabilities to handle the courses of such Open University. Second, perform analytical study on the IT program courses content to predict whether the blind student can manage to go through them safely, i.e. pass them with minimum acceptable scores, putting in considerations the difficult areas (domains) that a blind student cannot handle such as graphs and figure, mathematical symbols and logical statements. Such challenges would be a good input for sets of recommendations that will be passed to Arab Open University to enhance their service for visually impaired students and hence increase the chances of such candidates to join the IT world in the Arab countries.

Ali, the case of this study, did perform well in the first year of his study. In fact, because of his deep interest and background skills in handling computers, his score in this course was the highest compared to other subjects such as English and Arabic communications.

From the analytical study conducted on the content of courses covered in the remaining of IT program, to predict if the case could handle them and pass them safely, results were positive. In both methods that were applied, the study showed that Ali is most likely going to mange his way through the program, provided that he gets the appropriate support from the university to overcome the difficulties that were identified during the course of this study. Some of these challenges are due to

1. The course content that contains lots of mathematical, graphical and logical statements.

2. Lack of specialized counseling and guidance for such students

3. Lack of preparation programs for such candidates, when accepted into the program

4. In-availability of soft copy of many courses, although the hardcopy provided by the university is very much comprehensive to be understood by blind students

5. Lack of specialized computer labs that support blind students with assistive tools

Recommendations

With the operational model followed, especially in terms of course delivery and contents, Arab Open University would be an ideal place for blind students that are planning their higher studies. Not to forget, one of the main objectives of the university is "Education for all, regardless of nationality, age, gender, or place of living". However, and in order to make higher studies more attractive to such visual impaired candidates, certain improvements are recommended as follows:

1. **Bylaws of University**: As with many western universities, AOU should introduce Bylaws that will support blind students and protect their rights, by specifying the services provided to them from the day the student applies for admission till he/she graduates.

2. **Establish Disability Services Program (DSP)**: One of the main challenges of blind is how to survive in a environment of the university with normal students and some time even compete with them, unlike the treatment they received in the pre university blind institutes. DSP office would play a key role of bridging that gap by providing several support, guidance and counseling services to such students. For instance, they could provide services, but not limited to

   a. Note taking by other students, enrolled in the same class in which notes are needed.

   b. Training on the use of Adaptive/Assistive technologies.

   c. Recording and converting services from hardcopy study materials into Braille format.

   d. On the emotional and personal side, visually impaired students need continuous support by specialized councilors who stands beside them, motivate them to challenge their disability and push them toward achieving their objectives.

3. **Course content (e-content):** AOU, who is a member of UK Open University, is well experienced in this regards. The university has plans to convert all the material to an electronic format in the long term. However, there are still big numbers of courses that are provided in hardcopy. Additionally, convert majority of exams and midterm test, whenever possible, into electronic means (online test). In all cases, all the e-contents must be convertible to Braille output. AOU is already well into E-learning applications and platform, this is a great support to blind students and should be emphasized in all courses. It is a platform where they can use and interact with course content, instructor and other colleagues.

4. **Assistive supported lab**: All the above should be further supported by a lab with number of assistive tools that are available worldwide. These tools come in different forms of software such as screen readers, or hardware devices such as Peg graph board, that allows feeling graphical shapes. Also, software such as Zoom Text program that enlarges the computer screen for the visually impaired with some sight [15] [16].

ACKNOWLEDGMENTS

REFERENCES

[1] Legal Information Institute at Cornell Law School. *Individuals with Disabilities Education Act.* Available from: http://www.law.cornell.edu/uscode/20/usc_sec_20_00001400----000-.html

[2] Revenaugh, M. (2000). "Beyond the digital divide: Pathways to equity?", *Technology and Learning*, Vol. 20, No. 10, P 39.

[3] Greer, Toni. Holinga, Donna. Kindel, Christy. and Netznik, Melissa (1999). *An Educator's Guide to Visual Disabilities.* Available from: http://www.ed.uiuc.edu/wp/access/visual.html

[4] National Telecommunications and Information Administration (October 2000). *FALLING THROUGH THE NET: TOWARD DIGITAL INCLUSION.* Available from: http://search.ntia.doc.gov/pdf/fttn00.pdf

[5] Alexander, Steve. (2000) *Blind programmers face an uncertain future.* 6th November 1998. Available from: http://www.cnn.com/TECH/computing/9811/06/blindprog.idg

[6] Siegfried, Robert M. (2006) Visual programming and the blind: the challenge and the opportunity. Adelphi University, Garden City, NY. ACM Digital Library. Pages: 275 – 278. Available from:

http://portal.acm.org.newdc.oum.edu.my/citation.cfm?id=1121341.1121427&coll=ACM&dl=ACM&CFID=27521169&CFTOKEN=26823870

[7] Babcock, Charles. (2nd **October 2006)** *FIVE QUESTIONS FOR PETER LUNDBLAD, GOOGLE PROGRAMMER.*
InformationWeek, © 2009 United Business Media LLC. Available from:

http://www.informationweek.com/news/internet/search/showArticle.jhtml?articleID=193100330

[8] Poluck, Mel. (24th January 2007) Reading in the dark - Blind programmer leaves Freedom Scientific to start open
source Software Company. LiveJournal.com. Available from: http://kestrell.livejournal.com/312218.html

[9] Hahn, Sangyun. (27th June 2006) *Experiences of a Blind Computer Scientist.* University of Washington. Available
from:

http://www.cs.washington.edu/homes/ladner/hahnexperiences.html

[10] Khawaja, Mohd. **(18th October 2007)** *Blind... But with Vision.* Shoot 4 The Moon, Available from:
http://mkhawaja.jeeran.com/archive/2007/10/352902.html

[11] Khawaja, Mohd. (October 2007) *Life is Virtual.* JO Magazine. Available from:

http://farm3.static.flickr.com/2120/1599926402_a928e2d982_o.jpg

[12] Al-Shar', Mohammad. (2007) *About Me: AT Explorer.* Available from: http://www.atexplorer.com/about-me

[13] GraphPad Software. *P value calculator* .GraphPad Software, Inc. © 2002 - 2005. Available from:
http://www.graphpad.com/quickcalcs/pvalue1.cfm

[14] Wikipedia, the free encyclopedia (17th June 2010). *P-value.* Wikipedia® is a registered trademark of the Wikimedia
Foundation, Inc. Available from:

http://en.wikipedia.org/wiki/P-value

[15] Freedom Scientific. **JAWS for Windows.** © Large Print Reviews 2002. Available from:
http://www.largeprintreviews.com/jaws.html

[16] Training Modules of the Assistive Technology Division Mississippi Department of Rehabilitation Services. Software for
the Blind. September 2004. Available from**:** http://www.msprojectstart.org/blind%20software.htm

[17] Anne F. Maben from *"Statistics for the Social Sciences"* by Vicki Sharp. (13th September 2004). *CHISQUARE TEST.*
The Environmental Literacy Council, © 2002. Available from: http:// www. Enviroliteracy.org/pdf/materials/1210.pdf

Author' biography with Photo

Ali AlSoufi is an assistant professor at University of Bahrain. He has earned his PhD in computer science
in 1994 from Nottingham University, UK. He has worked for Bahrain Telecom Co for 8 years as a Senior
Manager Application Programme where he overlooked number of mega IS Application projects. Dr Ali
worked at Arab Open University as the head of IT program and Assistant Director for Business
Development during 2007-2010, while working as a consultant for Bahrain e-Government Authority
(EGA) in the area of Enterprise Architecture. He is also an active member of the Bahrain National ICT Governance
Committee. His specializations is Strategic IT Planning and Governance, IT project management, Enterprise Architecture,
Information Systems in Organizations.