Cognitive Task Analysis: A Contextual Inquiry Study on Basic Computer and Information Literacy Skills among Physicians

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ABSTRACT

With the advancement of health information technology, knowledge in the healthcare sector is also expanding vigorously. Adequate competencies and skills in computer and information literacy are required by the physicians to take advantage of the expanding medical literature. This study explores the basic computer and information literacy skills of physicians which are required for implementation of successful evidence based practice. Video recordings and think aloud methods are used as data collecting tool. This is a cross sectional qualitative study and convenient sampling technique is used to collect data. In this study, up to 20 health care professionals participated. The equal skill program of ECDL (European Computer Driving License) divides the basic computer literacy skills into 4 categories. Tasks were formulated from all of these 4 categories addressing the computer and information literacy skills. The results were analyzed by taking bloom's taxonomy into account. These tasks and subtasks were further analyzed for proficient computer literacy and standardized information literacy skills. Result shows that information literacy skills for evidence based practice are severely deficient than basic computer literacy skills. As this is the information and digital age which challenged the traditional horizontal skills and competencies of medical professionals to being vertical, thus, creating a more holistic view of learning.

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1. INTRODUCTION

The Healthcare provision can be improved with the help of advances in technology, better access to information and more efficient processes. Technology enables these processes by supporting information management and knowledge creation for evidence based practice. Computer literacy and information literacy are important aspects to practice evidence based medicine. Therefore, basic computer and information literacy skills along with the domain specific skills are essentials for health care professionals at every level. As this is the electronic age, informatics applications will continue to flourish in healthcare with the passage of time. These applications have great impact on medical education as they are cost-effective, care-enhancing and time-saving. 21st century is the digital and information age as there is no turning back the clock. Therefore, it is not enough for the health care personnel to be able to use computers rather, their ability to apply their competencies and skills according to the situation and need. Because physicians are not only the experts on the subjects with medical knowledge but they are experts for problems, and problems can travel across the border of different disciplines. During the past decades use of information technology is significantly increasing in medical education [1]. There are many factors contributing in this increased use of technology, some of them are, changes in health care delivery, the paradigm shift towards evidence based decision (EBD) and outcome based education which claims to improve the quality of health especially in resource poor settings [2][3]. As information is the backbone of any professional qualification. Therefore, the information and digital age challenged the traditional horizontal skills and competencies of medical professionals to being vertical. Hence, failure to sustain the flow of basic advances in computer science,

electrical engineering, materials development, physics, and mathematics will ultimately spoil the efficiency of biomedical research [4]. Physicians need to weed through a huge collection of electronic algorithm, the additional chapter after the "Introduction" chapter and before the "Research Method" chapter can be added to explain briefly the theory and/or the proposed method/algorithm [4].

Physicians need to weed through a huge collection of electronic information to pull only that part of information which is applicable according to specific cases and time context. Therefore having proficient information literacy skills and computer literacy skills are crucial. Table 1 will show a comparison between the information literacies skills, defined by the Association of College and Research Libraries (ACRL), and steps involved to practice evidence based medicine.

Table 1. Comparison of Information literacy skills and steps in EBM

Steps for IL competencies defined by ACRL	Steps in evidence-based medicine (adapted from Sackett, 2000)
Determine the nature and extent of the information that is needed.	Convert the need for information (about prevention, diagnosis, prognosis, therapy, etc.) into an answerable question.
Access needed information effectively and efficiently	Track down the best evidence with which to answer the question (select the best evidence resource and research it efficiently and effectively).
Evaluate the information and its sources critically and incorporate selected information into one's personal knowledge base and value system.	Critically appraise the evidence for its validity (closeness to the truth), impact (size of the effect), and applicability (usefulness in clinical practice).
Use information effectively to accomplish a purpose	Integrate the critical appraisal with clinical expertise and with the patient's unique biology, values, and circumstances.
Understand many of the economic, legal, and social issues surrounding the use of information and access and use the information ethically and legally.	Evaluate the effectiveness and efficiency in executing the four above steps and seek ways to improve them for the next occasion.

According to the comparison, although they do not fully parallel to one another yet they form a valuable and beneficial pattern for considering the skills that will be required for EBP in the evolving climate of information overload.

Bloom presented taxonomy of learning outcomes. This includes 6 hierarchical levels which are knowledge, comprehension, application, analysis, synthesis, and evaluation [5] these levels can be applied to any form of literacy or learning. Thus a model of MU (mutual understanding) can be constructed to address the gap between access to information and information understanding [6]. Andre B, identified many key factors which cause hindrance in the adoption process of computer technology in health care settings. He noticed that attitude is a learned predisposition with a consistent response towards a situation or object and negative attitude of users is one crucial factor and the reason of this is lack of knowledge. Hence the feeling of having a control on technology is directly link with the knowledge via the concept of self-efficacy. Employee's knowledge, skill and attitude are the spirit for any organization and studies have shown that there is a link between knowledge attitude and skills of the users towards the introduction and adoption of a new technology. Research concluded that the use of computerized tools in the health sector is valuable, therefore, it is needed to address the educational curriculum to build adequate computer knowledge and skill competencies among physicians of third world countries [3] [6] [5].

National Health Information competency survey reports a large gap between required and existing information competencies at both levels of senior and junior physicians. Physicians have no knowledge or education in informatics skills in their domain. Informatics skills and competencies are required to use and participate in the development of information systems and HIT. A term "Google generation" is introduced in 2008 for the digital natives and it is analyzed that the "Google generation" do not have sufficient Information literacy skills to get the right information at the right time (CIBER, 2008). The physicians, who were trained before this information age, were of great concern as they are inadequately equipped with the IT skills needed to perform the clinical work with more efficiency [8]. Although worldwide opportunities are there to develop these competencies and skill in different level of health care professional education but at the same time the element of information literacy and computer literacy is totally missing in many developing countries like Pakistan [9][10]. Economic pressures, governmental directives, the competitive environment in the health sector and the availability of latest technology are pushing physicians rapidly into new yet poorly understood territory of information technology.

The aim of this study is to determine the basic computer and information technology skills necessary for evidence based decision making by physicians. This study will be a great help for checking the water of knowledge and skills of physicians before diving in the technology and information oriented world. By recognizing and addressing the gaps in physician's knowledge and skills. It will help them to be proactive towards evidence based medicine. Neglecting these skills will have a serious short term and long term negative impact on the performance of individual health care providers.

The research main theme will mean to serve as a call to reassess the medical curricula to address possible unintended consequences in evidence based medicine. The rest of the paper is organized as follows.

Section 1 gives the introduction of the research domain, section 2 outlines the methodology used in this work, the results are in section 3, section 4 covers the discussion and conclusion is summarized in section 5.

2. RESEARCH METHOD

This was a cross sectional qualitative study. Prior to the study, a list of basic computer and information literacy skills was made after an extensive literature, IMIA (international medical informatics association) -endorsed documents and EITS (Essential IT Skills Program) of NHS literature [11]. The categorization of the equal skill program of ECDL, (European Computer Driving License) was followed [12], to make the list of the tasks which participants of this study will perform during video recording.

Literature review to design these tasks ensure that formulated tasks encompass each category of the skills or knowledge covered in ECDL, EITS program and involve the steps required to practice evidence based medicine. Each task further subdivided into subtasks and reflective model for learning by Edward and Bruce (2000) is used in the formalization of subtasks [13]. Total of four tasked were formulated for this research. Convenient sampling technique was used to collect the data. As the research is targeting to special target group that's why a small sample size of 20 Physicians in practice participated in this study but still this sample size is sufficient according to the total population of physicians registered with Pakistan medical and dental council (PMDC). Video recordings and think aloud methods were used as data collecting tools. Overall equal time of 30 mints was given to each participant to complete the tasks. These recorded videos were transcribed according to the predefined list of subtasks. The data analyzed by using descriptive analysis method for each task and subtask then Bloom's taxonomy for literacy is used for descriptive analysis of the data for both computer and information literacy skills.

3. RESULTS AND ANALYSIS

Participants were recruited among health care professionals. 20 physicians in practice participated in this study. They are having clinical experience ranging from 2 years to 30 years. By qualification they belong to different fields of medicine (dentistry, cardiology, gynecology, general medicine, radiology and general practitioners) and having an entry level professional degree which is M.B.B.S and B.D.S approved and registered by Pakistan Medical and Dental Council (PMDC). Physicians from both clinical and academic sectors included in the sample. 9 physicians are working in the academic sector while 11 are from clinical settings. Female to male ratio is 7:13. All of them are qualified from medical Institutes in Pakistan. All participants performed the tasks.

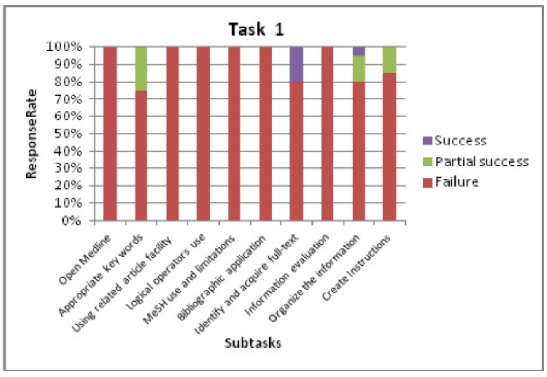

Figure 1. Results of Task 1

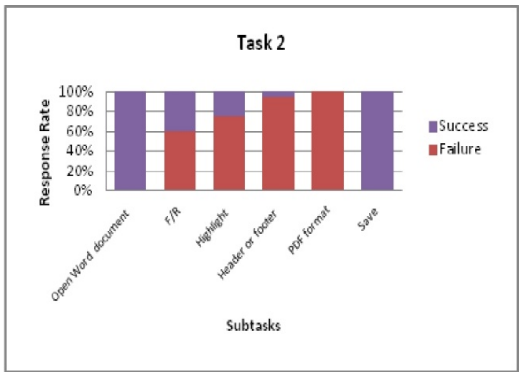

Figure 2. Results of Task 2

Task 1 was to perform a MEDLINE search to find 5 pertinent references to give guidelines/instructions to patients on sleeping position of infants to avoid Sudden Infant Death Syndrome. Results of task 1 are shown in Figure 1.

Figure 1 shows a great mismatch between existing skills and required skills to use an online information source by physicians. It is noted that participants are not familiar with MEDLINE database. 20 % participants are familiar with Pubmed. Both databases come under the huge umbrella of the national library of medicine (NLM). Pubmed is the source of free full texts while searching on MEDLINE database one need to buy most of the articles. All participants were guided to the home page of the MEDLINE database. Use of logical operators for example Boolean (AND, OR and any combination) and ability to apply limitations for their search is observed in use of logical operator subtask and results show that participants are not familiar with these terms and their use. In subtask 5, use of MeSH (medical subject heading) was observed. Neither the participants were familiar with the term neither they were able to use it to get desired results. MeSH stands for medical subject heading and it is a thesaurus provided by NLM for the consistency and uniformity

of medical terminologies and it is a distinctive feature of the MEDLINE database. Subtask 2, 3, 4 and 5 shows that the participants are not familiar with the facilities provided in the database. It is observed that none of the participant could use any standard bibliographic applications to quote the references. 80% of the participants were unable to get full text articles they only use abstract to make the guidelines. Subtask 8 was meant to assess their ability to evaluate the information by knowing the factors that influence the accuracy and validity of information in general and the ability to distinguish different types of information sources in terms of their currency, format, authority, relevance, and availability. Critical appraisal by knowing the strengths and weakness of any study is also a part of this subtask. It was observed those participated physicians were lacking this knowledge.

Results of subtasks 6,7,8,9 and 10 shows the incompetency towards evidence based medicine as these skills are important in EBP (List of subtasks are shown in table 3).

Fig. 2 shows a graph showing the results of task 2 which represent the skills of physicians in using Microsoft word application. Subtask 1 and 6 shows 100% success rate. Subtasks 2,3,4,5 show the ability to use the available functions in the application. 60 % participants are not familiar with finding and replacement (Ctrl+f) they were doing the task manually one by one. 75% participants changed color of the font when asked to highlight a specific word in the document. 95% participants cannot perform the subtask by using the header and footer facility. 100% failure rate is noted when participants were asked to convert the format of the document into PDF.

The graph in figure 3 presents the results for task 3. Task 3 represents the communication skills by using e-mail. The results show that participated physicians have proficient skills as 100% success in response rate for log in, attaching the document and sending the email is noted. Only 5% participants are familiar with the term of shouting mail. This result is due to the common use of email service by the physician to have communication among peers. It is also observed that they are unable to troubleshoot any login problem while log in, attaching the document or sending the e-mail.

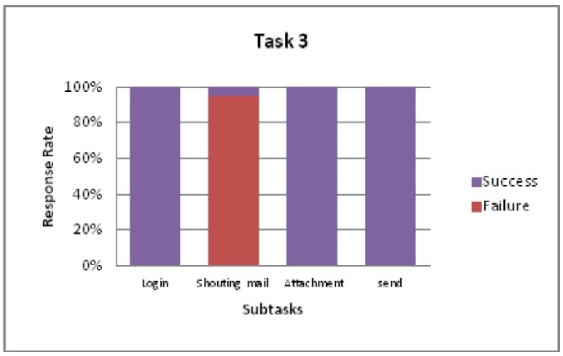

Figure 3. Results of task 3

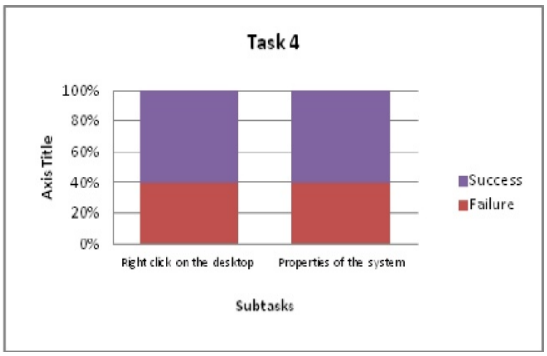

Figure 4. Results of task 4

The graph in figure 4 displays that only 40% of the participant can explore the properties of the system on which they were performing the tasks. This task somehow represents the lowest level of technical knowledge of the computers. According to the results, 60% of the respondents are lacking in the technical knowledge of computers.

After this descriptive analysis the results are analyzed according to bloom's taxonomy skills in computer and information literacy as this taxonomy provides a good guide to evaluating health informatics [5] . Level of the skill was determined according to the bloom's taxonomy skills with the computer and information literacy.

Table 2. A table showing the blooms taxonomy for the computer and Information literacies

Literacy skills according to Blooms Taxonomy for CTA		
Skills	Computer Literacy (1)	Information Literacy (2)
1.Understand	1.1	1.2
2.Apply	2.1	2.2
3.Analyze	3.1	3.2
4.Evaluate	4.1	4.2
5.Create	5.1	5.2

Table 2 identifies and summarizes the five skills or knowledge levels by using blooms taxonomy for literacy skills. This table relates these levels of skills with the computer and information literacy, and this categorization helped to determine the level of skill needed to complete the tasks for this study. Then it analyzed that which level of literacy skill is required to complete the tasks performed in this research by using level assigned in table 3.

A rubric is shown in table 3, which was made to identify the knowledge gap for the performed tasks and subtasks. According to the assigned rubrics a gap of 52.5% for task 1, for task 2 a gap of 55%, task 3 gap of 34 % and 40% gap for the successful completion of task 4 is noted. Overall 45% gap between existing and required skills is noted in this study.

Table 3. Rubric table for the study

A Rubric for evaluating tasks of CTA Study
If subtask done successfully, give full credit (2 points)
If subtask done with partial success, give partial credit (1 point)
If subtask not performed, give no number (0 point)

4. DISCUSSION

Results provide the information regarding the existing skills of computer and information literacy of physicians to make a use of valuable online information resources for EBP. The results not only provide the evidence of the gap or mismatch between required and existing skill level, they also reveal that participants were not recognizing these skills as relevant and significant to their clinical practice. On average the largest gap was observed in task 2 and task 1 which is 55% and 52.5% respectively. Proficient level of information literacy is of prime importance for EBP. Steps to practice evidence based decision making includes, ability and potential to define a searchable question, assessing the online information, critically assessing and evaluating the information, apply the information by engaging in collaborative decision making and re-evaluating the evidences of applied information to identify new information needs and making improvements for the future [15]. Task 1 in this study includes all of these steps and results shows the lack of information literacy awareness and concept among physicians. This finding is also supported by a research to find the role of information literacy skills for EBP among nurses in the United States [14].

There are some limitations of this study. Although the qualitative method used for this study gave a deeper exploration of issues around their computer and information retrieval skills for EBP, which are, otherwise, difficult to achieve with a quantitative survey. However, despite a search of conflicting perspectives and methods aimed at safeguarding validity, qualitative analysis remains biased because of its nature, chances are always there that with different respondent groups, the same themes may interpret differently. Selection of sample from few institutions, the small size of sample and self-selected sample are some limitations of the study. Although these findings will aid its nature, chances are always there that with different respondent groups, the same themes may interpret differently. Selection of sample from few institutions, the small size of sample and self-selected sample are some limitations of the study.

Although these findings will aid in making changes in the existing medical curriculum for EBP but we still need to understand more about the learning needs and conditions that result in more optimal use of online information into routine medical practice.

5. CONCLUSION

The value of this study is to develop consciousness of need of information and computer literacy education among physicians to enable evidence-based practice. In the long run, investment in the development of computer and information skills will promote the benefits of improved productivity and efficiency of evidence based medicine. As it is already understood that skill infrastructure is more important than physical infrastructure. This paper shows the existence of competencies and skill gap of basic computer and information literacy skills. Neglecting these skills will have a serious short term and long term negative impact on the performance of individual health care providers. Consequently, physicians need to be adequately educated and trained in this domain to integrate best available evidences into their practice for clinical problem solving. Health care professionals must be aware of the need for health informatics education and its role in evidence based practice.

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