Issues in Designing Learning Frameworks for Visually Impaired Learners


Abstract— Learning by Imitation (LBI) is the most natural way to learn a natural language and classic literacy. When LBI is doped with learning by doing (LBD) and learning by memorization (LBM), then this combination help learners to master courses based on arts, science, technology and others. Researchers from pedagogy claimed that teaching strategies used for classroom/online teaching depend heavily on learning style adopted by the learners. But they do not talk about visually impaired learners. This paper highlights some solved as well as some unsolved issues associated with the application of skill-based learning concerning visually impaired learners (VIL). The prime focus of this research is to propose a framework entitled “VIL Framework” which uses LBI, LBD and LBM learning styles and help educators in designing course contents, physical learning games, audio-based learning games, psychomotor skills-based teaching aids, skills-based learning environment and teaching environments for visually impaired learners. The proposed framework includes mock drills as a core component which reflects LBD and LBI. Apart from this, we will highlight some issues on which we are working, and we will be working in the near future associated with VIL’s in this research. We believe that the study of this kind help psychologists and educators to design quality educational games, courses contents and learning environments covering different dimensions for visually impaired learners.

Index Terms— Learning By Doing, Learning By Imitation, Learning By Memorization, Visually Impaired Learners, Educational Games, Mock Drill.

I. INTRODUCTION

The art of designing course content and learning environments for non-visually impaired students follows standard frameworks and theories developed around Bloom’s taxonomy [19]. These theories superbly handle parameters like content complexity, depth of knowledge and others concerning non-visually impaired students. Nevertheless, when it comes to designing the same infrastructure for visually impaired students/learners, then these theories fail to achieve their goals. So the modifications in these theories are required for developing contents and learning environments for VIL learners/students.

The content and learning environment designing process for VIL learners heavily depends on natural psychomotor skills possessed by VIL learners. So all contents and concepts must be modeled around teaching aids and instruments specially designed to teach the targeted contents, concepts and skills to the VIL learner’s. The designing principals concerning teaching aids and instruments must focus on learner’s psychomotor skills.

This research presents a framework for designing courses, audio-based learning games, learning tools, learning systems and environments for VIL learners. The complete detail of this framework, named VIL framework, is given in section III. The proposed framework can be viewed from two points of views, namely (a) VIL learner’s point of view and (b) course designers and educators point of view. These two views or perspectives help readers to understand the core crux associated with the learning environment design concerning VIL learners. These views are discussed in detail in section III.

Further, in section IV of this paper, we discussed the use of the proposed framework for designing the solution to self-first aid problem concerning visually impaired students. This section gives an insight to readers and collaborators regarding our expectation. In the very same section, we listed some other sample problems on which we are working. This highlights our expectations concerning framework, system, instruments and other learning environment designs for VIL learners.

Through this research, we ask collaborators to develop (a) frameworks, (b) course content designing guidelines, (c) audio-based learning games, (d) learning systems and (d) other tools for VIL learners which help them to learn and shape their skills in order to live a better life.

II. RELATED WORK

The pedagogical issues associated with the development of educational audio games, physical games, and mock drills concerning VIL learners are critical. Online educational game designers pay nearly no attention for the development of games for VIL. Several HCI researchers are trying to make guidelines for designing audio-based games [1-9] for regular players. However, the guidelines they proposed can be extended concerning design issues related to VIL’s. On the other hand, researchers from the field of psychology are trying to understand the impact of game-based learning on overall mental and psychological development for the students. These psychologists do not genuinely concern issues related to VIL learners. On the other hand, many researchers tried to develop methods and approaches for collaborative play between VIL and non-VIL students [10]. They also showed that coordination between non-VIL and VIL learners helps in the development of learning eco-system, which helps VIL learners to shape their skills. Their study further showed that such interaction has a strong positive psychological effect on VIL students [11-14]. Many researchers also talked about pedagogical aspects concerning VIL learners [15]. They presented several theories and conceptual frameworks which help in the improvement of teaching and related pedagogical issues concerning VIL learners. We also developed several frameworks for non-VIL learners. The modified versions of these frameworks can easily be used for VIL learners [16-18]. Researches done based on Bloom’s taxonomy [19-21] allow offline as well as online educators to design effective systems for non-VIL learners. However, these researches fail to design the same systems for VIL learners. Hence, they require up-gradation and fine-tuning so they...
can easily model real needs for VIL learners.

III. THE VIL FRAMEWORK

The art of teaching depends on learning styles adopted by learners/students. This theory works perfectly well for teaching non-VIL learners but fails when learners are visually impaired. Instead of the single, simple and standard way of teaching, the VIL learners require a dynamic, innovative and effective way of teaching. VIL learners are sophisticated towards psychomotor skills. Hence requires designing of the learning exercises, which involves the use of psychomotor skills. All course instructors must design their course contents using teaching aids which somehow relates to psychomotor skills concerning VIL learners.

This section presents the VIL framework. This framework help educators and course designers to design courses, psychomotor skill-based teaching aids, learning games, learning environments and other learning systems for VIL learners. The proposed framework (see Figure 1) contains eight essential elements, namely LBD, LBM, LBI, VIL learners, Instruments, Algorithm, Instructions and Mock Drill. In figure 1, the stepwise flow is represented by black lines and conceptual flow by bold orange lines. When we follow the stepwise flow, then the starting point is instructions. Otherwise, when we follow logical/conceptual flow, then the starting point can either be instructions or algorithm or instruments. The complete framework can be viewed from two points of views, namely (a) VIL learners point of view and (b) course designer and educators point of view. We will be discussing both views of points in this section.

A. VIL Framework from the VIL Learners point of View

From the VIL learners point of view, stepwise flow is considered the best. According to this point of view a course, exercise, game, learning environment and other learning features designed using this framework help VIL learners to learn new things. The learning process starts by using LBM style to learn some basic instructions concerning the targeted task, followed by LBD and LBM to understand the application of instructions on instruments/teaching-aids. These instruments help VIL learners to execute some critical tasks. Once learners are exposed to instruments and trained accordingly, then LBM is used to teach them the process/algorithm which uses instructions and instruments to accomplish the targeted task. This allows learners to get a clear conceptual view of the procedure to accomplish the targeted task. Then LBD and LBI styles are used to train students using mock drills. Doing so induces practical problem-solving patterns in VIL learners.

B. VIL Framework from the Course Designers and Educators point of View

The VIL framework from the course designers and educators point of view consists of strongly coupled modules, namely (a) instructions, (b) algorithm, (c) instruments and (d) mock drill. The VIL learners can start the learning process using learning styles as shown in figure 1, from either module (a), (b) or (c) then once all three modules are covered (as all three modules are interconnected) then only the final (d) module is covered.

This view treats each module as an independent unit having high coupling among them. This allows course designers and educators to independently design course content and concerning policies for the modules mentioned above. Then the course content and policies are coupled with each other using coupling elements. The pedagogical tools help in designing coupling elements.

IV. SELF-FIRST AID DRILL FOR VISUALLY IMPAIRED STUDENTS AND OUR EXPECTATIONS FROM COLLABORATORS

During COVID-19, when my country India was locked down, we faced first aid related issues in visually impaired students living in private hostels. Due to the scarcity of human resources, these hostels failed to provide night attendants. Due to this, when many visually impaired students suffered from health problems like fever, headache, loose motions and indigestion at night, then there was no one to give them first aid. This section discusses how we solved this problem of first aid at night.

To overcome this problem, we used the proposed VIL framework. First, we designed an instrument which is a Braille script encoded medicine box. This medicine box contains four sections, and each section contains three sub-sections. This box can hold four basic types of medicines for four common health problems, namely fever, headache, loose motions and indigestion. The first subsection of each section contains medicine name, its use and dose details written using the Braille script. The second subsection of each section contains the allopathic medicine, and the third subsection of each section contains the equivalent Ayurveda medicine.

Then we trained each student to measure the rough intensity of fever using pulse rate. Then we taught them how to use the box and medicines. The 4 Ayurvedic herbs placed in the third subsections are of different aroma and taste. We intentionally did this, so visually impaired students who do not know Braille script can take correct Ayurvedic medicine or equivalent allopathic medicine by tasting Ayurvedic medicine.

Then we trained each student concerning the use of the medicine box, the art of measuring fever through pulse rate, and procedure to take correct medicine. After the accomplishment of training, a mock drill was conducted to clarify the concept and complete procedural protocol associated with the self-first aid problem to the visually impaired students. This is how the problem of self-first aid is solved. We want to solve several problems associated with visually impaired students. The highlights of these problems are as follows.

We want to develop procedures and frameworks for teaching Braille script and associated Braille based classic literacy to VIL learners in their native language. We want to do this because India has...
more than 22 official spoken languages. Moreover, 19500 unofficial languages and dialects are spoken by Indians. So developing guidelines for assigning Braille codes for all native Indian languages helps VIL learners to learn in their native language.

We further want collaborators to suggest some changes in government policies, forms and procedures which help visually impaired person to perform complex daily life tasks like banking, railway ticket booking, accounting, and others without depending on another person.

Our co-author Mr. Akash Verma suggested one such policy change concerning Indian voting system. This change allows visually impaired voters to vote without any attendant. We encourage collaborators to come up with more such innovative ideas.

We are also working on gadgets and their training procedures which allow the visually impaired person to do clerical work in offices. This helps them to become socially active and earn their living. We welcome ideas which make the life of visually impaired person easy, happy and socially active. We are doing this work for the service of humanity and want our collaborators to collaborate with us with the same spirit.

Fig. 2. Showing the expected workflow from the collaborators.

Now let us discuss the workflow which we are expecting from our collaborators to follow. Figure 2 pictorially shows the complete workflow. We want our collaborators to come up with innovative ideas concerning VIL learners. Then we want to conduct a discussion concerning two aspects as follows.

(a) The set of advantages VIL learners gain from the proposed idea.

(b) Number of user stories derived from the proposed idea.

Then based on aspects mentioned above, user stories will be prioritized in the form of a list known as story list. Then one user story (i.e. story with the highest priority in the story list) is taken at a time, and prototype system/product/policy concerning the selected user story will be fabricated for the same.

Then we will be conducting mock drills using VIL learners in order to obtain feedbacks concerning fabricated prototype. On analyzing feedbacks if they meet the requirements of the VIL learners, the next user story is taken into account. Otherwise, we will refine the designed plan and do changes in the designed prototype accordingly. The VIL learners will be validating the changes done in the prototype using mock drill-based testing.

This process is repeated until all user stories in the story list are not considered, and the resulting final prototype which satisfies the needs of the VIL users is not achieved.

Then using the final prototype, the final system/product/policy is crafted, and final mock drill is conducted. Then the final system/product/policy is given to the VIL learners for use and maintained/refined as per need.

V. CONCLUSION

In this paper, we talked a lot on different types of learning’s and their role in choosing appropriate teaching style. We discussed that standard learning theories fail to fulfill their goals when learners are visually impaired. So standard theories must be tuned concerning VIL learners. Considering this in mind, we proposed a framework named VIL framework. This framework helps content designers and educators to design learning systems for VIL learners. These learning systems include audio-based learning games, psychomotor skills-based training instruments, course contents, learning policies, learning processes and others.

After discussing the core elements of this framework namely (a) LBI, (b) LBD, (c) LBM, (d) Instrument, (e) Instructions, (f) algorithm and (g) Mock Drill, we showed an application of this framework for solving the self-first aid problem. Then we presented our point of view concerning future work and our expectations from the collaborators. To present our expectations, we explained some scenarios and highlighted work done by our co-author Mr. Akash Verma to accomplish our aim.

We genuinely believe that the highlights given in this research help future researchers to come up with very effective frameworks, audio-based learning games, learning policies, learning procedures, learning tools, learning instruments and gadgets for VIL learners. This help visually impaired person to live a socially active, self-sufficient, self-motivational, confident, mentally stable and independent life.

We welcome researchers, students, teachers and other stakeholders of society to give their valuable ideas concerning the development of systems and policies for helping visually impaired persons.

REFERENCES


Siddharth Srivastava is a PhD research scholar in the department of computer science and engineering at Indian Institute of Technology, Kanpur, India. He is currently working in the field of software architecture. He loves to develop applications for improving Indian education sector using software architecture and artificial intelligence. Before joining the PhD program, he was working as Lecturer at Central Institute of Plastics Engineering and Technology, Lucknow, India. He is having more than ten years of teaching experience. You can reach him at xenonion@hotmail.com.

Akash Verma is a student in special education in the dept of visual impairment at T.S.M college for special education and rehabilitation centre, Lucknow, India. He loves to conduct online as well as offline workshops for the visually impaired persons. He can be contacted at akashverma141998@gmail.com.

T.V. Prabhakar is interested in building system and still feels excited about science and technology. He worked in multiple areas like Databases, Logic Programming, User Interface Design, Internet Technologies, Software Architecture, Knowledge Modeling, Indian Language Technologies. He worked with CMC R&D, Satyam Computer Services and have been a consultant to a large number of IT organizations and e-governance initiatives. He is currently working as Professor in the department of computer science and engineering, Indian Institute of Technology, Kanpur, India. He can be contacted at tvp@iitk.ac.in.