Designing Technology for 287 Million Learners

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Abstract—How can we design technology for 287 million adult illiterates in India spread across 22 Indian Languages? In this paper, we summarize our experience towards addressing this challenge over the last 6 years. We briefly present our journey of technology for adult literacy in India emphasizing the key shift in focus between different generations. We then present the design of technology for adult literacy from multiple perspectives of learning methodologies, learning technologies, software engineering and HCI. The main thrust of this paper is to present a holistic perspective of designing technology for supporting education in the context of mass scale and variety.

Keywords-design; process; learning methodologies; learning technologies; software engineering; human-computer interaction

I. THE JOURNEY OF TECHNOLOGY FOR ADULT LITERACY IN INDIA

The National Literacy Mission (NLM) of Government of India (GoI) has been thriving to address the challenge of adult literacy in India since 1988 [1]. Despite rapid progress and proliferation of ICTs in India and several technological aids to support adult literacy in India [2] [3], still there are about 287 million adult illiterates in India according to the EFA report from UNESCO in 2012. In this section, we briefly present our journey of technology for adult literacy in India to emphasize the shift in focus. Figure 1 shows the role and progression of different generations of technologies from being a platform for converting physical instructional material to digital content to modeling adult literacy instructional design using ontologies and with a futuristic goal to deliver personalized instruction. The following questions are tackled during different generations:

1. How to support adult literacy with technology? Tata Consultancy Services (TCS), an Indian Software House has been contributing in this direction since 2001 [2].
2. How to reduce the enormous effort during the creation and evolution of educational content for a mass scale and variety of scenarios in adult literacy? [3]
3. How can we improve quality of instruction while designing technology for adult literacy? [4]
4. How to reduce the inherent complexity in adult literacy? How to systematically capture the knowledge about different aspects of instructional design and use that knowledge as a way to improve quality of instruction and accelerate technology development? [5]
5. How can we design and deliver personalized adult literacy instruction for 287 million adult illiterates?

II. DESIGN OF TECHNOLOGY FOR EDUCATION—AN INTERDISCIPLINARY ENDEAVOR

It is often studied that a majority of failures in technology enhanced learning (TEL) initiatives stem from the inability to facilitate and synthesize different stakeholders’ concerns. Additionally, addressing the ever increasing sophisticated nature and continuous evolution of TEL projects requires a holistic approach and interdisciplinary research from several disciplines. In this section, we present the four most important perspectives that we have seen during the design of technology for adult literacy. Figure 2 shows the key perspectives, research questions from each perspective along with our solution from adult literacy case study.

A. A Learning Methodologies Perspective

Despite several advances, the use of technology in education is still at a minimal level and many teachers are often reluctant to use technology to support their teaching. A major cause for this reluctance seems to be the lack of underlying learning methodologies for most of today’s learning technologies. The role of technology in learning has been discussed extensively in the literature however most of the current learning technologies often focus on supporting administrative and managerial aspects of learning. How can technology improve teaching and learning effectiveness? The focus must shift to address this question more aggressively and this can only happen when there is enough emphasis on learning methodologies. In adult literacy case study, we relied on NLM’s IPCL learning methodology. IPCL is a pedagogy that emerged out of a decade long research on teaching adult illiterates in India [1]. It suggests the use of eclectic method, thematic content and nationally and locally relevant instructional material taught in an interactive way [1]. We see that technology should expand its horizon to enhance teaching and learning effectiveness by aligning with learning methodologies.
B. A Learning Technologies Perspective

The significant use of technologies in education has rapidly increased in the last decade along with their continuous evolution to enhance learning. On the contrary, learning technologies have become more complex and sophisticated making it difficult for teachers and educational institutions to adapt and use them. A constrained view of learning technologies without considering learning methodologies has been the major cause of concern for learning technologies community. Lack of infrastructure is another major obstacle for the use of learning technologies in developing countries. Despite pertinent use of mobiles even in rural villages in India, we are still using computer aided technologies as most of the mobiles are useful only for messaging and voice services. Harnessing the power of web and cloud computing to support adult literacy is still a long way considering the unavailability of power for more than 8 hours a day with internet being still a dream.

C. A Software Engineering (SE) Perspective

Irrespective of different terminologies and technologies available today, a major part of TEL revolves around the development and maintenance of a variety of software and digital content development. How to manage infrastructure for huge amounts of data that has to be created and maintained as part of TEL? Cloud computing from SE can be explored to address this challenge. How to create contextualized and personalized educational content for diversified learners? Leverage social computing and emerging Web 2.0/3.0 ideas like semantic web, novel user interfaces, linked data, collaboration platforms. How can we reduce the complexity and massive effort to create and maintain learning technologies? Software product lines (SPL) is a paradigm to improve productivity of a family of systems. In adult literacy, we have applied SPL and reduced development effort from 5 person years to 5 person months [3]. Our IDont modeling framework systematically models instructional design as data and lays a foundation for aligning with learning methodologies and technologies [5].

D. A Human Computer Interaction (HCI) Perspective

What kinds of technologies intuitively support learners and enhance their learning? Does the use of technologies make it easier for learners? Consider the case of adult literacy, where learners show interest in multimedia and often find text based interfaces difficult to navigate. Evaluating the needs of learners and designing interfaces for learners is the key advantage of taking a HCI perspective. How much effort does it take for teachers to use learning technologies in their teaching? and How much effort does it take for teachers to create and manage learning content? Authoring tools have been a major source of problem for teachers because of their complexity and a HCI perspective can help towards better design of these tools. We have designed a preliminary tool named EasyAuthor for low computer proficiency teachers to support content authoring.

III. KEY LESSONS LEARNT

- Design of technology for education requires a holistic and interdisciplinary approach.
- It is critical to capture and communicate instructional design knowledge to all stakeholders.
- Scope of learning technologies must expand beyond current administrative and managerial uses.
- Agile, global and collaborative software development approaches have to be adapted for diversified contexts.
- Methodologies and technologies have to be adapted and customized for every instance of learning technologies.

IV. CONCLUSIONS

We ventured into the challenge of designing technology for 287 million adult illiterates in India from software engineering perspective 6 years ago. But as discussed in the paper, we progressed towards designing technology from a holistic perspective aligning with learning methodologies, learning technologies and designed technology platforms and tools from several perspectives like SE and HCI. Based on this approach, we have also designed an ontology based educational modeling framework called IDont as a basis for integrated research. While we have restricted ourselves to adult literacy, we strongly believe that a holistic approach as shown in this paper will add significant value to the design of learning technologies way beyond adult literacy.

ACKNOWLEDGMENT

We thank TCS and Kinshuk for their valuable support.

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