

GAMBLE: Towards Ensuring Quality of Education using Goal Driven Model Based Learning Environments

Automating a family of eLearning Systems by integrating Lean and Software Product Lines

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Abstract—The exponential decrease in the quality of education despite innumerable number of learning systems has motivated us to design learning environments that ensure quality of education. We propose GAMBLE as a goal driven model based approach to teaching/learning that emphasizes on making goals of learners and instructors explicit and provides a platform for designing, refining and debugging models to achieve these goals. We also propose the idea of SPLEAN that integrates lean thinking and software product lines to significantly improve productivity. This paper also discusses construction of eLearning Systems that are of broader interest to society like adult literacy as a means of evaluating proposed approaches and ends with many possible future directions towards ensuring quality of education.

Keywords—eLearning; lean; software product lines; quality

I. INTRODUCTION

The trend of using eLearning and ICTs as a mode of instruction has tremendously increased in today's knowledge era as it offers the flexibility of *anytime, anywhere access to any interesting topic at low cost effectively*. However, on the contrary there is significant decrease in the quality of education [1]. Lack of emphasis on learning theories (systematic approaches to teaching/learning) in today's eLearning Systems seems to be the most critical reason for this failure so is the lack of synergy between learning theories and learning technologies. Instructional Designers often tend to focus on devising instructions based on learning theories ignoring economical issues. On the other hand, software vendors focus on reusing learning materials, packaging them for flexibility and ignore the suitability of the instructional software in a partial context. Even though there has been remarkable progress in learning theories and learning technologies, there is scope for extensive research in integrating them which we try to address in this work.

From a Software Engineering perspective, the need to develop and maintain gigantic number of eLearning Systems catering to all markets with huge number of students, diversified languages, customizable learning goals, contexts and environments presents the challenge of reducing the technological effort for construction and maintenance of these systems. This presses the need to research novel ways of constructing software and reduce the overall effort of technology in learning.

In this context, we have identified two key research problems that are significant to Learning as well as Software Engineering and which are not dealt enough in the literature.

(i) *What kind of learning theories make sure that eLearning Systems that are designed today deliver quality education?*

(ii) *How do you handle the scale and variety inherent in developing and maintaining these eLearning Systems?*

We have researched and tried to address some of these sub-problems during our earlier work TALES, that supports automation of a family of eLearning Systems reducing development effort from 5 person-years to 5 person-months [2]. The eLearning Systems addressed in TALES are computer based multimedia packages that aid in teaching adult illiterates spread across 22 Indian Languages and their dialects. Most importantly, TALES uses a uniform learning theory called Improved Pace and Content of Learning (IPCL) [3] devised by National Literacy Mission (NLM) to ensure quality of literacy. In IPCL, an adult learner progresses from familiar to the unfamiliar using thematic content with distinct learning achievements at three stages of learning. TALES also employs standardized product structure, development processes and tools to significantly improve productivity.

II. RESEARCH METHODOLOGY & CONTRIBUTIONS

- Design a learning theory named GAMBLE that essentially enforces instructors and learners to make their teaching/learning goals explicit, provides learning environments' to achieve these goals using different model based approaches to teaching and learning.
- Apply GAMBLE while designing various kinds of eLearning Systems (adult literacy, school education and so on) to ensure quality of education.
- Evaluate GAMBLE by employing action research and case study approaches to field test these eLearning Systems in collaboration with Government and NGOs.
- Design SPLEAN approach to address the problem of developing and maintaining large scale and variety of software systems by integrating ideas from Lean and Software Product Lines.
- Employ SPLEAN for practical development of families of eLearning Systems and study the effort.

III. GAMBLE - GOAL DRIVEN MODEL BASED LEARNING ENVIRONMENTS

How can we ensure quality of education whilst catering to diversified requirements and contexts? In our extensive experience of being involved for four years in Adult Literacy Project (ALP) initiative [4], we have analyzed and observed 9 eLearning Systems in the context of learning theories and found few insights that form the crux of GAMBLE. ALP was based on a learning theory called IPCL that has specific learning goals at every stage to ensure quality of literacy. It also uses various models like puppet theatre, audio-video synchronization to achieve the specified goals. Ideally, learning has to be mainly driven by learner's goals and syncing them with teacher's goals and teaching process. However, most of the eLearning Systems today do not state the goals of teaching/learning explicitly making them ineffective and even if the goals are specified, the emphasis is more on quantitative goals like scores rather than qualitative goals that specify levels of understanding and knowledge. Goal driven learning describes learning as an active and strategic process to satisfy information needs of a learner [5]. Setting the goals is one aspect and achieving the goals efficiently and systemically is another key aspect of GAMBLE. Most of the learning theories today use models and simulations of varied forms in widely different contexts, approaches and perspectives ultimately leading to enhanced support for learners as well as instructors to achieve their specified goals [6]. These models are of immense use as they deliver value to the learners by adhering to their learning goals and achieving these goals systematically while relying on an underlying basis of cognition. Model Based Approaches to Teaching and Learning have been widely discussed in [6]. Based on our experience of analyzing ALP and learning from existing literature, we propose that integrating goal-driven and model based approaches to teaching/learning leads to significant improvements in quality of education. Goal driven learning can be used to represent goals as quality parameters and model driven learning environments help in ensuring that these goals are adequately addressed by models. In GAMBLE, people learn by (de)constructing mental models using instruction models, reason them for debugging the learning and improving it. We plan to design or adapt a modeling language to express and reason about goals and models. The essence of this exercise is to express quality of education through goals, design models that achieve these goals in a systematic way.

IV. FAMILIES OF eLEARNING SYSTEMS

eLearning Systems are there everywhere, to aid in teaching adult illiterates of India spread across 22 Indian Languages, aid school education, engineering education, computer literacy, vocational training and they occur as families to handle diverse content, multiple languages and varied contexts. We intend to design and develop a family of eLearning Systems based on GAMBLE to evaluate our approach with respect to quality of education. This is a system building effort resulting in practical eLearning Systems that are of broader interest to society.

V. SPLEAN - LEAN SOFTWARE PRODUCT LINES

How can we reduce the effort of developing and maintaining a large scale and variety of eLearning Systems? Traditionally, *Software Product Lines* address these concerns by focusing on a family of products using core and variable assets [7]. On the other hand, Lean thinking [8] encompasses a variety of techniques like value-stream mapping, 5S and others to eliminate waste and achieve the same of goal of reducing the effort while adding value to all stakeholders. While SPL is a well planned approach for long-run and more stable requirements, Lean and Agile thinking is on the other end of the spectrum suitable for short-term, less planned and dynamic requirements. We propose to develop an approach named SPLEAN that integrates ideas from Lean thinking as a means of constructing software for a family of systems and reduce the effort of SPL whilst improving agility. *This research is necessary to reduce the huge amount of effort in developing eLearning Systems based on GAMBLE.* To the best of our knowledge, this is the first attempt of applying lean to SPL and can lead to significant contributions in Software Engineering.

VI. CONCLUSION & FUTURE WORK

We have briefly presented GAMBLE as a solution to reduce gap of learning theories and learning technologies while ensuring quality of education. We introduced the idea of SPLEAN that integrates Lean thinking to SPL and significantly improves productivity. We have also discussed about building practical eLearning Systems that are of interest to society and to evaluate the ideas of GAMBLE and SPLEAN. This work is at a very preliminary stage and hence a lot of future work is possible in terms of proposing and detailing the ideas of GAMBLE, SPLEAN, developing practical eLearning Systems based on this approaches, doing studies from HCI perspective ultimately *contributing to Learning, Software Engineering and HCI communities.*

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