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Learning Analytics: Game-based Learning for Programming Course in Higher Education

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Abstract

The traditional classroom teaching is monotonous based teaching techniques and it lacks interaction and students lose the curiosity to understand the purpose of studying the course. The learners anticipate new teaching techniques, digital assignment, and challenging assessment patterns. In higher education, various new teaching-learning process is introduced to engage the learners with motivations and kindle the practice of self-learning thereby paying the way for acquisition of better competency skills and knowledge. With the various innovations in ICT for higher-education, game based learning is one of the innovative teaching-learning strategies which gained interest in various universities. The paradigm shift of ICT is tangled with various teaching methodologies in-order to match the 21st- century learners. The game based learning for programming course stimulates the curiosity to learn and understand the programming concepts in a better way. It also suits all the types of learners in the classroom especially the slow learners. The purpose of choosing gaming as a teaching aid, the learners are so much interested and addicted to any form of gaming. Using this as opportunity and interest in higher education, the programming courses will surely yield better performances and motivate the learners for lifelong learning skills. This ongoing project is focused on developing game-based learning for programming courses for first-year undergraduate students of our university. All the first-year students of various departments undergo a Python programming language course during the first semester. This programming course delivers conventional classroom teaching with chalk/talk or powerpoint presentation equipped with a practical session for all the students in the laboratory. It is also embedded with game-based learning for few sessions. The topics from programming courses are developed as gaming platforms with stages and characters. This aids the students to acquire knowledge about a topic while playing games and interact with the gaming console. The gaming technology encourages the students to enhance their cognitive skills with coding and debugging skills, thereby enhancing their competency skills. The gaming technology binds the learners with motivation to enrich the performances and achieve the course learning outcome for the Python programming course. This gaming environment includes various levels with time durations and the scores acquired based on the completion of stages. The gaming phase includes activities like complete the code, drag and drop, debugging and guess the output.

The learner's scores are evaluated using rubrics metrics which are defined by the course instructors based on the course objectives. The total scores acquired from all the stages are analyzed using learning analytics. The Artificial Neural network, regression techniques are used to measure the learner's performances and it is compared with the traditional teaching assessment process. This comparative study helps the academic curriculum to understand the impact of game-based learning for the Python course and the determination of the students to

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undergo such innovative teaching style in the classroom.

Keywords: Game based Learning, Learning Analytics, Student-Centered Learning Learning, Lifelong Learning

1. Introduction

The traditional classroom teaching are monotonous and lack to engage all the levels of the learners. The Gen Z learners are experimenting and expecting more in the classroom teaching, since they have opportunity to use various technology outside classroom to gain knowledge. It is high-time, the conventional teaching should be embedded with various pedagogical model to actively involve and make students to participate in teaching-learning process. Use of education technology can yield better interaction and improve the teaching learning process. The Information and Communication Technology (ICT) can support the classroom environment for better engagement and knowledge acquisition. Any online learning platform using ICT can supports learning and teaching experiences. The technology can enable better learning process with the embed of different instructional design in higher education. It should be an interdisciplinary approach, requiring collaboration between lecturers, software and technology developers, also involving students. The game-based learning is considered as one of the innovative teaching-learning process for better utilization of technology. The games are always fun, active participation of the students and this interest can be extended to learn new concepts to interactive way.

Digital game-based learning uses the games with educational model for students of higher education. The conventional teachings can various levels of games for different courses and involve active participation of the students. The course instructors have to design personalized games for understanding and solving the concept of particular topic. The lecturer contents must also design it in different patterns and standards to make the game interesting with the advantages of scaffolding in mind. The intrinsic motivation of the learners also play essential role in the game based learners and it will be challenging for the learners to solve many problems in game mode which will reflect positive feedback and performances of the student. The game based learning benefits in various ways like active participation, personalized learning, better curiosity to learn, collaborative learning, improves self-efficacy, The game-based learning offers the opportunity to explore and experiment with new research skills for students of higher education.

The analysis of the instructional strategies is important to measure the outcome of the learners' behavior in any pedagogical models. In recent years, learning analytics are very popular in various domain of education technology to collect, measure and analyze the data related to the learners behavior and activities in higher education. The supervised learning, unsupervised learning, and reinforcement learning algorithm are also effective measures to analyze the performances of the learners.

2. Proposed Work

The objective of this research work is to apply and analyse the effectiveness of game based learning in higher education. The benefits of the game based are explored in various aspects for undergraduate computer science course. Learning the programming concepts is a challenging course for most of the students during their academic period, which is also essential for the professional life and career development. In this regard, improving the cognitive level of the students for the programming course plays a crucial role during teaching-learning process. The undergraduate computer science is chosen for this research study. The first years B.Tech students undergo the common programming course namely "Problem Solving and Programming" across all the departments. This

programming course includes Python programming and "C" programming. A common pattern of teaching styles, assessment process and evaluations is adopted for this course. This course is laboratory based course where the faculty teach the concepts followed by the practise sessions in the laboratory with higher-order thinking skills. The students make use of the online interactive portal to practice, test the code and submit it for the evaluations. All the practice test, assessment, challenging task, multiple-choice questions, debugging and evaluations are done using this portal. The students are taught with the focus of developing higher order thinking skills as per Bloomy's Taxonomy of higher levels like analyse, create, apply and evaluate. The evaluations are done using Rubrics metrics defined by the subject matter expert of programming course. The evaluation pattern includes continuous assessment process throughout the course.

The game based learning mobile app is designed for this programming course and the students practice various concepts through by playing games. This initial plan of work is started with the gaming platform for few python programming concepts with various levels of stages. The game based learning helps all the level of learners ranging from novice to expert students. The learners are encouraged to play the mobile gaming app for programming courses and it is designed to attend various task like debugging, drag and drop activity, find the odd man out, and multiple choice questions. The students can learn, play and engage actively in this gaming platform. The scores and behaviours of the learners are tracked and performances of the learners are analysed for identifying the cognitive level of the learners using game based learning. The proposed architecture is given in the Figure 1 with the design of the overall objective of this research work.

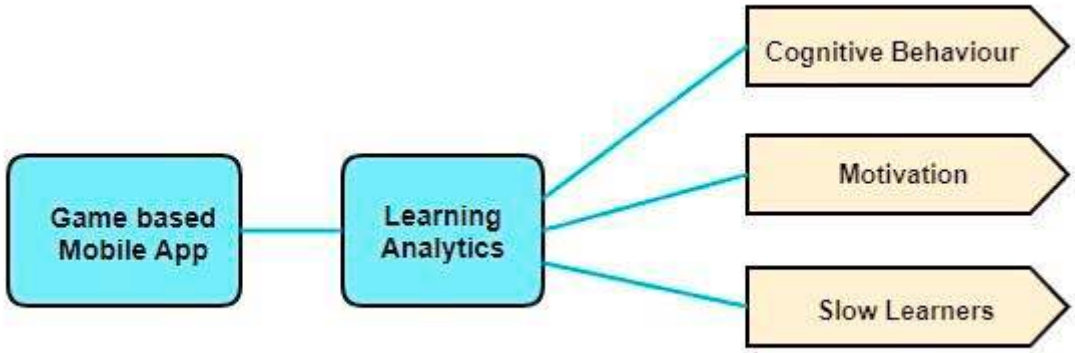

Figure 1 : Architecture for Game- based Learning

3. Conclusions

This research work is focussed on developing a game based learning for under graduate first year students for programming courses. This is an on-going research work with the various stages of game to be developed for analysing the cognitive and motivation behaviour of the leaners. These observations are also directed towards enhancing the performance of the slow learners with active engagement. The learners interest in playing a games are utilized as a platform to actively engage and learn programming concepts by playing games. The learners behaviours are tracked and analysed in each level and stages. The factor of intrinsic motivation metrics are considered for this study. The behaviour are measured using Learning analytics. This analysis will give us the clear insight of the students cognitive, motivation behaviour and overall performances. The unsupervised algorithm is be best suitable for this analysis.

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