Sanskrit Guru: Development of Gamification-Based M-Learning Application

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Abstract

Sanskrit, one of the oldest languages in the world, and has a very rich literature. Though there are many tools available for learning Sanskrit, these tools sometimes fail to engage the students. Gamification has brought a positive change in the teaching and learning; it helps keep students motivated and highly engaged. This paper proposes a system that will harness the positive effect of gamification to help learn Sanskrit. But just blindly learning is not Detailed reviews of the concepts are also provided that help build the design requirements of the system

Keywords: Gamification, Learning Algorithm, Sanskrit, Spaced Retention.

I. INTRODUCTION

Sanskrit is the oldest and the most systematic language in the world [1]. The "Sanskritam" means 'refined' or 'purified' [1]. Sanskrit has been prevalent since thousands of years and has not worn out. Due to Sanskrit's unambiguous nature and rich literature there has been growing interest in learning the language [2] [3]. There are various e-tools available for learning Sanskrit, but there is also need for a tool that makes learning fun. Including fun in learning has positive effect on the learner; it improves educational effectiveness of the subject. Games are such example where the user is highly engaged, motivated with high interaction. Game related elements can be applied to non game scenarios to generate high level of interest. This approach known as Gamification can be applied for language learning. It is highly effective and ensures user engagement, with high level of interest. In this paper we propose a Sanskrit language learning system Sanskrit Guru that will make use of gamification to teach Sanskrit in fun and engaging way.

A. Sanskrit and Existing Language Learning Tools

Sukapurath and Carmichael [4] discuss varied ways of teaching Sanskrit and how we should harness the advancements in the technology to teach Sanskrit so as make learning experience memorable. Chandra et al. [5] developed a online learning tool called Swagatam for teaching and learning Sanskrit Grammar in Higher education. Swagatam is being used by the Undergraduate and Post Graduate Sanskrit students. Patel [6] survey various e-learning tools that can be used to learn Sanskrit online. An overview of determining criteria or the effective use of e-tools, for both students and teachers is also provided. Also there are various websites and android applications available to learn Sanskrit. [7]

B. Gamification

Gamification means using game elements in non game contexts as defined by S. Deterding et al. [10] Hunicke et al. [9] proposed a MDA framework which is a formal approach to understand games in which one attempts to bridge the gap between game design and development, game criticism, and technical game research. The MDA framework formalizes the consumption of games by breaking them into their distinct components Mechanics, Dynamics and Aesthetics investigated Basten [11] explore various applications of gamification and its underlying technologies.

C. Learning Systems based on Gamification

Jianu et al. [14] proposed an E-Learning system that adapts according to the user's response. The system teaches the students basic HTML, Web Application, Servlets and CSS. Gamification elements such as scores, experience points were used to keep the students engaged. Bachtiar et al. [15] developed an E-Learning system to teach Java programming course. The system named CoMa (Code Mania) uses gamification elements like Experience points, User Level, Achievements and Challenges to increase student interactivity.

D. Effectiveness of Gamification In Learning Systems

Llorens-Largo et al. [12] proposed a gamified learning process of a subject, and lessons are summarized in the following concepts: fun, motivation, autonomy, progressiveness, feedback, error tolerance, experimentation, creativity and adaptation to the specific case. They concluded that the existence of fun during the tasks of the course is an important indication that learning is occurring. Flores [13] covers second language learning methodology and approaches, Gamification as a concept, motivational theory, educational implications for integrating the strategy effectively, and current applications used. It can be established that the use of Gamification in second language learning contributes positively to the learning experience.

E. Spaced Effect and SM-2 Algorithm

Ebbinghaus[17] studied the forgetting behavior of our brain, after performing a series of tests on himself , he found the exact shape of forgetting curve after analyzing all the recorded data as show in figure. He discovered that forgetting is exponential in nature i.e. we forget more during the initial days, later too we forget but at the slower rate. To remember things more effectively we can use spaced repetition practice that exploits the psychological spaced effect. Spaced effect means that people tend to remember more when they study in short periods spread over long time interval. Hanks et .al[19] used SM-2 algorithm to learn English and German words, they proposed an experimental project to test learning English words based on the spacing effect. Colbran et.al [20] compared two digital flashcard spaced repetition algorithms SuperMemo 2 (SM2) algorithm and older Leitner algorithm, their results confirmed SuperMemo 2 to be a better algorithm than Leitner with respect to the theoretical examination.

II. METHODOLOGY

The detailed design of the working of the application is described below. Architectural design, Algorithm used, Mathematical model of the system are explained in this section.

A. Architecture

The proposed system is designed using a model driven architecture introduced by Rivera et al.[13]. The system is divided into different packages such as Media, Workflow, presentation and content. The Fig.1 shows basic system architecture. It consists of a database in which Sanskrit words and phrases are stored. The System also uses Gamification elements such as Experience points, Badges, Levels, Leaderboard.

- Experience Points: The more the user spends time learning the Sanskrit words and sentences the more Experience points they will gain.
- Badges: When the user performs a task with fewer mistakes or achieves a task, they will be presented with Badges. For example a badge will be given when user completes 5 quizzes without making any mistakes.

- Levels: The user has to complete a level before moving on to the next level. This will help user learn the words slowly and with more efficiently.
- Leaderboard: the Experience points of the user will be displayed with the points of the friends of the user. This will motivate the user to gain more points in order to stay on the top of the leaderboard. The gamification elements will keep the user motivated.
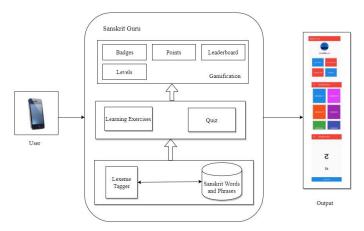

Fig. 1. Architecture of the proposed system.

B. SM-2 Algorithm

To achieve the spaced effect in the proposed learning system the SM-2 algorithm by Wozniak [18] is used.   Following is the SM-2 algorithm.

1) Divide the knowledge to be acquired into smallest possible items.
2) Associate all items with an E-Factor equal to 2.5.
3) Repeat items using following intervals:
   I(1):=1
   I(2):=6
   for n>2: I(n):=I(n-1)*EF

   where:
   I(n) - inter-repetition interval after the n-th repetition (in days),
   EF - E-Factor of a given item
4) Round up the interval to nearest integer, if it is a fraction.
5) After each repetition assess the quality of repetition response in 0-5 grade scale:
   5 - perfect response
   4 - correct response after a hesitation
   3 - correct response recalled with serious difficulty
   2 - incorrect response; where the correct one seemed easy to recall
   1 - incorrect response; the correct one remembered
   0 - complete blackout.
6) Modify the E-Factor of the recently repeated item according to the formula after each repetition:

   EF':=EF+(0.1-(5-q)*(0.08+(5-q)*0.02))

   where:
   EF' - new value of the E-Factor,

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EF - old value of the E-Factor,

q - quality of the response in the 0-5 grade scale.

7) If EF is less than 1.3 then let EF be 1.3.

8) If the quality response was lower than 3 then start repetitions for the item from the beginning without changing the E-Factor (i.e. use intervals I (1), I (2) etc. as if the item was memorized anew).

9) After each repetition session of a given day repeat again all items that scored below four in the quality assessment. Continue the repetitions until all of these items score at least four.

C. Mathematical Model

1) The proposed system Sanskrit Guru consists of following sub systems.

SG = {EP,B,EF}

where:
SG - Sanskrit Guru
EP - Experience Points
B - Badges
EF - E-Factor

2) Increment or Decrement points based on the user performance in completing the exercises
Total EP = ±EP

3) After Completion of the tasks update Badges.
Total B = +B

4) Check user retention using EF and update the list of weaker words accordingly.

III.   RESULT AND DISCUSSION

This section provides the implementation details of the proposed system. The following table shows few examples of the Lexeme tags used in the application. The words are tagged according to their function, so as to group them and teach them to the user accordingly. For example 'का', is a question meaning 'Who?' in feminine form use, hence tagged as QUES.F.

Table I. Lexeme Tag Table

Word	Lexeme tag
क	ALPHA.GRP11
किम्	QUES.N
का	QUES.F
कः	QUES.M
सः	PRON.M
सा	PRON.F

The following table shows the various elements of gamification used in the application. The elements have following main objectives:

1) To provide the Look and Feel of progression

2) To provide Feedback to the user

3) To provide Emotional response to the user

Table II .Elements and their Objectives

Gamification element	Objective
Achievements	Look and feel
Badges	Look and feel
Points	Look and feel
Levels	Feedback
Leaderboard	Emotional

Here provided are three screenshots of the proposed system Sanskrit Guru. The system assumes that the learner is beginner and is not aware of the Sanskrit Language at all. The application is for English Speakers. The learning will start from the basic letter and then compound letters, then slowly words will be introduced. The user can learn the language at own pace anywhere as per their convenience.

Fig. 2. Screenshots of the proposed sytem

As shown in Fig 2. there are various levels for the user to clear. As the user completes on level, only after that next level can be accessed. As mentioned earlier the learning will start from basic letters as shown in Fig. 2. Learning exercise is where the users are able test themselves. After completion of each exercise the user will gain Experience points, also Badges after completion of specific tasks. This score is displayed on the Leaderboard. The retention is measured using SM2 algorithm and the weak words are then highlighted, user then practices the weaker words and also remembers the words already learnt.

IV. CONCLUSION

Sanskrit is a very old language, with a very rich literature. Not knowing the language would deprive us of that rich literature. Teaching and learning Sanskrit should harness the advancements in the technology. Learning should not be just for the sake of learning but with complete engagement and high interest. The proposed system would help achieve this by using the positive effect of gamification. Gamification could help user learn Sanskrit in a fun and effective way.

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