

Motivation has always been one of the most important factors for student achievement in learning, as students with high motivation engage more in learning activities and are more likely to complete a course.

The literature review on designing intelligent tutoring systems that aim to boost student motivation, was carried out and my analysis is classified into sections:

**Assessment of motivation, Enhancement of motivation and my Hypothesis for improving motivation.**

### 1. Assessment of Student Motivation

In Intelligent Tutoring System (ITS), the assessment of motivation is needed in order to promote personalized interactions with students according to their level of motivation.

Experienced teachers usually infer student 's motivation from observational cues such as posture, gesture, conversational cues etc. which are difficult to be processed by computer systems. Therefore, most of the researches in the field of e-learning are directed towards finding a way to assess motivation from cues that can be easily processed by the e-learning systems (e.g. learner 's actions, time spent on a task, his/her statements about his/her level of motivation).

The following are reviews of some of literature focusing on **Assessment of motivation**:

#### 1.1 Using Learner Focus of Attention to Detect Learner Motivation Factors

This paper presents a model for pedagogical agents to use the learner's attention to detect motivation factors of the learner.

A Dynamic Bayesian model was used to combine evidence from the learner's eye gaze (information without certainty) and interface actions like mouse click, type and scroll window events in VFTS (information with certainty) to infer the **learner's focus of attention**.

Later a Plan recognizer which has capability for interpreting the learner's actions and forming expectations of future actions, was used to combine **learner's focus of attention** with information about the learner's activities to detect the learner's motivation factors such as degree of confidence, confusion and effort.

Baseline	Confidence	Confusion	Effort
With the human tutor's observation	82%	76.8%	76.3%
With the learner's self-reports	70.7%	75.6%	73.2%

#### 1.2 Assessment of Motivation in Online Learning Environment

Here approach for the assessment of motivation was based on Social Cognitive Learning Theory and especially related to self-efficacy (SE) and self-regulation (SR) concepts.

As part of first phase of the study, factors influencing student drop-out were researched, wherein time was used as a general indicator of drop-out risk:

A too short or a too long focus on an issue may indicate "problems".

However, both could be due to other factors: a too short time spent on a task might be explained by a good knowledge and exceeding time could be justified by factors like breaks or deep thought. Hence these situations can be clarified by asking the learner to build model.

The next step after spotting the learners in danger of giving-up was to interact with them in order to identify the ones really in danger (as situations like the ones mentioned above can occur) and engage them in a dialog in order to explicitly elicit information about their motivation and build a learner model

### **1.3 Assessment of Learner's Motivation in Web Based E-Learning**

In an e-learning system, information can be delivered in two different methods.

The first is the asynchronous method where students can acquire knowledge at any time and in any place; they can learn following their own pace. The most popular forms of asynchronous e-learning are instructional websites, email, and forum.

The second is the synchronous method where the teacher and the student interact in real time, which include real-time web chats and video conferences

This research focus highlights need for having an effective web based e-learning systems that can assess learner 's motivation in real time.

The paper proposes that motivation can be assessed in WBEL in real time by taking into consideration motivational factors such as: confidence, effort, and engagement

Modelling Confidence:

Use the time variable as indicators for student confidence combined with other indicators such as help requests and the number of steps in the problem solving process. Additionally, dialog based interaction could be used in more complicated situation.

Modelling Effort:

They propose to use the time variable such as time spent on the task as indicators for student effort while other indicators such as the number of attempts to complete a task and requests for help to perform the task may also be combined as indicators.

Modeling engagement:

Use cues as indicators for engagement/disengagement to include browsing fast rather than reading, skipping sections, and time to perform the task or answering the questions.

## 2. Enhancement of motivation

The following are reviews of some of literature focusing on **Enhancement of motivation**:

### 2.1 Enhancing Student Motivation and Learning Within Adaptive Tutors

#### Video Feedback:

Controlled trials were conducted in ASSISTments platform in order to enhance student motivation and performance by enriching content through optimized feedback delivery. Results suggested significant effects of video feedback, showing enhanced learning outcomes on next question performance after receiving adaptive video tutoring.

#### Student Choice: Exploring opportunities to make students shareholders in the learning process

Some students given choice were asked to select their feedback medium, while those without choice were randomly assigned to receive either text or video feedback.

Results suggested that even if feedback was not ultimately used, students who were prompted to choose their feedback medium significantly outperformed those who were not.

#### Partial Credit: To promote vice usage of hints: Attempting to boost motivation and proper system usage through improved assessment techniques.

Adaptive tutoring systems typically function through measures of binary correctness on a student's first attempt or first action within a problem. Within such systems, students who take advantage of tutoring feedback are unduly penalized. This creates an environment in which students are afraid to use the beneficial features of these platforms, or instead, overuse feedback if they have already lost credit (i.e., skipping to the answer rather than reading a series of hints).

The establishment of partial credit scoring would help to alleviate these issues, serving to motivate student performance while simultaneously offering teachers a more robust view of student knowledge.

### 2.2 Motivating Learning in the Age of the Adaptive Tutor - ASSISTments

Two facets of the research namely: Optimization of feedback delivery and Provision of student autonomy were elaborated.

#### The optimization of feedback delivery

##### Problems Identified:

a) Disengagement with Feedback: Both questions and feedback have traditionally been presented using rich text. In some cases, the feedback is too dense, too simplistic, or otherwise boring.

b) Maladaptive Usage of Feedback: In other cases, students are deterred from the appropriate use of feedback because the system records binary correctness on their first

attempt or action when solving a problem. This can create an environment in which students avoid feedback due to the potential for penalization or instead, overuse feedback if they have already lost credit (i.e., jumping to the answer rather than reading through a series of hints).

Disengaging feedback and maladaptive practices surrounding the use of feedback reduce the likelihood of robust learning.

The following solutions were proposed:

a) Enhancing Feedback through Video and Partial Credit.

According to Mayer's multimedia principles for the optimal design of e-Learning environments, it is possible to use hypermedia elements (i.e., video) to promote active learning while reducing cognitive load systems that make use of video tend to do so in a manner that resembles lecturing (i.e., Khan Academy) rather than content specific feedback.

A novel approach is taken to embed brief (15-30 second) video snippets as feedback within the ASSISTments platform.

b) Data mining has revealed that partial credit scoring would help

To alleviate the maladaptive usage of feedback, serving to motivate student performance while simultaneously offering teachers a more robust view of student knowledge.

Results suggested a significant effect of video feedback, showing enhanced performance on questions following adaptive video tutoring, as well as increased efficiency in problem solving. Further, the majority of students self-reported video as a positive addition to their assignment.

The provision of student autonomy

Problem Identified:

ASSISTments is built largely around assessment, putting teachers in control of assignments and leaving students with little say (a traditional approach to education). However, the platform offers untapped opportunities to examine the motivational effect of choice.

Results suggested that even if feedback was not ultimately utilized, students who were prompted to choose their feedback medium significantly outperformed those who were not.

## 2.3 Motivational Design in an Intelligent Tutoring System That Helps Students Make Good Task Selection Decisions

This research work uses a user-centered design approach to extend an ITS for equation solving, Lynnette, so the new designs may motivate and help students learn to apply a general, transferable rule for effective problem selection, namely, to select problem types that are not fully mastered ("Mastery Rule").

### *User Research for user-centered design*

Classroom Experimentation: It was found that the presence of an Open Learner Model (OLM), in the form of mastery level progress bars, significantly improves students' problem selection decisions.

For the no-OLM condition, on average, 34% of the problems completed by each student were from mastered levels, while only 8% of the problems were selected from the mastered levels for the OLM condition.

Students in the OLM condition selected significantly fewer mastered problems as compared to the no-OLM condition

OLM might have encouraged the students to work in new levels in order to fill all the mastery bars.

It was observed that students tend not to challenge themselves with new levels, and often fail to persevere in more difficult levels

### Interviews and Storyboards:

From classroom experimentation, it was inferred that some of the students do not understand the concept of mastery, and have misconceptions about the mastery bars in the OLM

Hence the Mastery Rule was explained in some of the storyboards, and found that it was not difficult for students to understand and accept the rule. The Mastery Rule can be explicitly taught to the students.

The lack of motivation may prevent the students from applying the Mastery Rule even if they are aware of the strategy.

### *Prototypes of tutor features*

Prototypes of tutor features were designed that aim to foster a mastery-approach orientation as well as transfer of the learned Mastery Rule when the scaffolding is faded. Features included:

- Daily Challenges and Achievements

- Interactive tutorial: Explanations of the concept of mastery and the mastery bars needed to be presented to address students' misconceptions

- Feedback Messages from Avatars: to fine tune problem selection towards Mastery approach

## **2.4 The Effects of Motivational Modeling on Affect in an Intelligent Tutoring System**

Studies the differences in learners' affective state transitions in two learning environments on ecology for young learners namely, Ecolab and M-Ecolab. In terms of cognitive content and pedagogy, the two environments were exactly the same. The principal difference was that the M-Ecolab incorporates motivational scaffolding whose behavior is driven by a model of the learner's motivation, while Ecolab does not.

Affective states and transitions among students were studied in two private, co-educational grade schools in the Philippines. Each student used Ecolab or M-Ecolab for 40 minutes, and each student's affect was observed 12 times as he or she used the software.

The observations of affect were conducted using Baker, Rodrigo, & Xolocotzin's method for quantitative field observations of student behavior and affect. The observations were carried out by a team of three observers, working in pairs during any given observation session.

Each observation lasted twenty seconds, and was conducted using peripheral vision. Within an observation, each observer coded the student's affective state. The affective categories coded were boredom, confusion, delight, surprise, frustration, flow, and the neutral state. Observers looked for students' gestures, verbalizations, and other types of expressions.

Considering both the overall prevalence of each affective state within Ecolab and M-Ecolab and the likelihood of transitions between states, study focused on how a student's current affective state influences the probability of a student being in the same specific affective state or a different state 180 seconds later.

Results suggested that both Ecolab and M-Ecolab are generally successful in encouraging Flow and avoiding Frustration but that students still experienced a considerable amount of Boredom. It was observed that a student who is bored in Ecolab/M-Ecolab is likely to still be bored 180 seconds later, and a student who is frustrated is likely to still be frustrated 180 seconds later

In M-Ecolab, there was a statistically significant likelihood that a student seen in delight continues in delight in 180 seconds later however this wasn't the case in Ecolab.

This study revealed that it wasn't yet clear which factors explain the persistence of delight in M-Ecolab, whether it is the motivational strategies, the narrative, other incentive to open the treasure chest. It however acknowledged that it would be valuable to analyze in future research, which aspect of M-Ecolab led to the persistence of delight.

### **3. Hypothesis for improving motivation**

In this section I would like to present some of my thoughts to improve student motivation in an ITS environment, encountered during literature review.

3.1 Can student motivation be driven if ITS requires that the more, the student solves/attempts to solve a problem which belongs to an individual's unmastered concepts, the less would be probability of such concepts being asked in exam.

Hence student might tend to pick questions which are difficult from student's perspective to practice on homework rather than to face them on an exam.

So eventually we may have a personalized exam designed so as to assess and record mastery level for each student. Unlike traditional approach with use of standardized exam, students are unsure what concepts they are good at. Hence instead of a single numeric score/percentage, we should have a histogram of concept mastery level as the student performance report.

3.2 Frequency of usage of adaptive system and time variables like time spent on unmastered/difficult question may serve as a heuristic to detect intrinsic motivation level of students.

3.3 Earn-While-U-Learn:

Some of Intelligent Tutoring Systems include elements of game such as stars, badges, (for instance Khan Academy) to inspire students. Instead of just virtual rewards, we can provide options to redeem points accumulated to produce coupons for ice-creams, chocolates or toys