Assessment of Learner Emotions in Online Learning via Educational Process Mining

Dasuni Ganepola
Department of Information Technology
University of Moratuwa
Moratuwa, Sri Lanka
0000-0002-1992-1155

Abstract*— This Research Work in Progress paper presents a novel work on affective learning. At various stages in the learning process, emotions can have an impact on the learner. Positive emotions could act as a catalyst during learning while negative emotions could act as a resistor. As educators, it is crucial to consider learners' emotions during their learning process. Educators need to design their teaching methods/ practices adapting to learner emotions. For this, emotions need to be assessed. Assessment can be done during physical classes where educators assess through their tacit knowledge. However, it is quite impossible for educators during online classes. This research focuses on assessing learner emotions during online learning by analyzing learner behavioral patterns using behavior theories. Data for the analysis is obtained from event data in Moodle Learning Management System. Finally, I expect to develop a software solution beneficial for educators to design their teaching methods/ practices considering their learners' emotions.

Keywords*— Online classroom, emotional learning, behavior theory, learner emotion assessment

I. INTRODUCTION

A. Background:

Psychology now proves that human emotions do have a considerable influence on their cognition which includes processes like learning, memory, problem-solving, reasoning, attention, etc. With this evidence, the education research field has now understood the importance of the role of learner emotions during teaching. Hence, emotions are now viewed as either an accelerator or a resister that regulates learning activity [1].

B. Research Need:

When emotions play a substantial influence on learners, assessing learners' emotions also plays a substantial influence on educators as it provides constructive feedback. A major characteristic of this feedback is that it fosters teaching methods/ practices designs [2].

Hence, it is crucial to assess learners' emotions. It is possible to conduct emotion assessment during physical teaching through the tacit knowledge of the educator by analyzing learner behaviors. However, in the present context with the Covid-19 pandemic, online and hybrid learning have become the most preferred among university students. As such, educators are not able to witness learners at all or witness them imprecisely via low-resolution domestic web cameras. This prevents them from analyzing learner behaviors precisely which in turn makes them difficult to obtain constructive feedback. The above issue could be viewed as a demanding and grand challenge in the education domain at present.

In an effort to solve this grand challenge, this research is being conducted with the purpose of developing a computational mechanism that can assess learner emotions during online learning for educators to obtain effective constructive feedback on their teaching methods/ practices. The mechanism will follow a behavioral pattern analysis approach to evaluate learners' behavior within the Learning Management System (LMS), which is a key platform in online education at present.

The primary aim of this research is to facilitate educators to innovate and develop adaptive and dynamic teaching methods/ practice designs that will utilize learner emotions as an accelerator toward learning.

II. LITERATURE REVIEW

Assessment of emotions via LMS is not a new approach. There had been developments of emotion-aware learning systems/ affective LMS with the aid of the affective computing domain in the recent past. This domain of computing focuses on developing systems that function based on human emotion (affective state) feedback. For affective LMSs, emotional data is input either implicitly or explicitly. Implicit input involves a system detecting human emotions through biological signals which can be analyzed to identify the affective state of the user. Explicit input involves the system capturing emotions by the way humans communicate with the system (e.g. Identifying learners' emotions from blogs through Sentiment analysis) [3].

The explicit model has mostly been data-centric. Data Mining (DM) techniques such as regression, classification, clustering, and text analytics are being utilized to analyze and evaluate insights from data. The area of applying DM to educational data is known as Educational Data Mining (EDM). A category that falls under EDM is Educational Process Mining (EPM). EPM, however, is process-centric, meaning the data type is events. An event is referred to as a case/ activity that has a timestamp. Event logs are collections of cases recorded with their timestamps. EPM analyzes event logs to identify and discover insights in the educational environment [4], such as modeling all comprehensive and

abstract observed behaviors of learners within the learning environment [5], examining study habits of high and low performing students [6], identifying the strategies for problem-solving by students, receiving high marks [7].

III. RESEARCH GAP

It was observed that the number of EPM research has increased with time and EPM research has gained popularity since 2017. With the growing number of research, it could be viewed that EPM is an aspiring line of the research domain.
However, I also observed that research associated with the analysis of learner emotions using this approach is lacking. Hence, this research will address the above gap in the research domain of affective LMS.

IV. VALUE OF RESEARCH

A series of research has been identified by my faculty with a vision to inculcate in the first-year undergraduates following the computing discipline, a higher degree of computational thinking skills.
This research focuses on the role of learner emotions played during the development of the above cognitive skills and I intend to assess learner emotions by developing a learner emotion-behavior model.
Hence, this research would be immensely beneficial for the educators of the faculty to effectively design their teaching methods/ practices.

V. RESEARCH METHODOLOGY

A. Research Hypothesis

The hypothesis I developed was based on the findings of [8], [9] [10].

[8] expressed that motivation was one of the major catalysts for learning and the "driving force that initiates and directs behavior".

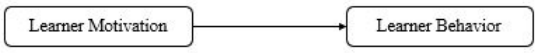

Fig 01. Relationship between learner motivation and learner behavior

[9] and [10] indicated in general (with no specific link to cognitive activities) that motivation is directly linked with emotions where emotions have a direct impact on a person's motivation.

Fig 02. Relationship between emotion and motivation

Accordingly, I formulated the Research Hypothesis as follows:
"Learner emotions have a direct impact on learner behavior and emotions can be assessed by analyzing the behavior"

Fig 03. Relationship between learner emotion and learner behavior

B. Research Objectives

Objective 01: To computationally model the learner behavior via EPM within an online learning environment into learner behavior process models.
Objective 02: To analyze the process models using behavior pedagogy theories to assess learner emotions.
Objective 03: To establish that learner emotions have a direct impact on learner behavior.
Objective 04: To propose a tool that would facilitate educators of the faculty to effectively design their teaching methods for assessing learner emotions.

C. Research Approach

In order to achieve the said objectives, the following process is adopted:

1. Replication of learner behavior within the digital environment using EPM to create process models.
2. Theoretical analysis of process models using suitable behavior pedagogy theories.
3. Assessment of learner emotions based on the findings of theoretical analysis.
4. Investigation of correlation of learner emotions and learner behavior.
5. Development of software for assessing learner emotions.

It is intended to elaborate the said process in the following manner:

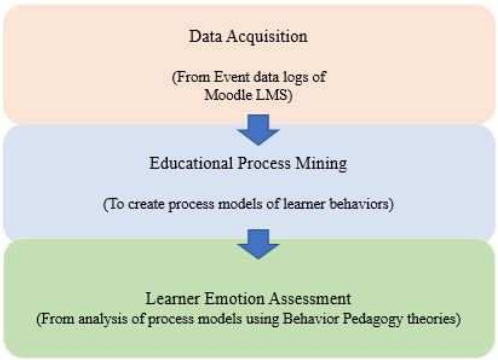

Fig 04. Research Approach

a) Data Acquisition:
The learners' behavioral patterns are captured online from the event log reports generated from Moodle LMS. Moodle LMS was chosen because the representative sample is most familiar with Moodle LMS when compared to other LMS products in the present-day educational technology market.

The sample is assigned a short course on learning computational thinking skills within an online learning environment.

b) Educational Process Mining:
Once, event log reports are gathered, data clustering will be done on the report data to group similar behaviors.
Afterward, EPM is applied to generate learner behavioral process models to discover and visualize learners' various learning processes.

c) Learner Emotion Assessment:

To model and investigate whether learner emotions have a direct impact on learner behavior, I intend to utilize the theories in Applied Behavioral Analysis (ABA) pedagogy theories.

Learner emotions are assessed in the Valence axis scale of the human emotion plane. The human emotion plane is defined by two axes, Arousal and Valence. The arousal scale measures the level of autonomic activation while the valence scale measures the degree of pleasantness in emotions [11],[12].

VI. RESEARCH STATUS

A batch of undergraduates in their first year of the Information Technology degree program at a state university in my faculty has been selected as the representative sample for this research.

The course was designed according to the ARCS (Attention, Relevance, Confidence, Motivation) pedagogy model of Instruction Design by Keller. This model was utilized since it would stimulate systematic learner behavior [8].

The learners' behavioral patterns are captured online from the event log reports generated from Moodle LMS.

VII. CONCLUSION

Learner emotions are an integral part when designing teaching methods/ practices by educators. This research aims to facilitate educators who are delivering online classes to assess their learners' emotions. This is conducted by formulating a hypothesis that states learner emotions have a direct impact on learning and it can be assessed by analyzing their behavior.

The research is done within an online learning environment where learner behavior is captured via the activity log data reports generated in Moodle Learning Management System. Educational Process Mining is utilized to model learner behavior into process models. These models are then analyzed via the behavioral pedagogy theories to understand the relationship between learner emotions and learner behavior. A tool that would facilitate educators to effectively design their teaching methods/ practices based on learners' emotions is to be developed as the outcome of this research.

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