

A Process Mining approach to analyze learning behavior in the flipped classroom

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Abstract: Flipped classroom as an instructional strategy promotes dynamic learning to increase student's engagement and learning outcomes. Video-based lectures and materials are to be referred before the actual class as a pre-class activity in the flipped classroom setting and completion status are evaluated through learner's feedback. In this paper, pre-class activities are evaluated by applying process mining on the student's clickstream data generated through learning platform "Delta" designed for current work. The students are categorized as credible and mediocre performers based on their pre-assessment score and process models are generated by applying fuzzy miner and heuristic miner based on their engagement with the tool. We further analyzed and registered the absolute & relative occurrences of events, identified a contrasting pattern in student behavior through trend analysis and process comparator. The various process models from learner's data were presented using several visualizations.

Keywords: Process Mining, Flipped Classroom, Heuristic Miner, Fuzzy Miner, Process Comparator

I. INTRODUCTION

Flipped Classroom [1] is a particular type of dynamic learning plan that anticipates that learners should complete appointed activities before joining the instructor-led class. The completion of preliminary work provides the opportunity to render higher-order learning tasks in the classroom. Flipped classrooms are progressively being embraced in tertiary education hence there is an increase in the investigation of students learning. Although utilizing learning management system has been widespread with regards to higher education and active research in analyzing learner's data from these systems attracted researcher community such as educational data mining and learning analytics but still paid less attention to developing analytical techniques to explore student behaviors in online learning settings. The educator or instructional designer plays a vital role in the process of developing analytical techniques by examining and deciphering the data in their learning setting and propelling the learning design and theory.

The new spotlight on learning analytics is to examine temporal dimensions of learning, provide

insights, and builds learning systems, self-regulated learning, and metacognition. There is, however, a deficient amount of research in the area of temporal process mining in education setting was observed. Grigorova, K et al. [2] brought out that process mining in e-Learning framework can work on the nature of educating, increment its accessibility and adequacy.

To our knowledge, there has been no work carried out to apply the process model in a flipped classroom to identify the impact of individual learners or a group in an individual class using behavior attention towards content using process mining. The objective behind this study is to investigate the behavior of the student in referring to the contents shared and seek an answer to the following research questions:

RQ1: Can process mining methods be the tool to detect the learning behavioral patterns from trace data collected during a flipped class session?

RQ2: To what extent the contrasting pattern of student behavior can be identified using the process model?

The rest of the paper is collocated as follows. Section 2 discusses about the connected work. In Section 3 we presented the methodology followed to carry out the research. Section 4 and Section 5 shared the results, discussion, and conclusions.

II. RELATED WORK

Process Mining is a contemporary procedure to investigate process-oriented knowledge revelation in educational frameworks including the disclosure, examination, and upgrade of processes and flows on the event logs produced by learning conditions. When students participate in a bunch of learning activities in online settings, their strategies for learning can be identified from the user trace data. These trace data allow the researcher or educator to analyze the behavior of students in the learning context which has a better advantage over self-reports [3]. Mining the time related and sequence nature of learning is receiving raised focus in learning analytics research. Analyzing behavior