

# THE FRAMEWORK OF INTERVENTION ENGINE BASED ON LEARNING ANALYTICS

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## ABSTRACT

Learning analytics primarily deals with the optimization of learning environments and the ultimate goal of learning analytics is to improve learning and teaching efficiency. Studies on learning analytics seem to have been made in the form of adaptation engine and intervention engine. Adaptation engine studies are quite widespread, but intervention engine work has been seen to studies very few. For the intervention engine studies, it was generally determined that interventions were made with feedback and dashboards. The aim of this study is to reveal an intervention engine framework which is based on learning analytics. Within this framework, a system design has been put forward which can provide instructional, supportive and motivational interventions to learners. These interventions are based on both the learning outputs of the learners and their learning experiences. Instructional interventions are planned to be based on learning outputs, supportive and motivational interventions are based on learning experiences.

## KEYWORDS

Learning analytics, intervention engine, learner output, learner experience

## 1. INTRODUCTION

Learning analytics primarily deals with the optimization of learning environments. So far, this optimization has been based on two basic components. These are adaptation engines and intervention engines. Numerous designs and researchers are being conducted for the adaptation engine. Whereas studies on intervention engines have, unfortunately, been limited to dashboards and feedback. The weakness of the intervention engine designs based on learning analytics is that the theoretical construct is not adequately addressed. However, the intervention is a concept that includes specific methods and models in psychology. Intervention defined; interact with people to help them in an ongoing system (Argyris, 1970). The dimensions of the intervention concept and types of intervention in the related field are stated as instructional, supportive and motivational interventions (Geller, 2005). But, the theory of intervention is structured in the field of behavioral psychology. Therefore, intervention theory based on behavioral psychology principles is not suitable for learning environments based on the constructivist learning approach. The aim of this study is to create an intervention engine framework which is based on learning analytics. Instructional, supportive and motivational interventions will be included in this intervention engine.

### 1.1 Learning Analytics and Intervention

E-learning provides a lot of benefits to learner and instructor designers. Besides this, there are some barriers in e-learning processes. One of the most important of these barriers is that online learning processes are biased. Here, the biggest bias is mentioned; online learning processes provide more benefits for self-directed learners. In other words, in online learning environments; a process that works against the learners who need intervention in favor of autonomous learners. In the solution of this negativity learning analytics is an intensively studied subject. For solving these problems, learning analytics offers opportunities for instructional designers, instructors, and researchers. Moreover, the main aim of learning analytics is to improve learning and optimize learning environments. Siemens and Gasevic (2012) proposed the concept of learning analytics in this direction: "Analyzing, measuring and reporting on learners and learning

environments data in order to understand and improve learning environments and processes". In this context, it appears that learning analytics will play an important role in facilitating learning and increasing performance. Because; the ultimate goal of learning analytics is to improve learning and teaching efficiency (Elias, 2011). Learning analytics provide a great deal of power to improve learners' learning performance and increase learning efficiency (Dyckhoff vd., 2012). Besides, that learning analytics can ensure better feedback on the learning process (Kloos vd., 2013). Based on the feedback obtained, environment designs are reviewed and improved to create more appropriate environments.

Learning analytics often rises on the educational data mining background. Educational data mining is the subject of analysis based on log data of learners in learning management systems. The relationship and / or difference between the two concepts can be sought in terms of analyze-analytic concepts. The concept of analysis refers to pattern discovery based on data, whereas analytic refers to the use of these patterns in a specific area. In this direction; while the educational data mining aims to discover the patterns of learning data in instructional environments, learning analytics requires the use of these patterns with instructional purposes.

With the use of learning analytics, it became possible for learners in e-learning environments to intervene and improve the learning environment during their learning experiences. The ultimate goal of the interventions; improve learner achievement or improve learners' learning experiences (Pardo & Dawson, 2016). But the delay of feedback and the inability to use real-time information is a concerning topic for adaptive diagnosis and intervention in e-learning environments (Wu, Huang & Zou, 2015). With the intervention engines, it is possible to give immediate feedback to learners and to use the interaction data in e-learning environments. In addition, if the successes and interactions of learners are ignored learners' successes and their environment engagement can be negatively affected. Effective interventions have been shown to have a significant impact on encouraging learners' performance of learning (Chen, 2011). A structured intervention model which is developed with learning analytics to support learning and teaching can improve the learning performance of learners(Wu, Huang & Zou, 2015). Studies on learning analytics have just begun. So, research on improving the learning environment seems to be lacking. The main reason of this lacking is that there is not enough study on the intervention engines.

## 1.2 Design of Intervetion Engine

In this research, an intervention engine framework which is based on learning analytics is presented. In the next stage, an intervention engine design and development will be done using the developmental research method. Before designing the intervention engine it is necessary to define the intervention which is a psycho-educational structure. Intervention is defined that interact with people to help them in an ongoing system (Argyris, 1970). Intervention theory and intervention models in the field of psychology have been put forward. In this research, "*ABC (activator-behavior-consequence)*" which is intervention model developed by Geller (2005) will be used. In this model; there are three types of intervention which are instructional, supportive, and motivational.

Table 1. Intervention types and definitions (Geller 2005)

Intervention Type	Definition
Instructional	Use an activator or antecedent to start a new behavior.
Supportive	If an individual learns what is right behavior and exhibits behavior, it can be used to turn it into a routine in daily life or to automate the behavior.
Motivational	Person know the right behavior but if it does not show it; he/she needs an encouragement from the outside or the interventions.

As we can see in the definitions interventions use for the changing the behavior. Interventions and intervention types are used to create about behavioral changes because of the concept of intervention is a psycho-educational structure. In the context of this research, this structure has been included in the intervention engine design in accordance with the e-learning environments. The aim of the intervention is improving the learning. These interventions both can be directly made based on learning outputs, and they can be indirect interventions to based on learning experiences. In the studies of the related field, it was seen

that the interventions to learners were usually based on learning outputs. In this research, interventions are based on both learners' learning outputs and learning experiences. Instructional interventions based on learners' learning outcomes and supportive and motivational interventions based on learning experiences are structured.

## 2. METHOD

Research is planned as developmental research. Developmental research is defined as; "*Design, development, and evaluation of a specific product*" (Richey, Klein & Nelson, 2004). The research process is conducted in accordance with the developmental research approach suggested by Reeves (2000).

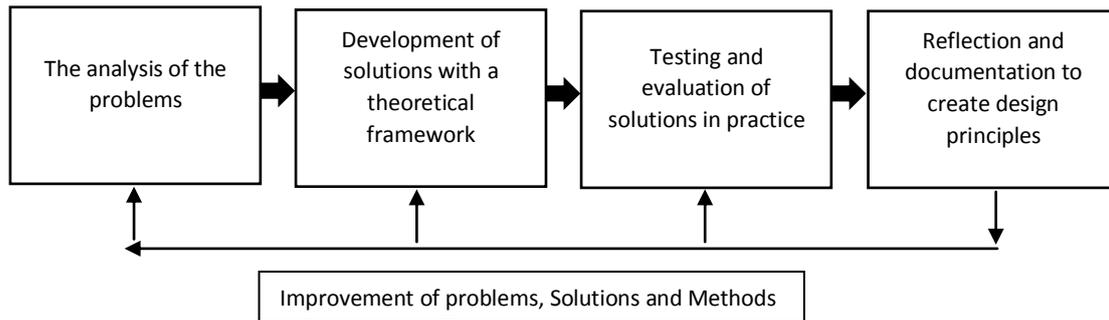


Figure 1. The process of developmental research

As you can see in Figure 1, developmental research is an iterative process that starts with needs analysis and ends with designing and documentation. In the context of needs analysis, focus group interviews were made with the learners by the semi-structured interview form. Then, we were decided from the obtained findings the interventions which are used in the intervention engine design. After the interventions have been determined, the prototype will be developed. After the final prototype is determined, the e-learning environment will be developed.

### 2.1 Framework of Intervention Engine

The intervention engine framework includes instructional, supportive and motivational interventions. Instructional interventions based on outputs of learning tasks; supportive and motivational interventions based on learning processes/experiences. The intervention engine framework which is planned to be developed is presented in Figure 2.

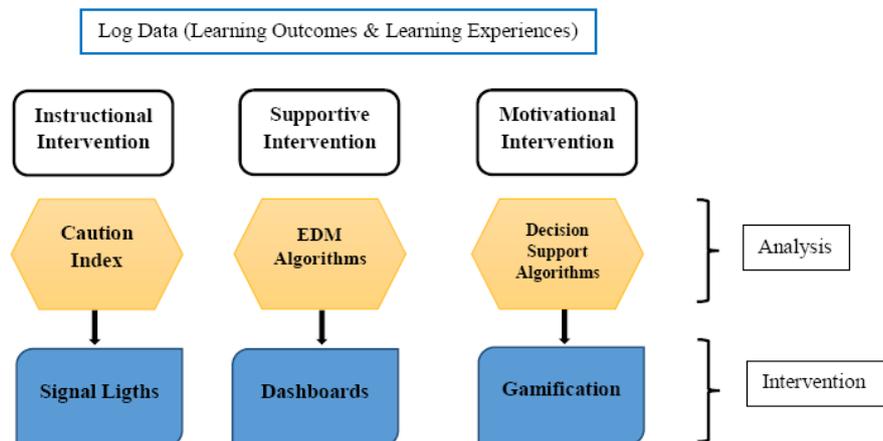


Figure 2. The intervention engine framework

As can be seen in Figure 2, instructional interventions will be done using the caution index based on the notes that learners have taken from learning tasks. According to the results obtained, direct feedback is given to the learners and information about weak or strong topics will be given by signal lights.

Supportive interventions which based on learners' experiences' data will be calculated by using educational data mining algorithms. The results will be presented to the learners via dashboards. In this type of intervention, predictions which the success status of learners will also be made.

Motivational interventions which based on learners' experiences' data will be calculated by using decision support algorithms. According to the results, the motivation items will be presented to the learners via gamification components.

### 3. CONCLUSION

In this research, an intervention engine framework based on learning analytics has been revealed. There are educational, supportive and motivational interventions in the scope of the intervention engine. Instructional interventions will be calculated according to the results of learning outputs of learners via the caution index. Learners will be presented information which is about their performance via direct feedback and signal lights. Educational data mining algorithms will use for supportive interventions and dashboards will be used to display the results. The gamification items will be used in the e-learning environment for motivational interventions. As a result of the research, an intervention engine for e-learning environments has been put forward. At the next stage, the intervention engine will be developed.

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