

# Chapter 27

## Automated Monitoring and Forecasting of the Development of Educational Technologies

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### ABSTRACT

*This chapter will describe an approach to monitoring and forecasting the development of innovative educational technologies based on text stream analysis. The approach will involve detecting education-related events in the stream of text documents, constructing situations, determining possible scenarios of further development of situations, and generating recommendations for successful introduction of detected innovations into the educational process of the university. The authors will propose a multicriteria model of an event reflecting its key aspects. The chapter will describe an event detection method based on incremental clustering, as well as a scenario generation method based on the principle of historical analogy. The authors will discuss several experiments to evaluate the quality of the methods.*

### INTRODUCTION

Novel methods and technologies constantly emerge in education with a goal to provide students with knowledge and skills demanded by modern society. To meet modern standards of education, universities introduce methods into their educational process. However, it is risky to introduce innovative teaching approaches because it is impossible to guarantee future success.

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There is a need to discover new educational technologies, track their development, and predict their future development to determine whether it is reasonable to introduce them into the educational process of a university. This can be achieved by periodically downloading and analyzing text documents from Web sites and domain-specific sources. However, experts cannot manually analyze a text stream because of the huge amounts of documents generated by the sources.

This chapter will describe an approach to automated monitoring and forecasting of educational technologies development based on text stream analysis. The authors will use the term *educational technologies* in broad sense, which will include teaching methods and promising innovations in science and engineering that should be considered when planning and implementing study programs in universities.

## **Background**

The authors will consider the process of the monitoring and forecasting of educational technologies development as a sequence of the following steps:

- **Step 1:** Detecting events in the text stream related to educational technologies.
- **Step 2:** Tracking situations development based on detected events.
- **Step 3:** Determining possible scenarios for development of tracked situations.
- **Step 4:** Generating recommendations for decision-makers.

The original task has been divided into four subtasks which will be described in the following sections.

## **Event Detection Subtask**

Researchers who deal with event detection in text streams use various definitions of the *event* concept. According to Raimond and Abdallah (2007, para. 2), event is “the way by which cognitive agents classify arbitrary time/space regions.” Allen and Ferguson (1994, p. 3) proposed a similar definition when considering events as “the way by which agents classify certain useful and relevant patterns of change.” When speaking of an event, a person classifies a change of the situation occurring within a certain area during a certain time interval. The person assigns the change to a certain pattern, such as scientific conference, invention of a new technology, or introduction of a new teaching method into the educational process of the university.

Real-world events are reflected in a stream of text documents, including scientific articles, media news, and regulatory documents. Therefore, the problem of event detection in the text stream can be defined as the task of detecting and interpreting changes in this stream (Yang, Pierce, & Carbonell, 1998). Kumaran and Allan (2005), as well as Dobrov and Pavlov (2010), proposed multicriteria descriptions of an event reflecting the following aspects: who, when, where, and what. Raimond and Abdallah (2007) presented an ontological model of an event in which the event has the following characteristics:

- Area where the event takes place
- Time interval when the event occurs
- Active agents participating in the event
- Factors under which the event occurs
- Products of the event

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