Chapter 7
Instructional Technologies of the XXI Century: Theoretical Approach

Vladimir Nikolaevich Romanenko
North-Western Branch of Academy of Information Technologies in Education, Russia

Galina Vasil'evna
North-Western Branch of Academy of Information Technologies in Education, Russia

ABSTRACT

The classical idea of an instructional process is to create some new knowledge, skills and abilities, so-called KSAs. If a student has a set of KSAs at the beginning of a learning process and if he or she has a new set of them at the end of a learning period we can say the instructional activity transforms the student from the starting state (state number 1) to the final state (state number 2). One can define such transformation as an effective action. It is possible to describe each action as a set of external impacts. In the case when this set is a series of standard actions, which usually give a predicted result, we can say it is a traditional education technology in so-called triad form: object number 1 transfers into object number 2. It is possible to present this in the form of a matrix equation. This equation is the main one in the general theory of technologies. The main idea of this article is to analyze the effectiveness of an instructional process based on mathematical descriptions, which was developed in the general theory of technologies.

INTRODUCTION

Heterogeneity is one of the universe's main properties. Its independent parts are usually denoted as objects. Objects, in turn, have a complex structure as well (Romanenko & Nikitina, 2014). All objects and all of their parts continuously interact with each other. These interactions are realized with the help of different flows: flow of substance, flow of matters and flow of information. These flows effect the objects. If the effect is strong enough, one can say that it is a transformation of an object. Yet frequently one can have a situation where the main part of an object does not change. This case is traditionally called a reflection. The difference between transformation and

DOI: 10.4018/978-1-4666-9634-1.ch007

reflection is frequently insignificant. One can say each object has some reflected information about other objects. In case of reflection, changes in objects' behaviors do not need to be very active. This means the main object's properties remain unchanged upon reflection. The properties of the environment are reflected on the objects in both of their main states, namely animated and non-animated states. Any car or building, for instance, can be reflected on a photo plate, on a memory card or in a human brain. However, changes of objects and environment, which are fixed as a result of reflection, may be different. For example, the reflection of a surrounding world usually stops after the reflection is finished. This is the case with the object of non-animated matter. One calls such reflection passive. Contrary to this, the reflection on the object of animated matter is active. It creates a set of further changes to the object (Romanenko & Nikitina, 2014). The transformations and processing are the most serious acts in this set. The difference between passive and active types of reflection is one of the fundamental differences between animate and inanimate forms of matter. Learning is a process specific to animated matter only. Therefore, the main goal of studying the theory of a learning process is to discuss a case of active reflection of animals. The learning process we are going to discuss is focused on human learning only. In response to the external world higher animals can set some simple goals. The goals set by humans are much more difficult and complex. At some stage of evolution humans started to pre-plan their actions to get desired results. Such sets of planned actions is denoted as human activity (Vygotsky, 1978; Vygotsky, 1986). The pre-planned activity usually consists of a set of different actions.

HISTORICAL BACKGROUND

Despite the complexity of the universe, its perception by humans is possible as a result of modeling. One defines modeling as a simplified description takes into account some properties. The loss of a number of important properties in the description of nature is the payment for simplification of studied problems. Therefore, a number of different models is necessary for study of each serious problem. The process of learning is tied to several models that take into account different theoretical points of view (Frigg & Hartman, 2011; Romanenko & Nikitina, 2009). The best known of them are theory of systems (Bertalanaffy, 1974), theory of human activity (Vygotsky, 1978; Vygotsky, 1986), theory of global evolution (Gould, 1981; Chaykovsky, 2008). The general theory of technologies is one of them. There are two important questions in the field of education, natural sciences, and sociology. The first question is what it is, and the second is how to do it (Romanenko & Nikitina, 2012b). The answer to the first question is given in physics and engineering. The answer to the second one can find in the field of chemistry and other types of processing. Processing is defined as a path of fabrication or transformation of different objects we need. One can transform objects by different ways. If the object under transformation is a person or a group of humans, such transformations cover areas of medicine, policy, and education as well. The processing can sometimes create objects we really need. Human knowledge develops unevenly over the time, and in different areas.

Philosophers began paying attention to transformation processes at the end of Renaissance. Many neologisms were introduced in Latin at that time. Some of them came from Greek words. The greatest contribution to the new terms was probably made in the countries of the German language. The most widely spread word at that time in German was *NützlischeKünste* (Troitzsch, 1999). It was well known in English as *useful art*s. The new term *technology* was at first used by famous German scientist Johann Beckmann. The best of his books were translated into many languages. The last of them were printed not long ago (Beckmann, 2006; Beckmann, 2014). After Beckmann, the new term *technology* became