The use of the semantic differential method in identifying the opinions of university students on education realized through e-learning

Milan Klementa* Miroslav Chráska a Marie Chrásková a

*Faculty of Education, Palacký University Olomouc, Žižkovo nám. č. 5, Olomouc 771 40, Czech Republic

Abstract

Modern higher education encompasses a variety of forms, methods, and tools, which aim for a goal directed, and systematic mediation, acquisition, and consolidation of abilities, knowledge, skills, habits, values, attitudes, and forms of social conduct and behavior of students. It should also be noted that it is precisely the forms and methods which have undergone and are still undergoing dramatic changes. They have been alternated, transformed, new ones have been created, and some have disappeared. The study presents the attitudes of university students towards e-learning, as one of the up-to-date forms of education, within the framework of their undergraduate studies. It also illustrates the course of the research investigation, carried out from the year 2014, and submits some of the outputs. The main objective of the above mentioned investigation having been to determine the preferences and opinions about the form, the organization of e-learning and about the tools applied, the present study is conceived as a contribution to the discussion about the possibilities and limits of the use of a fully electronic learning within the framework of the undergraduate and lifelong learning, based on the use of modern information and communication technologies.

Keywords: distance learning; e-learning; university students; semantic differential; ATER method

1. Introduction

The concept of undergraduate students' preparation includes both the educational process and the educational system. Studying at a university in terms of process is a general term for education of the adult population, and

E-mail address: milan.klement@upol.cz
includes all training activities implemented as regular university education, acquisition of a certain level of education or further education or lifelong learning. It is a process of goal-directed and systematic mediation, acquisition and consolidation of abilities, knowledge, skills, habits, attitudes, and forms of social conduct and behavior by those who have completed secondary level education and are preparing for their profession and subsequent entry into the labor market. In terms of the educational system, it is a system of institutionally organized as well individual, or self-teaching training activities which replace, supplement, expand, innovate, alter or otherwise enrich the initial education of adults who deliberately and intentionally develop their knowledge and skills, values, interests, and other personal and social qualities necessary for a full and fulfilling work life and successful playing of social roles. Higher education can thus be characterized as a process of training, in the course of which a person acquires a system of knowledge and activities which he or she subsequently internally processes, especially via interiorization, or learning, and transforms into knowledge, skills and habits (Muzik, 2004, p 4). This training takes place between two factors basically. The first factor is the educator, within the context of higher education, a lecturer; the other factor is the recipient of education, or a student. From the educator’s / lecturer’s perspective, we speak about teaching, from the recipient’s of education or student’s point of view, we speak about learning or studying. There is an interaction between these two factors.

All forms of education, university education being no exception, are implemented in specific forms. The forms and methods of education are also one of the crucial elements, which are subject to fundamentally different approaches of andragogy and pedagogy as regards practical experience. It should be noted that it is precisely the forms and methods which have undergone and are still undergoing dramatic changes. They have been alternated, transformed, new ones have been created, and some have disappeared. Therefore we can say that this area is one of those areas, which are also subject to significant influence of fashion and trends. Even in university pedagogy we might thus come across forms and methods which are called "in" by contemporary terminology… At present, the prominent ones would for example be e-learning (Klement, 2012) or coaching.

The perception of e-learning is often ambivalent and inconsistent, the main reason being an inhomogeneous terminology, to a great extent influenced by the linguistic impacts and by the diversity of approaches and technologies used (Saettler, 1990). Within the transatlantic space, activities related to the supporting of the education process by ICT (i.e. e-support) are not defined as e-learning, in favor of relatively set phrases of Computer-Based Training (CBT), Internet-Based Training (IBT) or Web-Based Training (WBT) (Lowenthal, Wilson, 2009). In Europe, a consensus was reached upon the use of a unified term of e-learning, which, according to the information at the e-learning portal for Europe Elearningeuropa.info, is understood as the application of new multimedia technologies and the Internet in education, in order to improve its quality by enhancing access to resources, services, the exchange of information and cooperation (Simonova, 2010).

According to this definition, e-learning covers not only a wide range of tools that are used for the presentation or the transfer of the educational content and for the management of studies, but also an entire spectrum of communication channels. The tools are used via LMS (Learning Management System), which is a prerequisite for the implementation of a truly effective learning process through e-learning. LMS thus represents a virtual ‘classroom’ environment comprised of tutorials, quizzes, study instructions, exercise plans or discussion forums (Mauhe, Thomas, 2004).

Apart from LMS, properly structured and didactically adapted educational texts, referred to as e-learning supports (Paulsen, 2003) contribute significantly to the implementation of e-learning. To get a clear and permanent definition of the term, it is therefore necessary to focus on the structure and the arrangement of individual elements that such a teaching material is composed of. Study materials for distance learning, in both classical form and the form of e-learning, have gradually evolved from textbooks. In terms of the text structure, a classical textbook (Möhlenbrock, 1982) is composed of two basic components, i.e. text components (‘written text’) and extra textual components (graphical components). It should nevertheless be noted that e-learning supports have their own unique characteristics as they are intended for a particular form study, characterized above all by a higher level of independence and individuality (Bates and Poole, 2003). A characteristic feature of thus structured electronic study supports designed for e-learning is the fact that their nuclear structure is enhanced by various interactive and multimedia elements, i.e. animation, multimedia records, dynamic simulation, sound recordings, etc., as shown in the figure number 1.
Having taken into account all the above stated facts, the author of the study present carried out a investigation research focused on monitoring and evaluating students' attitudes to e-learning enhanced by sophisticated electronic and multimedia enriched learning supports (Klement, 2010). These comprised and made use of tools designed to achieve cognitive, affective, as well as psychomotor learning objectives, completely in compliance with modernization trends in this area. Thus each e-learning support contained not only a static text part, i.e. verbal component of the text, a visual portion of the text, i.e. visual component of the text (images, diagrams, graphs, etc.), but also a dynamic part, i.e. dynamic component of the text in the form of multimedia extension, i.e. animation solutions, or even interactive simulations of particular steps (Chudy, Candik, 2004), through which students could acquire the necessary skills.

2. Viewpoints of Content of the Attitude Term

Attitudes of people, their behavioural tendencies, formed in social conditions during individual’s life, seem to be an important indicator of behaviour and experience. So far there has not been a unified definition of the attitude term. Variability in this field is caused by different bases of the individual authors, but also by different methodological and methodical approaches to empiric researches. There are many definitions of attitudes among social psychologists as well as in the view of other scientific disciplines.

1.1. Attitude Structure

An attitude is generally understood multidimensionally, when its internal structure is created by three components. A three-component model was defined in 1940s by Smith, Sherif, Campbell, Kresch and others (Nakonečný, 1997, pp. 217; Janoušek, 1988). The three-component model of the internal attitude structure expects the existence of cognitive and conative components (sometimes described as behavioural tendency).
• The affective (emotional) component concerns emotions experienced in relation to the attitude object. The object may have pleasant or unpleasant effect, it may be preferred or non-preferred. The affective component provides the attitude with its motivation character and determines its directionality. Sometimes it is described as affectively evaluating. According to the authors of the three-component model, it is formed by means of classical conditioning.

• The cognitive component contains opinions, views and knowledge about the attitude object. It also includes opinions or ideas about the manners of acting in connection with the attitude object. Different attitudes have the cognitive component qualitatively and quantitatively structured in a different way. Evaluating opinions are very specified pieces of knowledge contained in the cognitive component, those opinions may range in positions “favourable” – “unfavourable”, “wanted – unwanted”, etc. They are formed by means of cognitive learning.

• The conative component contains promptness to act which is connected to the attitude. In case of a positive attitude, an individual is more likely to be engaged in favour of this certain object and vice versa. Analogically, it is also true for negative attitudes. However, it is necessary to emphasise that promptness to act does not always have to be manifested in the form of real activity. It is formed by means of instrumental learning.

As far as the internal structure of the attitude is concerned, the opinions are not unified. Not all authors go along with the three-component model. Sometimes one-component model is contrasted with this model. Shaw and Wright came with it in 1969 (Janoušek, 1988). According to their opinion, the attitude has more affective character, cognitive component prepares a basis for evaluation and thus for the attitude, which predisposes an individual to a certain activity towards the attitude object. Other advocates of the one-component model are M. Fishbein and Ajzen (Výrost & Slaměník 1997, pp. 247), according to whom the individual’s attitude towards the object or attitude towards acting is unidimensional and expresses attractiveness of the given acting. Thurstone also considers a feeling for or against the psychological object to be an attitude.

The third model of the attitude structure was presented by Bagozzi and Burkrant (Výrost & Slaměník, 1997, pp. 247). The attitude is understood as a two-dimensional construct containing affective and cognitive components. Both of them effect intend to act in a certain way as well as acting by itself. According to the authors, each attitude must have cognitive and affective content, but it does not necessarily have to contain the conative component, which is probably at lower level of abstraction.

1.2. Methods of Attitude Measurements

Attitudes as complex psychical structures cannot be measured directly. They can be deduced from different types of man’s activities. There are many methods mentioned in literature by means of which we can measure existence and quality of the attitude (Janoušek, 1986; Svoboda, 1992).

Based on the character of responses, Cook and Selltiz (Janoušek, 1986, pp. 129) state the following classification of the attitude measurement techniques:

• Measurements, in which the conclusions about attitudes are deduced from statements about own opinions, views, feelings, behaviour etc. towards the object or category of objects (e.g. Semantic differential).

• Measurements, in which the conclusions are deduced from evident behaviour towards the object.

• Measurements, in which the conclusions are deduced from reaction of the individual to partly structured materials relevant to the object or from interpretation of those materials (different projective techniques – TAT, Rosenzweig picture frustration test, etc.).

• Measurements, in which the conclusions are deduced from performances in objective tasks, where the activity may be influenced by certain dispositions of the individual towards the object.

• Measurements, in which the conclusions are deduced from physiological reactions to the object.

Campbell (Janoušek, 1988) based its classification on the question of masking and apparentness of the methods used. He differentiated four method groups:
• Non-masked – structured methods: “direct” classical measurement of attitudes by e.g. attitude scales, Semantic differential.
• Non-masked – unstructured: interview, questionnaire, biographic studies etc.
• Masked – unstructured: projective tests – TAT, tests for completing sentences, Rosenzweig picture frustration test, etc.
• Masked – structured: similar to objective performance-related tests, e.g. information tests, critical thinking capability tests, tests concerning various skills, etc.

According to Krech, Crutchfield, Ballachey (Výrost & Slaměník, 1997), we can only measure the attitudes based on conclusions deduced from responses of the individual in respect to the object – from his evident acting and verbal statements about opinions, feelings and disposition to act in respect to the object.

W. A. Scott focused on stimulus level and response evaluation level when dividing the methods (Výrost & Slaměník, 1997). According to him, each method is an experimental situation with certain stimuli and those stimuli represent the first level of classification. The other level is a way of evaluation of the responses, it is a more specified form of the classical approach of method division for studying the attitudes.

2. Semantic Differential – Basis and Description of Research Method

It is relatively known (Hewstone & Stroebe, 2006) that if more individuals evaluate one object or term, each of those individuals perceive it a little (sometimes even very) different. Besides a common cultural meaning (denotation), every term has other, additional meanings (connotation), which characterise the individual evaluators. The semantic differential is a research technique developed in 1950s in USA by professor Osgood (Kerlinger, 1972, Svoboda, 1992, Janoušek, 1986, Výrost & Slaměník, 1997) for measuring the individual, psychological meanings of the words or attitudes towards something. It focuses on simple evaluating opinions and thus it is especially suitable for measuring emotional and behavioural aspects of the attitude (Hewstone & Stroebe, 2006). Its great advantage is easy administration and relatively fast evaluation.

Initially, this method was developed for measuring the connotative meaning of the terms, when each term can be expressed as a point in so-called semantic space (see Figure 1). The basic dimensions of the semantic space were determined by means of the factor analysis and the three most important factors were determined by means of this analysis. Thus, each term is usually evaluated in respect to those three factors:

1. Evaluation factor
2. Potency (power) factor
3. Activity factor

The own semantic differential consists of a certain number of scales, which usually have seven points. Each scale is significantly saturated by only one factor. The end points of the scale always mark one pole of the given factor (e.g. for evaluation pleasant – unpleasant, for potency easy – difficult and for activity fast – slow) and the respondents are supposed to determine on the scale (usually by marking with cross) how they perceive it. For example if the respondent perceives the term “money” as the worst thing.

The semantic differential measures the cognitive and emotional component of the attitudes (Výrost & Slaměník, 1997), especially the evaluation factor. Reliability of the semantic differential is high (0.87 – 0.91), validity is also very high (Svoboda, 1992). For more exact description of the semantic space, it is sometimes good to determine how far the individual terms are from each other in the semantic space. The so-called linear distance D (Kerlinger, 1972) is used as a distance measure. It is determined according to the relation:

\[ D_{ij} = \sqrt{(x_i - x_j)^2} \]

In which \( D_{ij} \) is a linear distance between \( i \) term and \( j \) term;
\( x_i \) is a scale value of \( i \) term;
When calculating $D_{ij}$ value between two terms, we can proceed from either one factor (most often the evaluation factor) or two or three factors. The calculated linear distances are recorded in so-called $D$-matrix. During its analysis we especially notice little and great values of the linear distance, which show great or little similarity of perception of the given terms. Extraction of three factors leads to relatively unreliable measurement when one scale measures different factors at different terms. The first factor was marked as the evaluation factor in compliance with Ch. Osgood. The second factor is a combination of the initial potency and activity factors and it was called the energy factor. The scales, which are saturated by the energy factor, express how much the respondents perceive the selected terms as “something”, which is connected with exertion, difficulties, changes or activity. This method of evaluating the respondent’s attitudes using the semantic differential is called ATER method.

The ATER questionnaire (Attitude Towards Educational Reality) was created by Chráska (2003, 2007). The latter used his own research (Chráska, 1998), successively modified it, and implemented factor analyses, which resulted in the design of a two-factor form of the semantic differential, which is suitable for assessing the concepts (objects) of the “pedagogical (educational) reality”, as “an analysis of three factors is too detailed” (Chráska, 2003, p 57). The ATER method comprises a total of 10 scales, of which 5 measure the evaluation factor and 5 measure the energy factor; some are arranged in reverse (in order to avoid unwanted stereotypes in the evaluation). Apart from the “predominant” factor of evaluation, the factor of energy is identified (combining Osgood activity and potency factors). It uses the following pairs of adjectives (Vašťatková & Chvál, 2010).

- factor of evaluation: good-bad, pleasant-unpleasant, fair-dark, ugly-beautiful, sweet-sour
- factor of energy: demanding-undemanding, strict-lenient, difficult-easy, troublesome-trouble-less, heavy-light.

Based on the analyses performed, ATER – a measuring instrument has been created. This instrument contains 10 scales, out of which 5 measure the evaluation factor (h) and 5 measure the energy factor (e), * marks reserve scales again – see 1. This measuring instrument was used in our research for measuring the attitudes of the Czech undergraduates.

The ATER method was applied also in order to evaluate the terms associated with e-learning: E-learning, Self-directed learning, Tutor, Learning support, Multimedia record, Electronic hypertext, Animation, Simulation, Online
communication.

The research sample consisted of 170 students of Palacky University Olomouc Faculty of Education, who have been provided with training in both distance study modes. The selected research sample corresponded with the overall structure of the Faculty of Education students, both in terms of gender distribution (research sample: 29% of men and 71% of women, faculty: 25% of men and 75% women), and age distribution (the average age of the research sample members: 21.5, faculty: 22.1).

3. Selected research results

The data, which were obtained from the students (Chrásková, 2011) by means of the individual scales of the ATER questionnaire, were analysed in the STATISTICA Cz 9.0 program by means of the factor analysis so that the factor compliance could be assessed.

The data from all students and regarding all concepts were arranged into columns for each pair of adjectives. A set of 170 students multiplied by 9 (concepts) giving a total of 1,530 lines was thus prepared for the factor analysis. In order to extract the factors, the method of main components, and subsequently the one of varimax rotation was used. Two factors corresponding to the estimated dimensions explained for almost 70% of the total variability. The internal consistency of both dimensions was around 0.85 or higher.

During selection of the scales, the scales were designed in such a way so that each scale would measure only one factor, i.e. only the evaluation or the energy of the term. If the designed scales are always supposed to measure only one factor, only two important factors, which always correlate with the same scales, i.e. the evaluation factor with the scales 1, 3, 5, 7, 9 and the energy factor with the scales 2, 4, 6, 8 must appear in the factor analysis. Summary of the factor analysis for all terms and scales is well arranged in the following Table 1.

Table 1. The check-up of the SD factor structure of Czech university students - terms associated with e-learning

<table>
<thead>
<tr>
<th>Term</th>
<th>Compliance with factor structure of scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>* first strongest factor is energy</td>
<td>s1  s2  s3  s4  s5  s6  s7  s8  s9  s10</td>
</tr>
<tr>
<td>E-learning</td>
<td>y    y    y    y    y    y    y    y    y    y!</td>
</tr>
<tr>
<td>Self-directed learning</td>
<td>y    y    y    y!   y    y    y    y    y    y!</td>
</tr>
<tr>
<td>Tutor</td>
<td>y    y    y    y!   y    y    y    y!   y!   y</td>
</tr>
<tr>
<td>Learning support</td>
<td>y    y    y!   y!   y    y    y    y    y    y!</td>
</tr>
<tr>
<td>Multimedia record</td>
<td>y    y    y    y    y    y    y    y!   y!   y</td>
</tr>
<tr>
<td>Electronic hypertext *</td>
<td>y!   y    y!   y!   y    y    y    y    y!   y</td>
</tr>
<tr>
<td>Animation</td>
<td>y!   y    y!   y    y    y!   y!   y!   y!   y</td>
</tr>
<tr>
<td>Simulation *</td>
<td>y    y    y    y    y    y    y    y    y    y</td>
</tr>
<tr>
<td>Online communication *</td>
<td>y!   y    y    y    y    y    y    y    y    y</td>
</tr>
<tr>
<td>Compliance with factor structure proposed</td>
<td>9    9    9    3    9    9    8    8    5</td>
</tr>
</tbody>
</table>

During the measurement of the attitudes of Czech undergraduates, we calculated the average evaluation and energy of the terms from the following scales, which corresponded most to the designed model after performing the factor analysis:

- evaluation – scales 1, 3, 5, 7,
- energy – scales 2, 6.

When we look closely at the results of the factor analysis (see Table 1), it is evident that the scale s4 does not have a corresponding factor structure in our research sample and it should not be applied when calculating the energy of the terms. The scale s10 should not be applied either. However, it is up to the researcher to decide into what extent he wants to approach the scales with certain caution. Definitely, it is not good to take only finished measuring instruments without their critical assessment.

In order to prepare the semantic space of terms, from which links between the evaluation of a term and of its
energy would be clear, the table number 2 was created. It expresses the average evaluation and the average energy of the particular terms subject to examination.

Table 2. Average evaluation and energy of the particular terms subject to examination

<table>
<thead>
<tr>
<th>Term</th>
<th>Average evaluation of the term</th>
<th>Average energy of the term</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-learning</td>
<td>4,85</td>
<td>3,60</td>
</tr>
<tr>
<td>Self-directed learning</td>
<td>4,04</td>
<td>5,09</td>
</tr>
<tr>
<td>Tutor</td>
<td>4,85</td>
<td>3,84</td>
</tr>
<tr>
<td>Learning support</td>
<td>5,11</td>
<td>3,50</td>
</tr>
<tr>
<td>Multimedia record</td>
<td>5,45</td>
<td>3,02</td>
</tr>
<tr>
<td>Electronic hypertext</td>
<td>4,79</td>
<td>3,37</td>
</tr>
<tr>
<td>Animation</td>
<td>5,63</td>
<td>3,22</td>
</tr>
<tr>
<td>Simulation</td>
<td>4,93</td>
<td>3,77</td>
</tr>
<tr>
<td>Online communication</td>
<td>5,14</td>
<td>2,30</td>
</tr>
</tbody>
</table>

The values listed in Table No. 2 facilitated the creation of the semantic space of terms. The notion of semantic space was introduced by Tannenbaum (Osgood, Suci & Tannenbaum, 1957) and it designates a dictionary in which each word or term corresponds to the vector of a number. These vectors are the same length for all the words contained in the dictionary. Their length corresponds to the dimension (size) of the semantic space. By comparing the vectors, the degree of similarity of the words which correspond to the vectors, is determined. In the following picture number 2, the semantic space of the investigated terms is presented. Individual links between the various terms are obvious, too.

In Figure 3, the distribution of the examined terms in the semantic space is shown. Based on this connection, it is possible to observe the rate of “popularity” (factor of evaluation) and “ease” (factor of energy) of the particular
terms and thus evaluate students' attitudes to them.

Rather surprisingly, the term with the lowest rating and connected with the idea of the highest energy expended, is self-directed learning. This result is probably related to the degree of intentionality of the study. Self-directed learning is associated with an increased rate of self-regulation in learning, which itself implies a high degree of autonomy and awareness.

The top rated term is that of Animation, which is a term associated with e-learning. By the students, it is perceived as “easy” (factor of energy) and “highly popular” (factor of evaluation). This can be explained in particular by the fact that most students prefer visual information to the text.

The term which is associated with the highest level of “ease” (factor of energy), is the one of Online communication. The reason for this phenomenon might be the increasing popularity of social networking sites used by students not only to communicate but also to build their own educational networks (Siemens, 2006).

The very term of E-learning is perceived by students as “easier” (factor of energy). On the other hand, students characterize the former as “less popular” (factor of evaluation).

4. Conclusions

The semantic differential is a suitable method for measuring the attitudes, however, it is necessary to perform its checking factor analysis prior to every application in a different target group than that for which this instrument was determined and standardised. In our research we used the already standardised questionnaire – ATER, however, some of its scales could not be used for calculation of evaluations and energies of the examined terms. The checking factor analysis showed that some scales do not have an absolutely exact factor structure.

Despite the above mentioned minor shortcomings, it is possible to use the semantic differential method wherever you want to monitor and evaluate respondents’ attitudes to the investigated terms or phenomena. This fact was used in the above presented research study, too. It unambiguously, though rather surprisingly, showed that the concept with the lowest rating and the association of the highest level of energy expenditure by the students is Self-directed learning. The top rated concept is the one of Animation which is perceived as “easy” and “highly popular” by the students. The concept associated with the highest level of “ease”, is the one of Online communication.

Although the above stated results cannot be regarded as significant, they indicate trends that should be taken into consideration by up-to-date education making use of electronic distance learning texts and LMS. The attitudes of the students could provide us with a guideline helping to find the optimal way towards satisfied, educated and professionally prepared tertiary education graduates and graduates of lifelong learning programmes. The research investigation conducted shed some light on some of the preferences and attitudes of the students related to this field, which can be regarded as long-term. It can therefore help all those who want to design e-learning tools to meet the needs of their students or pupils the best way possible.

References


