

VISUALIZATION AND THE EFFICIENCY OF THE TEACHING PROCESS

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Abstract

The visualization of teaching is regarded as a positive factor of improving the efficiency of educational process. Two aspects of visualization are analyzed: informational – as a carrier of information and emotional – as expression of emotions. The emotional element of visualization stimulates substantial rise of its efficiency. Its link with the degree of concentration of the trainees during the lessons is investigated. An attempt of typology of concentration and the influence of visualization on it is presented. It is underlined that the visualization should be subordinated to the general logic of the teaching process, in which it has to play complementary not substitution role. The results of the analysis put forward new tasks to the teaching staff underlining the necessity of training of the trainers in a search of new teaching forms. At present it is necessary to reconsider the overall strategy of teaching, which requires substantial resources of adequate training of the teaching staff and assistance in acquiring and creative application of the new information technologies. They are regarded as a powerful instrument of formation of emotional and high-efficient visualization, substantially different for the well know up to now traditional forms of teaching.

Key words: visualization, teaching, efficiency.

JEL: M53, O15, Z13.

1. Introduction

The progress in information technologies unleashed new abilities to enrich visualization with new approaches and techniques. At the same time the students' perception to information changes dramatically and thus we are facing new problems and new abilities of their solution.

The aim of this paper is to shed light on the effect of visualization on the efficiency of teaching process for undergraduate students in Economics. It is based on the results of experimental works as a part of our experiences during the last decade. The paper reflects the latest practice in visualization, which takes into account the results of the previous works and their enrichment with new elements.

1. Literature survey

1.1. General setting

The modern education is in the deepest crises nowadays. It is result of many reasons: the change of perception of information among students due to the modern information technologies, the industrialization of education due to the ability to teach online and from distance, etc. It results in the creation of huge fictitious human capital, which means statistically high share of educated people and actually not adequate knowledge and skill standing after these statistics. Several decades ago we had to correct the basic models of economic growth with materialized in labour force technology. Now it is time to introduce a new correction – de-materialized technical progress in labour to reflect the effect of the increasing fictitious human capital.

One of the ways to overcome the present crisis in education is to reshape the existing models of teaching. Many endeavours have been made in this direction during the last years and in our paper we report the results of only few of them.

1.2. Visualization issues

The survey of the literature devoted on visualization indicates a big variety of interpretations of what visualization is. We avoid this discussion and accept the definition formulated by Manovich (2010) according to whom "visualization as a mapping between discrete data and a visual representation", "creating new visual representations from the visual media objects (images, video) or their parts".

Roth et al (1997) indicates that "visualization must involve much more than just enabling people to "see" information". As in our works we concentrate on interactive visualization "allowing users to explore the underlying data" (Isenberg (2011) our survey was oriented to the study of the efficiency of the interactive visualization.

Rasch Th. And Schnotz W. (2009) point out that "adding pictures to text was neither beneficial nor harmful for learning", which means that the interactive visualization may have effect on the educational process, when it is presented in art form – even in more complicated forms as for example videos. This is confirmed by the study of Paas et al (2007) applying more advanced forms of visualization as animation in teaching medicine. His hypothesis that "the interactive activities would lead to more efficient transfer performance" is confirmed "indicating that the interactive conditions required less mental effort to attain the same performance as the non-interactive condition".

1.3. Visualization and motivation

Our previous studies indicated that the motivation was the main factor affecting the level of understanding of lessons by students. Visualization is from this perceptive an instrument, which only combined with motivation may affect positively the level of understanding of lessons. The very motivation however is a complex process and is affected by many factors as for example the emotional status of the teacher.

Ruzek et al (2016) indicate how teacher emotional support motivates students “in their behavioural engagement and mastery motivation”. Jung and Choi show that even “tone of voice and intonation, humor, facial expressions and gestures, dress code and setting an example, touch, encouragement, and care” have educational effect on students’ playing “a pivotal role in encouraging pupils to enjoy the intrinsic value of physical education centred on moral values, and fostering a passion for physical activity that extends into participation for life”.

We indicate these details to prevent any overdosing of the effects of visualization. It is obvious that the search of new model of teaching is not an easy process and to have effective visualization many pre-conditions are required.

1.4. Visualization and the level of concentration

Most of the literature on this issue unambiguously indicates that “Concentration is absolutely essential for creative visualization exercises” (Clear Mind, 2016). There is however various interpretation on both visualization and concentration. In our work we are interested in concentration not as an effect of visualization but on contrary, how the type of concentration of students during the lesson can affect the educational effect of visualization.

2. Theoretical model

2.1. Visualization and motivation

Central element in the study is the efficiency of teaching and the role of visualization. It was realized in two basic forms: the first - a simple recording of the lessons with slides to allow listening them many times for better understanding and second - presenting the lessons as a summary in form of an art work video, which helps to improve the knowledge and at the same time makes it pleasant to watch, creating some emotional background of the lesson.

Our basic variable is the degree in which visualization helps understanding the lessons (HELP). From our previous studies (Danchev, 2013) we have observed that the crucial elements, which enhances this process is the students motivation (MOTIVE). Thus, we can formulate the basic equation of our study:

$$HELP = f(MOTIVE).$$

2.2. Visualization and concentration

We observed as well that the level of understanding of lesson is affected also by the level of concentration of students during the lesson. The observations are that there is not unique model of concentration but it varies from student to student in a different way during the lesson. We can formulate three basic types of concentration:

1. The concentration is high in the beginning of the lesson, but gradually it drops down. This is the case, when students are coming with an interest to

the lesson, but gradually they lose their interest in it (CONCENTR1).

2. The concentration is low in the beginning of the lesson, but gradually increases and is high by the end of the lesson. It is related to students coming without any special interest in the lesson, but increasingly it attracts their attention and they start to listen carefully the teacher’s presentation (CONCENTR2).

3. The concentration has a form of sinusoid, which changes during the lesson from increasing to decreasing and vice versa. This is related to students with average interest in the lesson (CONCENTR3). We expect it to be the most popular form.

The model allowing studying the link between the role of visualization and the types of concentration can be formulated as

$$HELP = f(CONCENTR1, CONCENTR2, CONCENTR3)$$

Theoretically we formulated also other models of studying the efficiency of visualization, but as far as they could not be supported by sufficiently statistically significant results we do not report them in this paper.

3. Features of the data

3.1. The sample

During the last decade we carry our systematic observations of the effect of visualization on the teaching process. Serious changes took place in the methods we used for visualization for this period, which restricted the ability of comparative analysis between the samples. The sample used in this paper is result of our last survey and includes data observations during the first semester of 2015–2016 academic year. It includes 3 groups of international students of various classes, respectively 60 (48%), 27 (78%) and 35 (20%) students (the number in the brackets shows the response rate).

Regionally the students are distributed in the following way:

Table 1. Regional distribution of students

	group 1	group 2	group 3
local	73%	89%	89%
Europe	3%	4%	3%
Asia	8%	4%	6%
Africa	15%	4%	0%
Latin America			3%
total	100%	100%	100%

There is not statistically significant correlation between the regional distribution of students and the response rate.

The interviewing took place after the completion of the lessons and before the final exam. The students received the questionnaire by e-mail and responded electronically. The response was regarded as a part of their participation in the lessons

and additional points has been added to the overall results for responding to the interviews.

2.2. The questionnaire

The questionnaire was constructed in a way to allow the collection of the necessary data. It included 8 basic questions necessary for the testing of our basic theoretical hypotheses. Five of them have been constructed as 5 Likert scale responses, one with visual illustration of the expected 3 types of concentration of students during one academic hour: increasing, decreasing and sinusoid forms. The last question defines the origin of students (the mother language).

Taking into account the results of the previous works we included also a variable of the level of motivation of students to studying a give course (measured in 5 Likert scale). We have to note that while during the past experiences we used three basic

types of video clips (Danchev, 2013) this time we included only the first two significant forms namely a simple recording of the lesson with slides to allow listening them many times for better understanding of the lesson and art work video, which helps to improve the knowledge and at the same time makes it pleasant to watch. As a new elements in the questionnaire was the inclusion of negative questions, namely regarding visualisation as a waste of time to test are there students, which prefer the classical academic teaching without video illustrations.

3. Empirical results

3.1. Statistical Characteristics of the Sample

We formulated several variables for testing the formulated model. Table 1 summarizes the descriptive statistics of all variables in the questionnaire.

Table 2. Descriptive Statistics of the variables of the sample

	N	Minimum	Maximum	Mean	Std. Deviation
MOTIVE	57	1.00	5.00	3.2456	0.76253
HELP	57	1.00	5.00	3.4561	0.90771
CONCENTR (1. 2 and 3)	54	1.00	3.00	2.3148	0.84282
HELPCON	56	2.00	5.00	3.5893	0.91008
ROLE	52	1.00	4.00	1.5385	0.75307
ROLE1	53	0.00	1.00	0.5849	0.49745
ROLE2	53	0.00	1.00	0.2830	0.45478
ROLE3	55	0.00	1.00	0.1091	0.31463
OPTIMAL	55	1.00	5.00	2.8727	0.90379
NUMBER	55	1.00	5.00	3.2727	0.98985
POINTS	57	0.18	0.94	0.5991	0.15693
ATTEND	57	0.00	0.97	0.5904	0.27217
LANGUAGE	57	0.00	1.00	0.8246	0.38372
Valid N (listwise)	50				

3.2. Testing the Main Models

Following the traditions from the previous works we tested the level of motivation of students to studying a given course (MOTIVE) as an important explanatory variable.

Crucial variable in the study was the question of the effect of using various kinds of clips for visualizations and their effect on the understanding the lessons (HELP). Both variables are positively correlated

$$HELP = 1.9 + 0.48MOTIVE$$

(0.49) (0.147)
R2 = 0.162 DW = 1.715

As the scope of the study is far beyond the present paper we report here only the main results. The analysis of the rest of the study will be object of other publications.

3.3. The Effect on the Level of Concentration

As we mentioned above an attempt was made to introduce some typology of the form of concentration among students during one academic hour and

to observe the link between the type of concentration and the effect of visualization.

We constructed a model of the three types of concentration, which proposed on students' attention: 1. high concentration in the beginning of the lesson – low concentration by the end (CONCENTR1); 2. low concentration in the beginning of the lesson – high concentration by the end (CONCENTR2); 3. Sinusoid form of concentration CONCENTR3). The prevailing form of concentration of students is the sinusoid form (56%) followed by the first (24%) and the second form (20%).

These dummy variables are correlated with the HELP in the following way:

$$HELP = 2.367 + 0.864CONCENTR1 +$$

(.919) (.950)
1.633CONCENTR2 + COCNENTR3
(.878) (.906)
R2 = 0.143 DW = 2.062

These results are unambiguous evidence of the positive role of visualization on the level of concentration of students despite the difference in the typology of this concentration. Especially impressive is the fact that the most influential is the effect on the

rise of the level of concentration (CONCENTR2) during the academic hour.

4. Discussion and recommendations

The experimental works with visualization put forward every time new problems. We observe stable tendency among students of preferences to art work videos with increasing requirements to the quality of this video. For example, during the last study we demonstrated old versions of given clips and the reaction of students was very critical and definitely in favour of the new clips. It means that the preparation of the visual materials becomes already a task of professional team of experts in both psychology of teaching, the high-quality knowledge of the very object of teaching and the necessary experience and mastery of preparing the visual part of the clips.

A new problem is how to integrate visualization with the change of level of concentration of students during the lessons. Although the primary aim of visualization is to stimulate the level of understanding of lessons taking into account the state of concentration of students during the lessons certainly would increase the efficiency of this process.

We are witnesses of the complication of the process of information perception by students, which reflects in complexity of the requirements to the teaching process. Nevertheless, we stand firmly after the vision that the visualization should be subordinated to the general logic of the teaching process, in which it has to play complementary not substitution role.

As Barnacle (2016) indicates “higher education has become a highly imagined space, replete with intense socio-political investment. It is also a complex place to work and study, which he defines as “an imagined, lived and affective space”.

The results of the analysis put forward new tasks to the teaching staff underlining the necessity of training of the trainers in a search of new teaching forms. At present it is necessary to reconsider the overall strategy of teaching, which requires substantial resources of adequate training of the teaching staff and assistance in acquiring and creative application of the new information technologies, regarded

as a powerful instrument of creation of emotional and high-efficiency visualization with a face different for the well-known up to now traditional forms of teaching.

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