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VALIDITY OF AN E-OFFICE MODEL FOR A GRAPHIC DISCIPLINE TEACHER

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Abstract: The *purpose* of this study is to develop a model and demonstrate its validity. *Methods*: the analysis of literary sources, validation method**,** and method of group expert evaluations. *Results*: the validity criteria were selected in accordance with significance of validity types (construct validity, content validity and criterion validity*)*. This approach enabled us to validate our model on the basis of existing and accepted criteria. *Novelty*: the task of the model validity study is considered the first time in pedagogical science. *Conclusion*: the results of this study correspond to the given tasks because identified the research specifics, and proved the validity of our model based on accepted criteria.

Keywords: E-office, Graphic Disciplines Teacher, Model, Validation.

INTRODUCTION

This work is a continuation of an earlier study which aimed to develop a model for an electronic office (e-office) for teachers of graphic disciplines (Nabi, 2017). Thus, in this article we apply the basics of analysis building on the notions of 'model' and 'modeling' to reveal the form and content of an e-office for teachers of graphic disciplines. Our model is developed based on unity of a number of parameters, including input, processing, and output, and we reveal the content of all parameters. We also provide a mockup variant as well as a model based on conformity to predetermined requirements. The form of our model is shown in Figure 1.

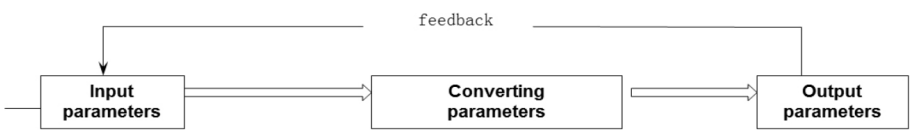

Figure 1: Model of an e-office for a teacher of a graphic discipline

In accordance with this form, our model content comprises the following structure, including the following *input parameters*:

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1. Description of the education quality problems;
2. Competence-based model of an educational institutions graduates in graphic disciplines, and;
3. Model of the innovative activity of educational process subjects.

Model content also includes the following *converting parameters,* which were divided into three blocks:

1. *Block 1:* A competence-based model of graduates from educational institutions at the appropriate level in the profile of graphic disciplines;
2. *Block 2*: Online courses for improving graphical preparation that enables users of the e-office to develop competencies;
3. *Block 3:* Methodological materials for the formation of pedagogical mastery;
4. *Block 4:* Online courses on the use of e-learning tools in graphic disciplines, and;
5. *Block 5:* A fund of methodological materials for teachers of graphic disciplines.

Output model parameters represent the material model, if embodied in the form of a computer program. These also encompass three levels:

1. Mockup of an e-office for a drawing teacher;
2. Mockup of an e-office for a technical drawing teacher, and;
3. Mockup of an e-office for teachers of descriptive geometry, engineering graphics, and computer graphics.

Many researchers indicate to the importance of the use of electronic means to improve teachers' skills. For example, R.A.Rashid et. al (2016) write: 'Discussion on teacher learning is often limited to a focus on formal professional development programmes. What and how teachers learn informally through their daily experiences is rarely explored'. Therefore, the authors investigated how teachers engage in informal learning for their professional development when using Social Networking Site (SNS) technology. In our case we use e-office for informal learning.

It is clear that modeling represents the process of model construction as well as subsequent study. With this in mind, we constructed our modeling in two main stages:

1. Model development, and;
2. Research and generation of results.

When researching our model we addressed the basic question, how does our approach correspond to requirements? Thus, to start with, we analyzed four sets of requirements and determined the inter-relationships between them (Figure 2).

Subsequently, we were able to show that the model we developed fits well with a number of selection requirements, specifically:

(a) Because it is designed following pedagogical design laws, the model will function well in a pedagogical environment;

(b) The model is simple because it is presented in the form of a compact scheme;

(c) The model is comprehensive, as it covers three groups of parameters, each of which includes a sufficient number of elements (i.e., modules, blocks), and;

(d) The model is exact. We excluded irrelevant factors and our approach corresponds to the purpose of modeling.

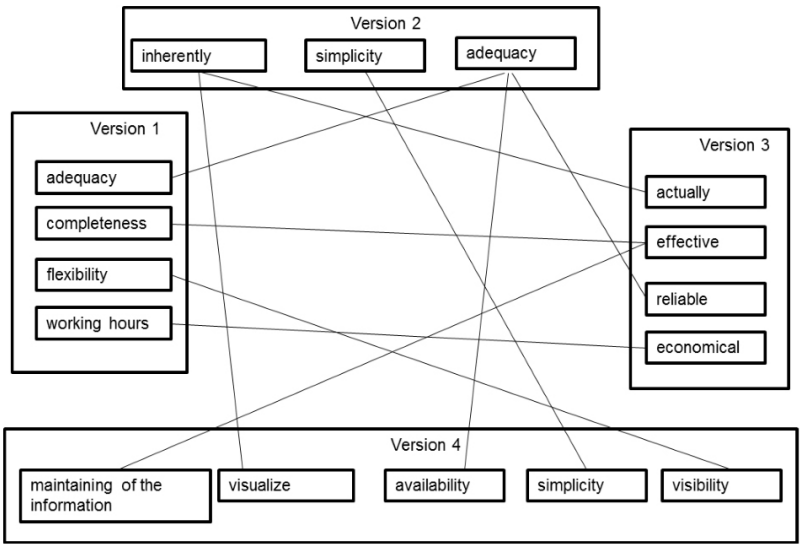

Figure 2: Interrelationships between requirements

At the same time, the question of how truthful (validity) our model is remains an open question and will be the subject of further research. In this regard, one purpose of this study is proof of the validity of our model. To achieve this we set ourselves two specific tasks:

1. To identify criteria of validity taking into account the specifics of our research, and;
2. To prove the validity of our model on the basis of accepted criteria.

The scientific novelty of this research lies in the fact that, for the first time in pedagogical science, we consider the validity of our model. As written Sarsa J. and Escudero T. (2016), 'In e-learning research, there is a large number of fields of study. In Hung's taxonomy of e-learning research, the most frequent themes

in the groups related to learning were: e-learning communities and interactions; multimedia in e-learning; adaptation and usability; gaming in e-learning; simulation in e-learning; support system design and development; teaching and learning strategies; how to improve the effectiveness of e-learning and student motivation; large-scale national or state-level e-learning projects; and emerging technologies' impacts in educational fields'. Indeed, this list does not include a topic related to the study of validity. The practical significance of this approach is determined by the fact that the results we obtained can be used as a methodological basis for the study of other models.

METHODS

Literary Source Analysis

The purpose of this method is to provide an objective analysis of available literature data that relates to the specific problem. The study of literature is necessary for a clearer understanding of research methodology as well as to determine general theoretical positions, and to identify the degree to which we can scientifically elaborate a given problem. It is always important to establish whether, or not, a specific problem can be elucidated in general scientific work as well as specific work on this topic, relating to the results of relevant studies (Architecture [Online]).

Analysis of literary sources must pass through several stages, initially a preparatory phase and then a direct research phase. In the preparatory stage, we made a description of the work performed in previously published papers and on this basis identified the problem (see Introduction). In the second phase, work with literature became more profound, and is necessary for grounding in obtained results.

The following levels of description are present in the scientific literature (Lektsii [Online]):

1. Abstract review;
2. Abstract analysis;
3. Theoretical statement analysis, and;
4. Theoretical and methodological analysis.

As can be seen, these levels of description vary in order of difficulty from the first to the last.

This study applies the fourth level of analysis, taking into consideration the complexity of our study, because the purpose of this research is to assess existing knowledge on a problem in terms of completeness as well as the implementation of certain methodological ideas.

Validation Method

The methodology used for validation gives strength to a study because it accords with international standards, as defined (Ramón, Carlos & Sandra, 2016). Indeed, model validity and validation in any discipline needs to have semi-formal and subjective components for several reasons and thus is an important and controversial aspect of any model-based methodology. Validity of the results of a model-based study are crucially dependent on the validity of the model (Yaman, 1996).

Although it is often assumed that a study's results are valid, or conclusive, just because the study is scientific, this is often not the case. As a consequence, a significant number of scientific studies are biased and unreliable. Bias can be defined as 'the combination of various design, data, analysis, and presentation factors that tend to produce research findings when they should not be produced.' Thus, bias is a form of systematic error, and there are innumerable causes, which can be related to the manner in which study subjects are chosen, the method in which study variables are collected or measured, the attitudes or preferences of an investigator, and the lack of control of confounding variables… Research biases tend to arise when researchers select subjects purposefully, or choose to only analyze data that is more likely to generate the results they desire (Validity of Research. [Online]).

Validation is necessary although it can be redundant and tedious to implement. An incomplete, or insufficient, set of criteria can lead to a state of 'validation' where in fact this does not instill confidence that the term intends. In other words, validation of validation criteria is an important aspect of research that is often overlooked. Establishing such validation criteria can be a very difficult task when evaluating complex systems (Academic Dictionaries and Encyclopedias [Online]).

Method of Group Expert Evaluations

Group expert evaluations method is as follows (Evlanov & Kutuzov, 1978):

1. conducting by specially selected experts a intuitive logical analysis of the problem
2. quantitative expression by experts of their judgments
3. data processing by methods of mathematical statistics.

Let m experts assessed the n objects. Then the evaluation results can be presented in the form of values x_{ij}, where i is an object number, j is a expert's number.

Group evaluation is performed on average values of evaluation:

$$x_{ij} = \sum_{j=1}^{m} x_{ij} f_{ij} \, (i = 1, 2, 3, \ldots n) \tag{1}$$

$$\sum_{j=1}^{m} f_{ij} = 1$$

where, f_j are the coefficients of the experts' competence.

The experts' competence coefficients are normalized values. An algorithm for its calculation has the form of a recurrent procedure:

$$x_i^t = \sum x_{ij} f_j^{t-1} (i = 1, 2, 3, \ldots n) \tag{2}$$

$$S^t = \sum_{i=1}^{n} \sum_{j=1}^{m} x_{ij} x_i^t (t = 1, 2, 3, \ldots m) \tag{3}$$

$$f_j^t = \frac{1}{S^t} \sum_{i=1}^{n} x_{ij} x_i^t \sum_{j=1}^{m} f_j^t = 1 \tag{4}$$

The computation starts with $t = 1$. In the formula (1) initial values of competence coefficients are assumed to the same and equal to $f = 1/m$. Then on the formula (1) group experts' estimation for first approximation equal to the average estimates values:

$$x_i' = \frac{1}{m} \sum_{j=1}^{m} x_{ij} (i = 1, 2, 3, \ldots n)$$

Then the following values are calculates:

1. the value of S′ by the formula (3):

$$S' = \sum_{i=1}^{n} \sum_{j=1}^{m} x_{ij} x_i'$$

2. the values of the competence coefficients of a first approximation by the formula (4)

$$f_j' = \frac{1}{S'} \sum_{i=1}^{n} x_{ij} x_i'$$

Using the competence coefficients of the first approximation, it is possible to repeat the entire calculation process according to equations (2) ... (4) and to obtain the second approximation x_i'', S'', f_j''.

We use the group expert evaluations method for determine the significance of criteria for each validity type. The experts evaluated the significance of criteria that were listed in the questionnaires. The significance of each criterion were calculated using the developed spreadsheet.

RESULTS

Criteria of validity

In this section, we assess the validity of the model. With this in mind, content, context, construct, concurrent, predictive, convergent, divergent, and the nomological validities of the model must be evaluated. Thus, one criterion for judging the validity of the model is whether, or not, it measures what it is supposed to measure, and predicts the effects of the alternative course of action with accuracy.

Validity is the extent to which a concept, conclusion or measurement is well-founded and corresponds accurately to the real world. The word 'valid' is derived from the Latin 'validus', 'meaning', 'strong'.

Validity refers to the degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure. In contrast, reliability is concerned with the accuracy of the actual measuring instrument or procedure, while validity is concerned with the study's success at measuring what the researchers set out to measure (Howell et. al., 1994-2012).

In selecting validity criteria, we analyzed a large volume of literature sources. In fact, the validity problem has been well-studied in psychology and management (Evlanov & Kutuzov, 1978). To ground of the criteria by which necessary to judge about a reliability of the developed model, we used the method of group expert evaluations. As experts we chose the staff of the Department "Economics and management" of Financial Academy (Astana, Kazakhstan). Questionnaires were distributed to the experts. Initially, the experts were invited to estimate a significance of validity types (Table 1). In the second stage they were invited to estimate the significance of criteria for each validity type (Table 2).

TABLE 1: QUESTIONNAIRE 1

Dear Expert! Please estimate a significance of validity types by scale from 5 (max) to 1 (min)		
Type of validity	*Definition for explanation*	*Expert's opinion*
Concurrent validity	It refers to the degree to which the operationalization correlates with other measures of the same construct that are measured at the same time. When the measure is compared to another measure of the same type, they will be related (or correlated).	
Construct validity	It refers to the extent to which operationalizations of a construct (e.g., practical tests developed from a theory) measure a construct as defined by a theory. "A construct is.. . a theoretical idea developed to explain and to organize some aspects of existing knowledge.. . It is a dimension understood or inferred from its network of interrelationships" The evidence involves the empirical and theoretical support for the interpretation of the construct.	

Dear Expert! Please estimate a significance of validity types by scale from 5 (max) to 1 (min)		
Type of validity	*Definition for explanation*	*Expert's opinion*
	It defines how well a test or experiment measures up to its claims.	
	It is agreement between a theoretical concept and a specific measuring device or procedure.	
Content validity	Estimate of how much a measure represents every single element of a construct	
	The extent to which a measurement reflects the specific intended domain of content	
	Construct validity ... assesses a suitability of test content (tasks, questions) by a measured domain	
Criterion validity	Evidence involves the correlation between a test and a criterion variable (or variables) taken as representative of the construct	
	Criterion-related validity, also referred to as instrumental validity, is used to demonstrate the accuracy of a measure, or procedure, by comparing it with another measure, or procedure, which has been demonstrated to be valid.	
	Validity and reliability are the objectivity of any study	
Face validity	A measure of how representative a research project is 'at face value,' and whether it appears to be a good project.	
	It refers to the degree to which a test appears to measure what it purports to measure	
Predictive validity	It refers to the degree to which the operationalization can predict (or correlate with) other measures of the same construct that are measured at some time in the future	

Note: Definitions taken from the following works: American Psychological Association. 1985; Carmines & Zeller, 1987; Cronbach et. al; Melnikova & Khoroshilov, 2014; Validity and reliability [Online]; Validity (disambiguation) [Online]; What is validity [Online]).

TABLE 2: QUESTIONNAIRE 2

Dear Expert! Please estimate a significance of the criteria for each validity types by scale from 5 (max) to 1 (min)	
Criteria	*Expert's opinion*
I Construct validity	
Theoretical relationships must be specified	
Empirical relationships between the measures of concepts must be examined	
Empirical evidence must be interpreted in terms of how it clarifies the construct validity of the particular measure being tested	
The measuring of an intended hypothetical construct	

Dear Expert! Please estimate a significance of the criteria for each validity types by scale from 5 (max) to 1 (min)	
Criteria	*Expert's opinion*
II Content validity	
Evaluation of each element of a construct denotes its modularity and complexity	
The extent to which a measurement reflects the specifics of a content domain.	
A division of task into two parts, in consequence obtained an index of content validity	
III Criterion validity	
Comparison of the test with other measures or outcomes (the criteria) already held to be valid.	
A division of study into several phases and clear documentation of the all actions and conclusions on each of them.	
Subjective evaluation of the studied properties parameter in everyday life	

Note: Definitions taken from the following works: Carmines & Zeller, 1987; Validity and reliability [Online]; Validity (disambiguation) [Online].

As a result of questionnaires processing with the help of formulas (1) to (4) obtained the following data. The significance of validity types is shown in Figure 3.

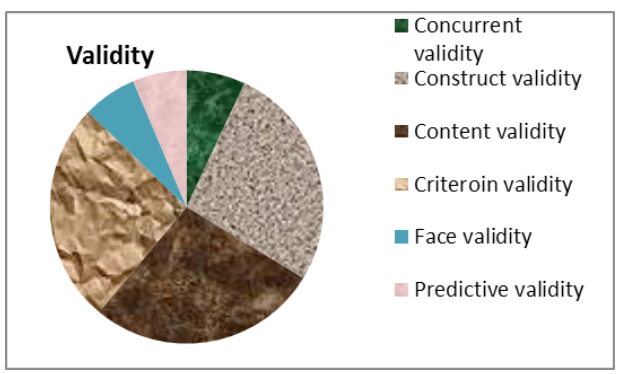

Figure 3: Significance of validity types

As you can see, the experts gave back a preference to the three types of validity: construct, content and criterion validity.

The significance of the criteria for construct validity is given in Figure 4, and for content validity is given in Figure 5.

For criterion validity, the experts chosen only one criterion (4.8 points for this criterion, other estimated by small points).

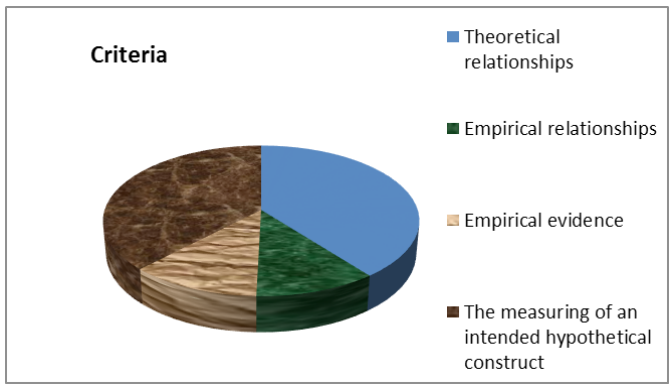

Figure 4: Significance of the criteria for construct validity

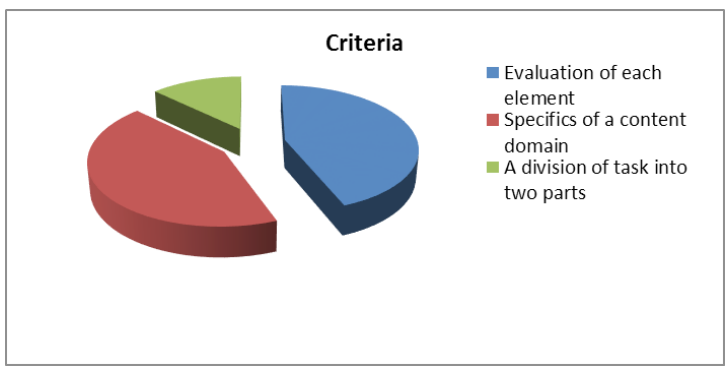

Figure 5: Significance of the criteria for content validity

Thus, the criteria of validity will be as follows:

1. *Construct validity*:
   A. A model should conform to the set objectives and have a solid methodological and theoretical base, and;
   B. A model should be an abstract construct
2. *Content validity:*
   (A) A model must have a modular structure, and;
   (B) A model must conform to a specific field of knowledge.
3. *Criterion validity*:
   (A) A model must meet external criteria, as defined in advance.

In the next section, we show that the developed model meets the criteria which were grounded.

Our model was developed with the aim of extending the possibility of inculcation of e-learning in the Republic of Kazakhstan. This was done to reflect

an essential series of defining ties, to demonstrate innovativeness and outline directions for future research, namely towards realization in a computer program format. As such, this procedure must demonstrate a clear theoretical basis (please, see Introduction).

Because we developed our model on the basis of regularities of pedagogical planning it is necessarily an abstract construct. However, as can be seen from the description of the model, it has a modular structure because it consists of modules and blocks. The specificity of the model is that it corresponds to a particular field of expertise, namely the educational system, as designed with the pedagogical design patterns.

In order to prove that a model matches external criteria, they must be defined in advance.

In our opinion, external criteria comprise key model properties. These derive from the general characteristics of the models (please, see our previous work, for example, (Nabi, 2017)). Based on these definitions, we can conclude what the model should have the following properties:

1. Sketchiness, because it is a scheme, a picture, or a description of a phenomenon or process in nature and society;
2. Limitedness, because it is a specially-developed form of an object for reproducing certain authentic characteristics;
3. Definiteness, because it must reflect the signs, facts, and relationships in certain areas of knowledge;
4. Approximations, because it presents an approximate, limited notion of the structure and functioning of a certain study object;
5. Conventionality, because it refers as the image, description, diagram, and representation of object or objects system used under certain conditions as his substitute or representative, and;
6. Abstractness, because it is representation of the object in some form than is distinguished from forms of its real existence and reflect some characteristic properties in an abstract form.

The analysis presented here demonstrates that external signs are fully reflected in the developed model. Thus, it is a scheme, limited to only some of the reflected characteristics of the object, while at the same time approximately reflects the object, is used under certain conditions, and has abstract form.

Thus, we can conclude that study of the developed model from the point-of -view of ensuring its validity demonstrates that it meets the accepted criteria, in accordance with the types of validity, namely content, construct, and criterion.

DISCUSSION

For the statistical consultant working with social science researchers the estimation of reliability and validity is a frequently encountered task. However, measurement issues in social sciences differ in that they are related to the quantification of abstract, intangible, and unobservable constructs. In many instances, then, the meaning of quantities can only be inferred in terms of validity and reliability (Types of validity [Online]).

We agree with the opinion of scientists on that impeccable validity only has impeccable theoretical experiment: experiment, in which the received effect evokes the independent variable, corresponds to reality, and its results give in generalization without additional constraints. Validity is a suitability and adequacy of using the results and methods of research in specific conditions. A more practical definition of notion 'validity' is the measure of correspondence of results and research methods to the given tasks. Validity is a fundamental concept of psychological diagnostics, organizational psychology, and experimental psychology. Nevertheless, we used this concept to study the pedagogical model.

When talking about the validity degree, consider how the results of the study correspond to the given tasks (but the validity is not measured in any arbitrary units). Therefore, we used the scientists' conclusion that, an important feature of validity is following: it is impossible once to install and use this evidence as a final argument for the quality of a certain method or experiment. The validity need to constantly justify new data, and to double-check in the independent studies. In this regard, we believe that the work performed has by practical significance as the obtained results can be used as a methodological basis for the study of other models.

The experts chose from the 6 types of validity only three. It happened, apparently, because the face validity repeats the general definition of validity (see, for example Academic Dictionaries and Encyclopedias), and predictive validity correspond to problem of diagnostic techniques, so its use is very difficult. However, the concurrent validity is analogous on meaning with the criterion validity, so it is not clear why it received low scores.

CONCLUSIONS

The research owns by scientific novelties because first time in pedagogical science was considered the validity of the model.

The results of the study correspond to the given tasks as was identified the criterions of validity taking into account the specifics of our research and was proved the validity of the model on the basis of accepted criterions.

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Statement

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