BASIC INDICATORS FOR ASSESSING THE EFFECTIVENESS OF THE E-LEARNING PROCESS

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Summary

The analysis of the main models for evaluating the effectiveness of the e-learning process is proposed, and differences in schemes are determined by the degree of integration of distance technology into the learning process and the degree of implementation of distance learning in the educational process. The general problems and trends of implementing models for assessing the quality of distance learning in the educational space are highlighted. A set of main problem tasks within the e-learning process is defined, and schemes for solving them based on the concept of distance education are proposed. A basic classification of the main schemes and models for evaluating the components of the e-learning process is proposed. The main sets of metrics and qualitative indicators (educational, didactic and economic) for evaluating the effectiveness of the electronic educational process are highlighted. The main models for assessing the quality of the educational process in the context of their strengths and weaknesses for the electronic educational process are analyzed. In the process of dividing schemes and models for evaluating the educational process into basic classes, basic attributes and primary features of the electronic educational process were identified.

Key words: quality assessment model; e-learning process; educational environment; quality metrics.

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1. Introduction

Modern methods and software tools of the remote (electronic) form organization of the educational process (EP) includes three components: technological, content (content) and organizational. The technological component is responsible for the material and technical base (hardware and software). Meaningful – for the content of training (content training modules), traditional and innovative training tools and EP control tools, distance courses and training programs *(Kitonova, 2022)*. Organizational consists in the implementation of the educational process using various organizational schemes of remote control. Thus, the general analysis of the literature in this study demonstrates a variety of approaches to the classification of organizational schemes and models for evaluating distance learning. At the same time, the authors choose different bases for classifying and evaluating the effectiveness of electronic EP components. Moreover, in many of them, the basis (dominant feature) for highlighting the EP assessment model is not clearly expressed, as a result, within the same classification, schemes are

identified according to different features, parameters *(Alt, 2021)*. Depending on how the metrics and models of evaluation (performance assessment) are selected, it is necessary to make a decision on the future fate of the course, training module, component of the electronic inventory item (leave, modify, remove, change the format, content, frequency – and so on). If it is decided to finalize or modify the electronic course or content module, then you can make a clear plan of changes based on feedback mechanisms and methodological recommendations *(Ferrer, 2010)*.

2. Presentation of the main material

Let's record what is included in the assessment of educational results of an electronic EP. To evaluate the effectiveness of distance education methods, several important actions must be taken:

Stage 1. Evaluate the training results of participants of the electronic EP (indicators before and after completing the electronic course, the results of completing intermediate and final training tasks, tests).

Step 2. Calculate the metrics of a particular set (current and final CSI and COR, final NPS).

Stage 3. Build a model (scheme) for evaluating the results of an electronic inventory item based on selected (artificially constructed) metrics for evaluating educational results.

Stage 4. Provide a feedback mechanism for the results of an electronic inventory item from students, teachers, and experts.

That is, depending on what the metrics showed (the model for evaluating the effectiveness of the EP component), you need to decide on the future fate of the course, training module (leave, modify, remove, change the format, content, frequency – and so on). If it is decided to finalize or modify the electronic course or content module, then you can make a clear plan of changes based on feedback mechanisms and methodological recommendations *(Pappas, 2019)*.

Consequently, there is a fundamental problem of comparing and selecting models for evaluating the quality of electronic EP components.

It should be noted that evaluating the effectiveness of EP (all organization schemes and models) is a problematic task that concerns both classical educational institutions and areas of corporate education. To date, there are about two dozen different models for evaluating the effectiveness of EP, which are modifications of 6 basic models of the quality of the educational process based on recording the results of EP. Research shows that only a small proportion of educational institutions associate educational activities with the results required by the business (here communication between the educational institution and the business remains a big problem). One of the first clear and simple models (frameworks) that allows you to assess the impact of EP on Business Processes was formulated by D. Kirkpatrick. Its model for evaluating the effectiveness of EP, with some modifications, is still used today and is considered basic.

Hierarchical model of Kirkpatrick – Phillips EP efficiency. Thus, the classical Kirkpatrick model assumes four levels of assessment of the effectiveness of EP (Fig. 1):

1) Reaction hierarchy – how much all participants of the emergency liked the educational process.

2) Hierarchy of content assimilation – sets of educational techniques and techniques that were learned based on the results of EP.

3) Hierarchy of behavior – analyzes how as a result of EP influenced the change in the working behavior of EP participants (in dynamics and educational results).

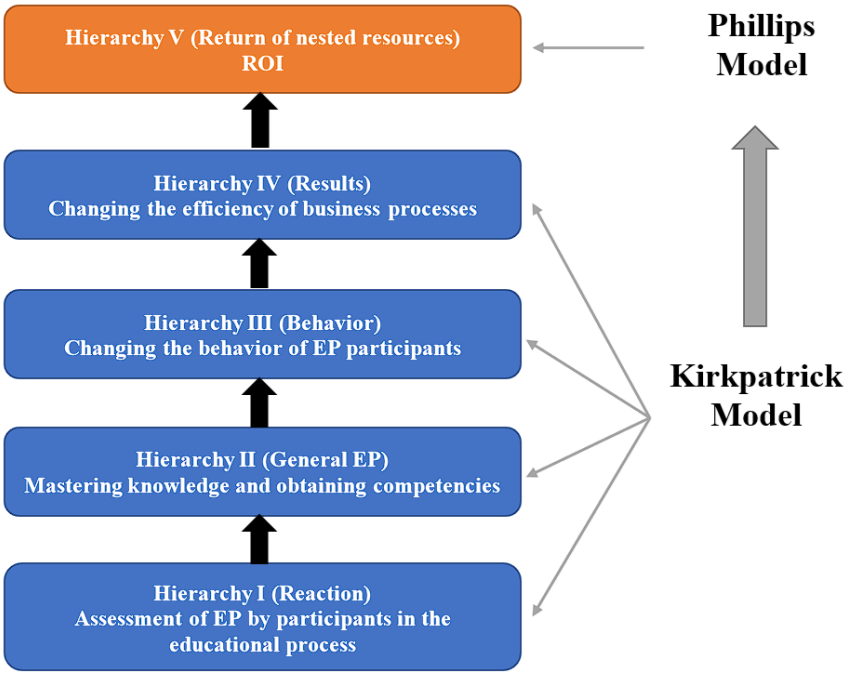

Fig. 1. Hierarchical model of Kirkpatrick – Phillips EP efficiency

4) Hierarchy of training results – analyzes which EP results for a productive structure (business processes) have the greatest impact – reducing resource costs, improving the quality of a business product).

The D. Phillips EP efficiency model (Phillips ROI model) adds a fifth level (hierarchy) of valuation to the classical Kirkpatrick model: return on invested capital (ROI metric). The ROI metric is estimated using the (1):

$$M_{ROI} = F_{Res}/R_{Edc}. \quad (1)$$

Note that here F_{Res} is the total financial result (in fact, the added value of the business product), and R_{Edc} is the total cost of the inventory item.

Note that the presented models should sometimes not be combined into a single Kirkpatrick – Phillips model (in practice, it is often advisable to separate them). The Phillips model not only adds a new hierarchy, but also adds new performance evaluation metrics to existing levels. Thus, metrics are added to the third level (the level of behavior assessment) to assess the reasons for changes that made it impossible for EP participants to apply new knowledge and competencies in their work. At the fourth level (the level of results), the set of tools and metrics for evaluating it is significantly expanded *(Revilova, 2015)*.

At this stage of the study, the fundamental question of evaluating each of the stages of the Kirkpatrick – Phillips model arises. So at the first level of "reaction" it is necessary to qualitatively assess the thoughts and emotional reactions of participants in an electronic emergency. To do this, use the following metrics:

– NPS metric-consumer loyalty index. Participants of an electronic EP are asked to assess their readiness to recommend an EP (electronic course) on a scale from 1 to 10 the results

of the assessment are divided into three groups depending on the points: 1–6 – critical attitude, 7–8 – neutral attitude, 9–10 positive attitude. At the end of the evaluation, the percentage of critics is subtracted from the percentage of supporters.

– CSAT metric-an index of satisfaction of training participants. To calculate it, students are first asked to rate the inventory item or its element (e-course) on a certain scale (for example, from 1 to 10, from "completely dissatisfied" to "very satisfied").

It should be noted that at the second level of the Kirkpatrick – Phillips model, the knowledge, skills and competencies that EP participants received as a result of passing the educational program are evaluated. It is clear that for this purpose, in the simplest case, it is advisable to use EP test tools (they are the simplest in terms of methodological development and do not require significant resource investments). However, we note that testing alone within the framework of an emergency will not give a complete picture of mastering the curriculum, so other tools are also used at this level (practical tasks, cases, role-playing games, etc.). Note that you need to evaluate your knowledge not only after training, but also throughout the entire inventory item and after – this will help you get more accurate results.

At the third level, changes in the behavior of EP participants after completing the course are evaluated (i.e., whether the EP goals are achieved or not). Therefore, two factors are important for evaluating the effectiveness of an inventory item at this level:

1) Results should be clearly evaluated and formalized (for example, using checklists or regulations). This way you can track and evaluate whether knowledge and competencies have actually been transferred to the practical plane.

2) An important element is the involvement of EP experts and administrators in the assessment of EP – this allows us to consider changes in the educational process systematically (evaluate EP in dynamics) and get more complete data and assessments.

At the fourth level of "results", a data analysis procedure is performed to determine what specific changes there are in productivity, quality of work (quality of business processes), or other key indicators. This assessment helps to identify the specific significance and effectiveness of the training program (its impact on Business Processes and overall productivity).

It should be noted that it is thanks to the ROI metric that it becomes possible to assess the economic efficiency of an inventory item, and based on the data obtained, it is already possible to directly correlate the productivity of a specialist from the completed inventory item.

The Stafflebim model (CIPP). The block diagram of this model is shown in (Fig. 2). the model allows you to evaluate both the results and the process of learning and improving EP itself. Therefore, this model can be successfully applied for long-term modular training programs (long-term e-courses).

The main idea of this EP assessment model is to answer the following basic set of questions:

1) Context Evaluation – a general assessment of the development context (who, what, and why to teach?).

2) Input Evaluation – general assessment at the input (how to teach and what is planned to get at the end of training?).

3) Process Evaluation – general assessment of the inventory item (how is the training going and what are the interim results of the inventory item?).

4) Product Evaluation – a general assessment of the final result of the inventory item (how was the training process and were the training goals achieved?).

The Bern model (CIRO). Note that this model is a logical continuation of the Stafflebim model – (Fig. 3).

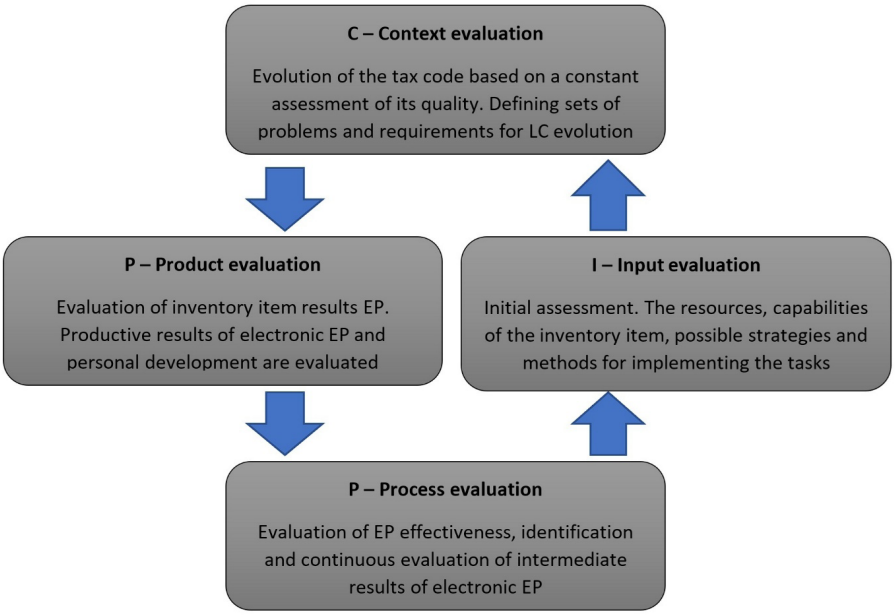

Fig. 2. Model for evaluating the effectiveness of Stafflebims (CIPP)

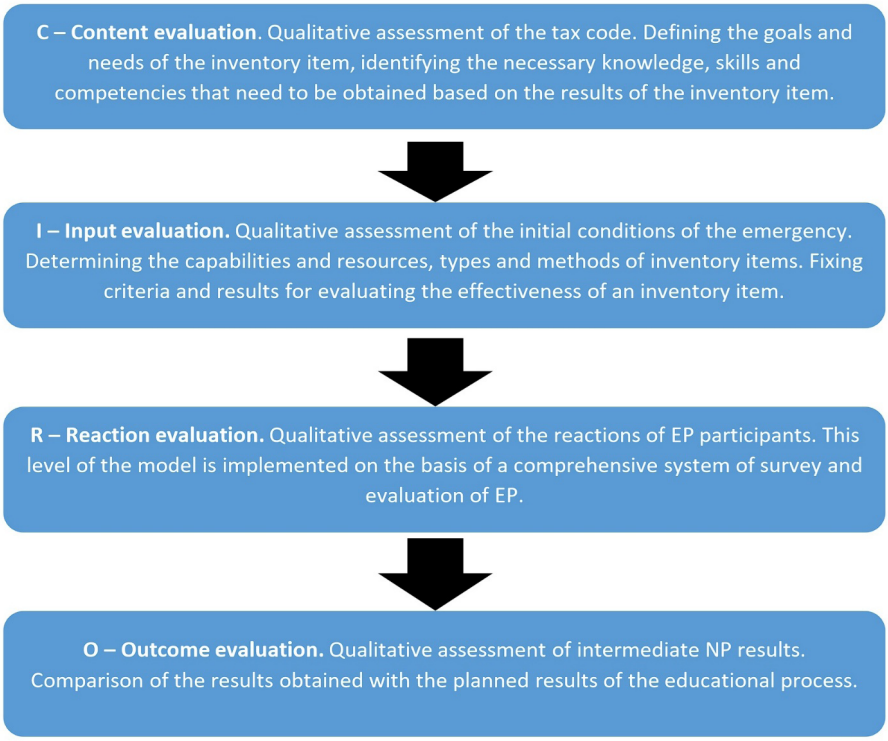

Fig. 3. Bern estimation model (CIRO)

Within the framework of this EP quality model, the following criteria for the overall educational process are evaluated:

1) Context Evaluation-a comprehensive assessment of the inventory item content.

2) Input Evaluation-assessment of the capabilities and preliminary results of the emergency.

3) Reaction Evaluation-assessment of educational reactions of participants in the emergency.

4) Out evaluation-a comprehensive assessment of the results obtained.

An important feature of this model for evaluating the effectiveness of EP is that the main attention is paid directly to the participants of EP (the human-centricity component prevails). Their overall perception of EP as a whole affects its effectiveness – an important component of the evaluation model. The model is useful both at the stage of launching an inventory item and at the stage of final evaluation of the effectiveness of the inventory item (based on training results).

Tyler target approach model. This model is based on the step-by-step selection and setting of sets of EP goals. Please note that the procedure for qualitative assessment of inventory items for this model follows the following scheme:

1) Primary formation of sets of EP goals and objectives.

2) Stage of classification of formed sets of goals and objectives of the inventory item.

3) The stage of defining a set of goals and objectives of the EP in terms of the behavior of the EP participant.

4) The stage of searching for strategies for verifying the achievement of the goals of an electronic inventory item.

5) Stage of development and selection of metrics and methods for evaluating inventory items.

6) Stage of collecting statistical data related to the effectiveness of inventory items.

7) Stage of comprehensive comparison of EP efficiency data with data on the effectiveness of achieving the desired EP results.

In other words, we can summarize that the main problem of EP (based on the Tyler model) is unclear (not fully defined) educational goals. Tyler's model offers:

1) Set detailed and clear EP goals. Classify EP goals each goal is a specific behavior model within the EP.

2) Think about how to check that the EP goals have been achieved, i.e. the behavior patterns have been mastered. Situations to check, rating scale.

3) Comprehensively evaluate the effectiveness of the inventory item. Collect data on the effectiveness of training and the workflow after – compare.

Note that the Tyler model is similar to the third level (hierarchy) of the Kirkpatrick model, but the processes occurring within the EP are considered in more comprehensive and detailed ways. Despite the tangible advantages of Tyler's targeted approach, it has one fundamental drawback – it is impossible to assess the financial effectiveness of the training conducted. In other words, using Tyler targeted approach, there is no way to use the ROI metric.

Skriven's non-target EP estimation model. Within the framework of this model of EP assessment, the final results of training are the main reference point that needs to be correlated with the initial needs (the need of the organization, educational institution, the needs of the EP participant, the need for business processes). Data for analyzing and evaluating the effectiveness of EP are collected by various methods (tests blocks, observations, sample surveys), then the obtained data are systematized and evaluated by an expert (expert group) to obtain an objective assessment of EP.

So, this model for evaluating the effectiveness of EP, aimed at the result of training, requires a set of external assessments (expert groups) that should not have information about the goals and objectives set for the EP (the requirement for independence). Peer review should determine the full cost and overall value of the training program based on a set of EP results.

In other words, the Skriven's model aims to introduce an expert on the assessment of EP from the outside. This is exactly what distinguishes it from the other models listed in the study above. In the Skriven's model, an external expert has the main task, which is to determine the effectiveness of the inventory item, as well as to assess the final cost of the educational process (the results of the inventory item) based on the results of its implementation. This model takes as its main goal the study of the final results of an emergency. The objectivity of an outside observer (expert group) leads to the convenience of this method if the emphasis is placed on the overall effectiveness of the educational organization. In the case when each member of the EP is evaluated separately, his professionalism and personal educational progress, this model for evaluating the effectiveness of the EP may not be of sufficient quality (the objectivity factor may not be preserved, and the results of the assessments are influenced by the human factor). This model of EP quality assessment allows us to analyze EP and determine its overall results, but it is not able to identify the root cause of low EP efficiency and identify undesirable patterns of behavior of EP participants that affected the final result.

3. Conclusions

So, we can summarize – all the analyzed models for evaluating the effectiveness of electronic EP are built in one way or another in order to conduct a comprehensive, objective and effective assessment of the results of EP. Thanks to the EP efficiency models described above in the section, you can determine the best form, method, and scheme of EP (adapt the EP to the specific need of EP participants) – (Table 1). As a rule, the Kirkpatrick – Phillips model is considered to be a classic approach to evaluating the effectiveness of training. Most other EP assessment models are based on this approach in one way or another.

Table 1

Comparative table of models for evaluating the effectiveness of EP

Comprehensive model for evaluating the effectiveness of EP	Advantages of the model performance evaluations EP	Disadvantages of the model performance evaluations EP	Possibility of effective application within the framework of the electronic EP
1	2	3	4
Kirkpatrick-Phillips hierarchical model	A classic model (hierarchy of two models) for evaluating the effectiveness of EP, which can be adapted to almost any model and scheme of EP organization. An important advantage is the possibility of integrated use of this hybrid model for the sphere of financial investment in EP and its elements (due to the ROI metric).	In classical model implementations, there are limited opportunities to define performance evaluation criteria and specific steps to implement the inventory EP. The fundamental disadvantage of the model is the lack of ability to adapt the performance assessment system to a fixed component of the inventory EP and a specific stage for its implementation.	This model as a whole (or its component) for evaluating the effectiveness of an inventory EP can be applied to an electronic inventory item of an arbitrary scheme and model of the organization. This model for assessing the quality of inventory EP is the most versatile in terms of applied application.

Continuation of Table 1

1	2	3	4
Tyler's target approach model	An important feature is that this model defines specific EP goals. Correct and consistent setting of EP goals and objectives ensures high efficiency of this model in comparison with others.	The fundamental disadvantage of the model is the lack of a direct correlation between the defined EP goals and the final ones results that affect performance EP (the possibility of its correction and improvement). This model does not include the impact on EP results sets of external factors (influence of the social environment, subjective factors of the EP participant).	This model for evaluating the effectiveness of an inventory item can be applied to an electronic inventory item of an arbitrary scheme and organization model. Direct application of the model may be limited due to the lack of an inverse relationship between EP goals and results (this is critical for electronic EP).
Skriven's non-target model	An important advantage of the model is the ability to conduct an independent external assessment of the effectiveness of EP at the expense of expert groups (the level of external expertise can be adjusted during the evaluation process). It is possible to evaluate both the inventory item as a whole and its individual components.	The fundamental disadvantage of the model is the inability to implement economic metrics for evaluating EP. In other words, it is not possible to perform preliminary calculations in order to predict the preliminary results of the EP as a whole. When working with this model, it is necessary to take into account the fundamental need to involve a third-party specialist (expert groups) to evaluate the EP or its elements. The involvement of external expert groups to evaluate EP makes this model the most resource-intensive (financially expensive) of all those presented in the study.	This model for evaluating the effectiveness of an EP can be applied to an electronic EP of an arbitrary scheme and model of the organization. However, this model is not suitable for business education and the forms of educational process associated with it.
CIPP model	The advantage of the EP assessment model is that both the EP itself and the results of the educational process are considered in a complex. In other words, the model provides a comprehensive approach to correlating the overall plan, forecast, results, and development of the EP as a whole. The presence of an efficient reverse coupling mechanism provides significant advantages over other models.	The fundamental disadvantage of the CIPP model is the inability to conduct an effective assessment of the business component of EP (the inability to comprehensively attract economic metrics for the assessment of EP and integrated evaluation of the effectiveness of EP in material terms).	This model for evaluating the effectiveness of EP can be applied to an electronic EP of an arbitrary scheme and model of the organization, provided that there are no requirements for an economic assessment of the quality of EP. The presence of feedback mechanisms adds advantages over other EP assessment models.

Continuation of Table 1

1	2	3	4
CIRO model	Similarly to the CIPP model, this approach will provide a comprehensive correlation scheme for the EP plan, forecast, and Main results training and development of EP. To a large extent, this is a common advantage in evaluating the quality of EP CIPP and CIRO models.	A fundamental drawback of the model, which also coincides with CIPP models, is the inability to assess the economic component of EP (the inability to work with EP business metrics).	This model for evaluating the effectiveness of an EP can be applied to an electronic EP of an arbitrary scheme and organization model in parallel with models of the CIPP class, without the possibility of taking into account the business components (economic components) of an electronic EP.

Therefore, we can conclude that there is a main problem in the assessment of EP, which is related to the impartiality and objectivity of any conducted program for evaluating the effectiveness of EP, since it is impossible to avoid the influence of the human factor on any assessment system. The experts who provide these processes have their own life experience, professional training and personal qualities, which cannot but leave its mark. You can also add to the above the influence of the acquired knowledge on the expert's personality. Thus, the question arises about minimizing the influence of the human factor on the results of evaluating the effectiveness of EP, which can be achieved either by minimizing external influence, or by minimizing one's own biased opinion about the object of study, its underestimation or, conversely, overestimation, by automating expert assessment based on specialized IS. That is, it is possible to minimize the impact of biases only with a systematic approach to the object of research (evaluation).

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