Multi-criteria decision-making model based on the level of doubt for information and training system

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Abstract

The urgency of developing information and training system based on multicriteria decision-making model is due to both scientific purposes better understanding of the information processes of learning and practical objectives to create more effective information and training systems, the implementation of which contributes to the quality of distance learning. The transition to this technology involves the use of new teaching methods, approaches, principles of organization of the learning process, including on the basis of information and training systems. Therefore, in this paper concerns the problem-oriented learning management based on multicriteria decision-making model that takes into account the level of doubt the user. The proposed method of measuring the level of doubt the user gives a clearer and more "transparent situational picture" for a more objective decision-making. Also, the method makes it possible to reduce the probability of guessing the correct answer, which increases the objectivity of knowledge in diagnostic systems for process control training on remote technology.

Keywords: multicriteria, distance learning, doubt

1 Introduction

Currently, the requirements for the quality of education (qualification level: knowledge, skills, worldview, mind and senses, abilities, personality and character) university students requires sophisticated testing methods to detect the level of knowledge, taking into account the social and psychological features of the student in order to effectively manage learning process.

The solution to this problem is possible:

- Firstly by the integration of all types and methods of testing and validation of knowledge (as well as checking ability, skills and outlook);
- Secondly, by automating the testing process, testing the knowledge and skill level (ie, quality);
- A third way to achieve maximum objectivity of evaluation of knowledge.

Therefore, in this paper address the latter problem is focused on maximizing an objective measurement of the level of knowledge. The possibility of solving this problem is to multicriterion approach, which measures the number of correct answers given by doubt.

Model development of a teaching element is constructed by the user when working with the system on the basis of personal identification properties. As a result, tracking personal properties in the system is generated for each user's image, which can be used to control the learning process according to the parameters in Table 1.

Based on multicriteria evaluation model of knowledge can identify key features for organizing and managing the automated process of training in information and training system. These include: (Savchenko Y.Y., 2012)

- Level of knowledge - the level of current results of the users.
- Level of difficulty - fixed characteristics prescribed settings teacher.
- Level of response - time estimates the user's actions in response to any impact.
- Level of confidence - probability characteristic inversely proportional to the level of doubt.

TABLE 1 Performance training for each educational element

№	Designation	Characteristic
1.	K_0	The beginner level of knowledge of educational elements
2.	K	The achieved level of knowledge of EE
3.	C	% doubt the level of knowledge
4.	S	Degree of difficulty of EE
5.	I	Intensity of using of EE
6.	P	Periodically of using of EE
7.	T	Spending of time on the development of EE
8.	H	Number of steps of learning
9.	D	Information handwriting user
10.	O	Percentage of errors when checking the EE
11.	V	Weight of training element
12.	R	Mode of operation of ITS

The level of doubt the user is latent parameter measurements, i.e. not directly measured. Level doubt plays an important role in the assessment of knowledge, because it takes into account the psychological characteristics of human behavior. At the level of latent doubt includes the following parameters: length of time the decision-making; periodicity; intensity; response to the outrage; reaction to the decision-making; artificially created situation; questionable actions of the user and others. For the measurement of these parameters are necessary quantitative characteristics: number of missed transactions; number of unconfirmed information; interrupts logical chain et al. To account for the level of doubt, the user is offered the following method

(Vinogradov G.P., Kuznetsov V.N., 2011).

The essence of the method is to confirm the doubts of the decision, by comparing it with the decision of this type. Defined latency parameter of this model uses the following quantitative characteristics: themes, complexity, and decision.

Testing formulated from x-issues. All questions are divided into x t-groups on specific topics. Each question has only one answer. In the entire test questions are divided into x of the n-levels of complexity. Each question has its own level of difficulty. The share issues by level of complexity must satisfy the following condition: for n=3 easy - 50%, average - 30%, complex - 20%. Each difficulty level corresponds to the weighting factor F (F_{max} - the most difficult, Fmax-1 - less complex, etc.) (Serbin V.V., 2013).

Questioned all questions that were answered correctly for all levels, except the first one. Doubt in answering the question level F, is calculated from the responses to the questions on the same topic (i.e., the same group), which is below the level of complexity of the complexity of this issue (Serbin V., 2010).

$$S_F = \sum_{i=1}^{m} k_i W_i ,$$

where m – number of difficulty levels below the one for which the calculation is carried out,

$$m = F - 1 ,$$

F – weighting factor of the current level of complexity;
k_i – weight ratio of doubt on the question below current levels

$$k_i = -\frac{i - m - 1}{\sum_{j=1}^{m} j} .$$

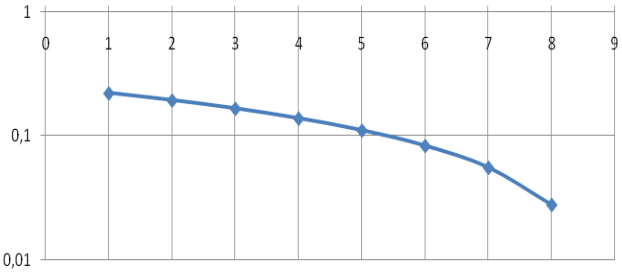

FIGURE 1 A plot of the weight coefficient Ki doubt on the current level of complexity of the issue (logarithmic)

W_i – total weight of the doubt question the i-th level,

$$W_i = \frac{1}{g} \sum_{l=1}^{g} V_i ,$$

where g – the number of questions the i-th level of complexity on the same topic as a question, for which the calculation is being doubt;
V_i – decision (answer the question)

$$V_i = \begin{cases} 1 - in\ \ case\ \ correct\ \ answer \\ 0 - in\ \ case\ \ incorrect\ \ answer \end{cases}$$

Assuming that the test in question may be several levels of complexity, there is a need to find a mean-value level of each question:

$$S_s = \frac{\sqrt{\sum_{t=1}^{q} S_{Ft}^2}}{q} .$$

Total factor characterizing the degree of doubt is:

$$S = \sum_{F=2}^{F_{\max}} f_{F-1} \cdot S_s ,$$

where S_F – doubt in response to the question of F difficulty, f_F – weight ratio doubt in response to the question of F difficulty:

$$f_F = \frac{F}{\sum_{j=1}^{m} j} ,$$

where F_{max} – maximum weight at the highest level. (Serbin V., 2013)

2 Results

The schema of multicriterial decisions making model shown in Figure 2:

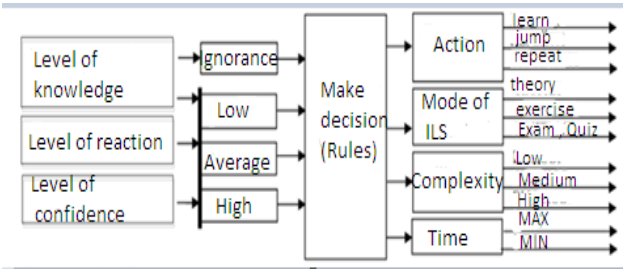

FIGURE 2 Multicriterial decisions making model

Decision making educational element (action, mode of operation, complexity, time) on the basis of the current state of the educational element is achieved on the basis of the truth table of decision-making in accordance with Table 2.

TABLE 2 The current state of the educational element and decision

State			**Decision of EE**			
Knowledge	Reaction	Confidence	Complexity	Time	Action	Mode
Z0	RA	UA	A	max	jump	theory
Z0	RA	UB	A	max	learn	theory
Z0	RA	UC	A	max	learn	theory
Z0	RB	UA	A	-	learn	theory
Z0	RB	UB	A	-	learn	theory
Z0	RB	UC	A	-	learn	theory
Z0	RC	UA	A	min	learn	theory
Z0	RC	UB	A	min	learn	theory
Z0	RC	UC	A	min	learn	theory
ZA	RA	UA	A	max	repeat	Exercise
ZA	RA	UB	B	max	repeat	-
ZA	RA	UC	B	max	jump	Exam, Quiz
ZA	RB	UA	A	-	repeat	Exercise
ZA	RB	UB	B	-	repeat	-
ZA	RB	UC	B	-	jump	Exam, Quiz
ZA	RC	UA	A	min	repeat	Exercise
ZA	RC	UB	B	min	repeat	-
ZA	RC	UC	B	min	jump	Exam, Quiz
ZB	RA	UA	A	max	repeat	Exercise
ZB	RA	UB	B	max	repeat	-
ZB	RA	UC	C	max	jump	Exam, Quiz
ZB	RB	UA	A	-	repeat	Exercise
ZB	RB	UB	B	-	repeat	-
ZB	RB	UC	C	-	jump	Exam, Quiz
ZB	RC	UA	A	min	repeat	Exercise
ZB	RC	UB	B	min	repeat	-
ZB	RC	UC	C	min	jump	Exam, Quiz
ZC	RA	UA	B	max	repeat	Exercise
ZC	RA	UB	B	max	repeat	-
ZC	RA	UC	C	max	jump	Exam, Quiz
ZC	RB	UA	B	-	repeat	Exercise
ZC	RB	UB	B	-	repeat	-
ZC	RB	UC	C	-	jump	Exam, Quiz
ZC	RC	UA	B	min	repeat	Exercise
ZC	RC	UB	B	min	repeat	-
ZC	RC	UC	C	min	jump	Exam, Quiz

The metric scale measuring the state of the educational element:

1. Ignorance (0%-49%) Z0
2. Low level of knowledge (50%-74%) ZA
3. The average level of knowledge (75%-89%) ZB
4. The high level of knowledge (90% -100%) ZC
5. Low level of reaction (0% -74%) RA
6. The average level of reaction (75% -89%) RB
7. The high level of reaction (90% -100%) RC
8. Low level of confidence (0% -74%) UA
9. The average level of confidence (75% -89%) UB
10. The high level of confidence (90% -100%) UC

The organization of the learning process in information-learning system based on a measure of doubt for control need rules, which formed the knowledge base.

Rules:

1. If (REs knowledge - ignorance and reaction - low, average or high and confidence - low, average or high) THEN (complexity - low, the learning mode - the theory, the effect of educational elements - learn).
2. IF (REs knowledge - ignorance, low, average or high and reaction - low and confidence - low, average or high), time (time - MAX).
3. IF (REs knowledge - ignorance, low, average or high and the reaction - high and confidence - low, average or high), time (time - MIN).
4. If (level of knowledge of UE - low. Medium or high and reaction - low, average or high and confidence - high) THEN (action educational element -Jump).
5. If (knowledge UE – low, average or high and reaction - low, average or high and confidence - low or average) THEN (action educational element - Repeat).
6. If (knowledge UE – low, average or high and reaction - low, average or high and confidence - Low) THEN (training mode - Exercise).
7. If (knowledge UE – low, average or high and reaction - low, average or high and confidence - high) THEN (training mode – Exam, Quiz).
8. If (knowledge UE - low or average and reaction - low, average or high and confidence - Low) THEN (difficulty - Low).
9. If (knowledge UE - low and reaction - low, average or high and confidence - average or high) THEN (difficulty - average).
10. If (the level of knowledge of UE - average and reaction - low, average or high and confidence - average) THEN (difficulty - average).
11. If (the level of knowledge of UE - average or high and reaction - low, average or high and confidence - high) THEN (complexity - high).
12. IF (knowledge UE - high and reaction - low, average or high and confidence - low or average) THEN (difficulty - average).

5 Conclusions

In this paper, decision making model was created on the basis of measuring the level of doubt the user to control the learning process. The proposed idea makes it possible to reduce the probability of guessing the correct answer for a more objective assessment of knowledge and adapt the learning process on the basis of the knowledge base.

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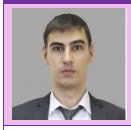

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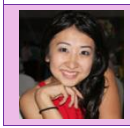

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