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Concordation factor for training program indirect expert evaluation method

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Abstract. *During the regular training process it is necessary to change training program due to novelties and fresh developments for the topic. With a huge quantity of changes it becomes difficult to evaluate the level of groups and people that are taking training course at different time periods. So it is necessary to use some value that would help to evaluate the level of educational process adequately and for such purpose the Kendall concordance coefficient usage has been chosen.*
Keywords: *external pilot, training program, unmanned aerial vehicle, coefficient of concordance.*

Introduction. During the adaptive training program of external pilots development and modernization process the necessity of possible changes evaluation appears. The task is complicated by the fact that the same person or group cannot consistently retake the course under the old and updated programs that makes it unreal to have direct comparison of results.

Usage of combined indirect expert evaluation method is proposed that combines the analysis of expected performance, complexity of stages, psychophysical load and feedback from trainees. This method allows to obtain a relatively objective assessment of changes in the training program without duplication, which is impossible to implement.

To assess the consistency of expert opinions for the method of expert assessment of the adaptive training program for external pilots of unmanned aerial vehicles effectiveness, usage of the Kendall concordance coefficient is proposed.

Purpose. To develop a method for evaluation of expert opinion consistency for the method of expert assessment of the effectiveness of an adaptive training program for external pilots of unmanned aerial vehicles in cases where a direct comparison with the original program cannot be applied. The method will provide more accurate conclusions about the changes made through the coordination of opinions of qualified experts.

Materials and methods. As at the experiment described in an article [1] there is purposefull selection strategy for definition of participants with the required experience. Experts were chosen by several criteria but the panel size were limited by quantity of 12 experts for the domain of external pilots training. Step-by-step expert selection method is not the topic of this development, so let us consider the detailed description of the logic of the following algorithm steps (fig.1).

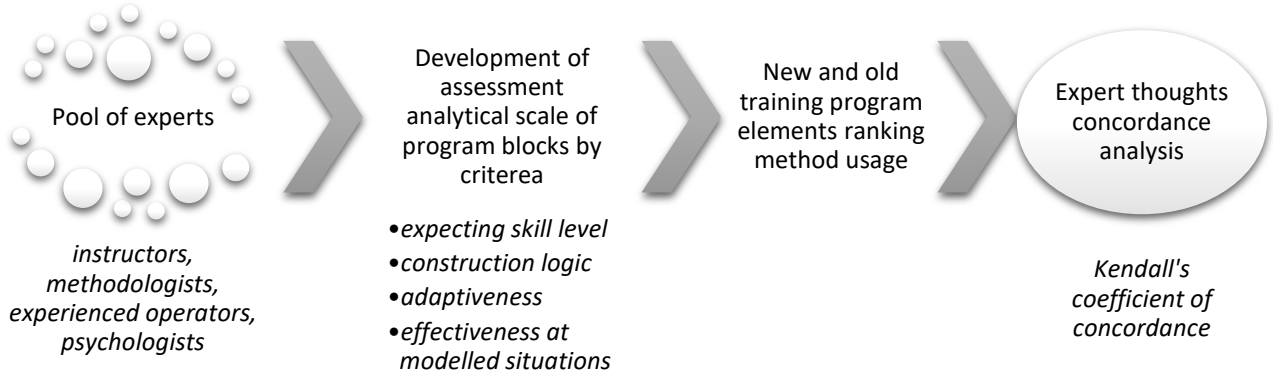

Fig.1. Step-by-step method методика підбору експертів

There is a similar scheme used at this development that have been used at the development [2]. This scheme has close connection to the available topic and were led to training course and quality assessment index system development for medical service. There was an attempt to substantiate it for training quality evaluation. The Delphi method was used at this development for expert reports, evaluations and modernization of the assessment indexes system and the significance of values were defined by the hierarchical analytical process.

Kendall`s concordation coefficient is used for confirmation of the developing training program evaluation after the expert development by the Delphi method and for comparison of expert estimation. In general case Kendall`s formula could be presented as:

$$W = \frac{12 \cdot S}{m^2(n^3 - n)}, \quad (1)$$

where n – quantity of objects of ranking;

m – quantity of experts;

$S = \sum_{i=1}^{n}(R_i - \overline{R})^2$ – sum of square deviation of the united rank of the R_i object from average $\overline{R}$.

Results. During the approbation process of the method based on the new external pilot training program the concordation coefficient that is using for concensus level between the expert opinions on brand new training program definition has been used. Ordinance of program blocks by criteria (expected effect, cognitive load, succesioness etc). It allowed to define the concordance of evaluations and to describe advantages of the modified program.

Let us consider the example of concordation confirmation on the example of matrix for four sequential blocks and twelve involved experts (table.1). Each expert

arranged changes for four blocks accordingly to a personal competence and evaluation domain profile. It is necessary to specificate that ranks cannot be considered as an absolute evaluation mark but only as ordinal for each expert. Kendall method cannot allow to evaluate how similar that ranks are by each expert.

Table 1. Example of expert assessments ranking using the Kendall method.

Program block	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	Sum of ranks R_i $\overline{R}$
A	1	2	1	2	1	2	1	2	1	1	2	2	18
B	2	3	2	3	2	3	2	3	2	2	3	3	30
C	4	4	4	4	4	4	4	4	4	4	4	4	48
D	3	1	3	1	3	1	3	1	3	3	1	1	24

There were calculated: average sum of rangs – 30; sum of squared deviations – 504; and Kendall's coefficient – 0,7.

There is a high evaluation concordation level that can be partly explained by the similarity of personal experience of experts and their relation to mutual domain. So for an updated program concordation coefficient is expected on the relatively high level not less than W = 0,6-0,7. Generally, the trustworthiness of expert conclusions is justified by the usage of proposed combination of methods. Preliminarily, the most part of experts were marking the decrease of cognitive overload (Block A) that improves subject material learning and practical training and disproves the hypothesis about general theoretical material composition influence (Block C).

Combined method allows to evaluate effectiveness of training programs without the necessity of retaking the course, taking into account remarks of experts and ensure the flexibility of training program formation based on justified professional reviews.

In the future method could be used for evaluation of changes at the other training programs, where direct comparison is absent, specifically at different simulation trainings.

Conclusions. Usage of the Kendall concordance coefficient is quite justified for the proposed combined method. This method is an effective means of obtaining a reliable expert assessment of changes in complex educational programs without direct comparison. Concordance coefficient usage would allow to establish an effective evaluation system and conduct more effective analytical work, which will allow to optimize the training program according to a common measurement procedure.

References

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