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To cite this article: Evgeny Ageev *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **971** 052078

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Methodology for determining the professional qualities of motor vehicle drivers

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Abstract. This article examines the factors that affect road safety in the Driver-Car-Road-Traffic Environment system, and defines the characteristics of the actions performed that are necessary for the vehicle operator. The author's version of improving the system of training candidates drivers, by determining the professional qualities of the system "driver-operator" of vehicles. The algorithm for checking the readiness of candidates for drivers is presented, taking into account individual personal qualities. To determine the quantitative parameter for assessing readiness to perform actions in the professional training system, the use of the graphical method "Spider CIS" is proposed, which allows determining the most optimal variant of the training system, and including additional classes, if necessary, taking into account individual and personal qualities.

1. Introduction

Road safety is the main indicator of the effective functioning of the Driver-Vehicle-Road-Traffic Environment (V-A-D-SD) system [1]. According to the report of the world Health Organization, 1.35 million people die in road accidents every year, usually in the age group of 5-29 years of Russian roads, the number of deaths was more than 16 thousand people over the past year [2].

According to the authors [3,4], the main factors that influence high accident rate are: driving style, age, physiological qualities, gender, level of professional training, education, functional status, motorization index, dynamic indicators of the vehicle, development of the road network.

The constant complication of traffic management leads to the risk of accidents, which in turn requires significant changes in the system of professional training, retraining of candidates for drivers who must meet the main characteristics of the operator's actions performed in the system (B-A-D-SD):

- error-free actions performed;
- the time of the decision;
- consistency of actions performed;
- professional reliability.

The error-free assessment of the performed actions is the decision-making time of the vehicle operator [5]. Let's look at the block diagram figure 1 of the driver's information activity when driving on roads in real time.

The car and the road network affect the driver's sense organs as a result, there are sensations-images of individual objects and phenomena that are transformed into conditions for the perception of



information. Then the received information is compared with images of past sensations and perceptions, stored in memory and is transformed into reflex actions.

The operator can not only reproduce images of past sensations and perceptions, but also process them, creating new images based on imagination. The final stage is the implementation of decision-making or its correction (control), which consists in generalizing the observed phenomena, their connections and relationships, identifying patterns through thinking.

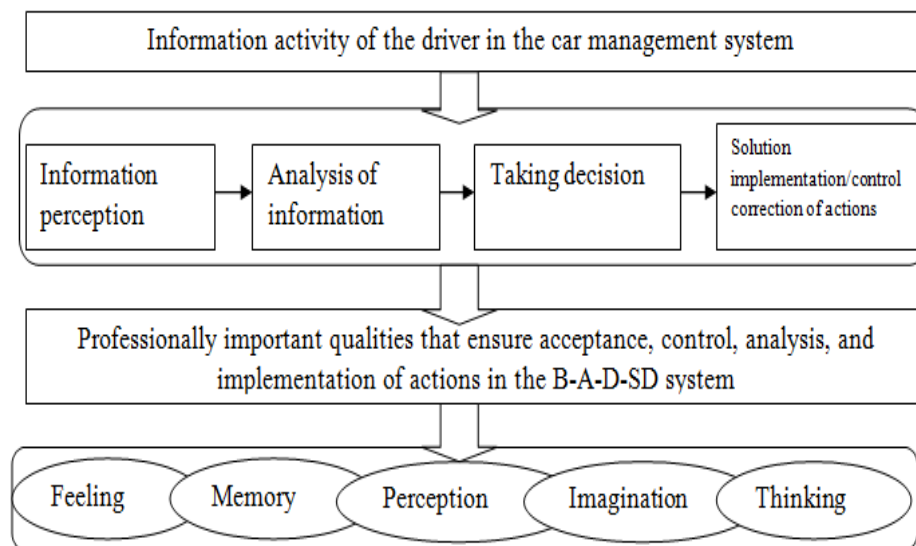


Figure 1. Scheme of information activity of the driver in the modern car management system.

In the considered scheme of information activity of the driver, it is the person who takes significant importance, as an element of the B-A-D-SD interaction system. The reliability of functioning of technological objects of the motor transport industry will depend on their professional qualities, formed in the course of professional training at the training center.

Analysis of statistical data on road accidents shows that most accidents occur for reasons related to the influence of the human factor [6].

In this regard, work is underway [7-9] to monitor and improve the professional reliability of the driver. At the same time, it is noted that one of the main components is the functional reliability of the "driver-operator" system of the vehicle, which provides dynamic stability in performing professional activities with a certain quality of training [10].

The purpose of this work is to improve the driver training system by determining the professional qualities of the "driver-operator" system of motor vehicles.

2. Materials and techniques

The research carried out using a systematic approach allows us to determine the professional qualities of candidates for drivers, formed in the course of training in the training center. Based on the use of the training rating, indicators that have an impact on road safety are formed.

The ranking of candidates for drivers is carried out by the method of expert assessments, taking into account the individual personal qualities of candidates for drivers. the most significant qualities include: X1-attention (concentration, stability, switching, distribution), x2 – perception (signal, control, speed of perception), X3 – memory (long – term, visual, operational, auditory, motor), X4 – ability to argue decisions, X5 – emotional stability, X6 – self-control, coordination of movements, X7 – endurance. The sequence of the algorithm for checking the driver's professional readiness is shown in figure 2.

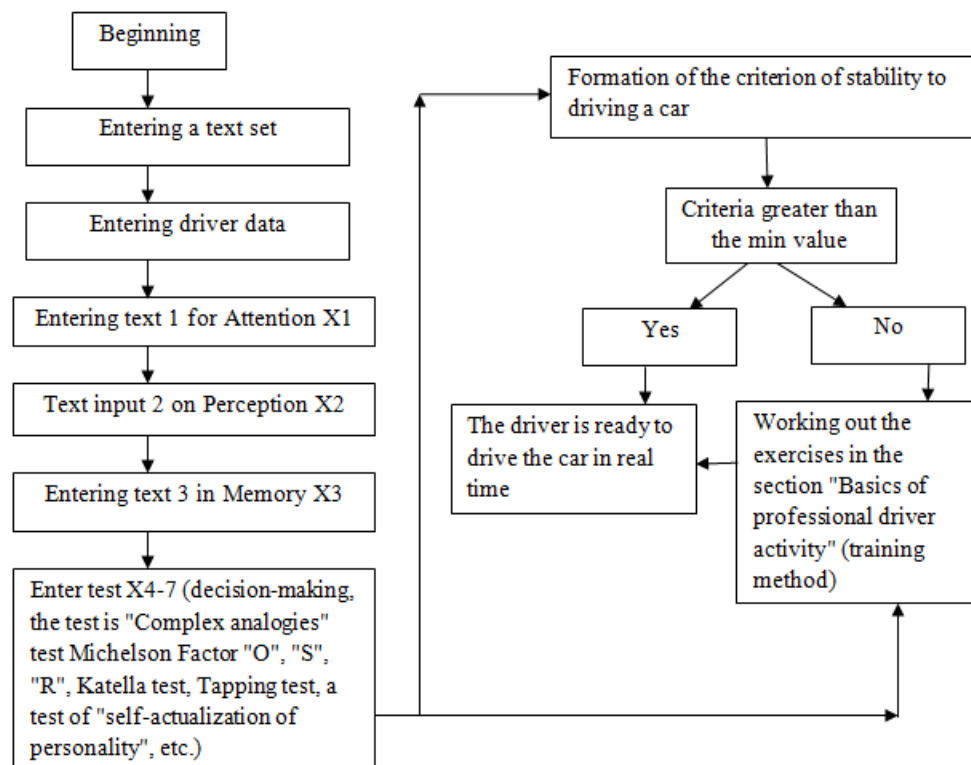


Figure 2. Flowchart of the algorithm for checking the professional readiness of candidates for drivers during training at the training center

The block diagram of the algorithm for checking the professional readiness of candidates for drivers shows that the necessary level of information for safe driving can be achieved by using a computer-training complex (simulator training), taking into account the individual indicators of students. Based on the results of the diagnostics, groups are selected taking into account the rating assessment and the criteria of professional suitability table 1.

Table 1. Criteria for professional readiness of candidates for drivers

The range of variation of	Indicator	Indicator characteristics
0.2-0.5	Low	The candidate's readiness to become a driver is in the minimum acceptable range, it requires adjustment of professionally important qualities, and mandatory training on the simulator is required.
0.5-0.8	Average	The candidate's readiness to be a driver is at an average level, the candidate is fit to drive a vehicle, provided that the recommended training on the simulator.
0.8 -1	Tall	The candidate's readiness to be a driver is at a high level, the candidate is fit to drive a vehicle, without additional training on the simulator.

To determine the quantitative parameter, we use The "SPIDER CIS" method, presenting the problem on the "Web" figure 3.

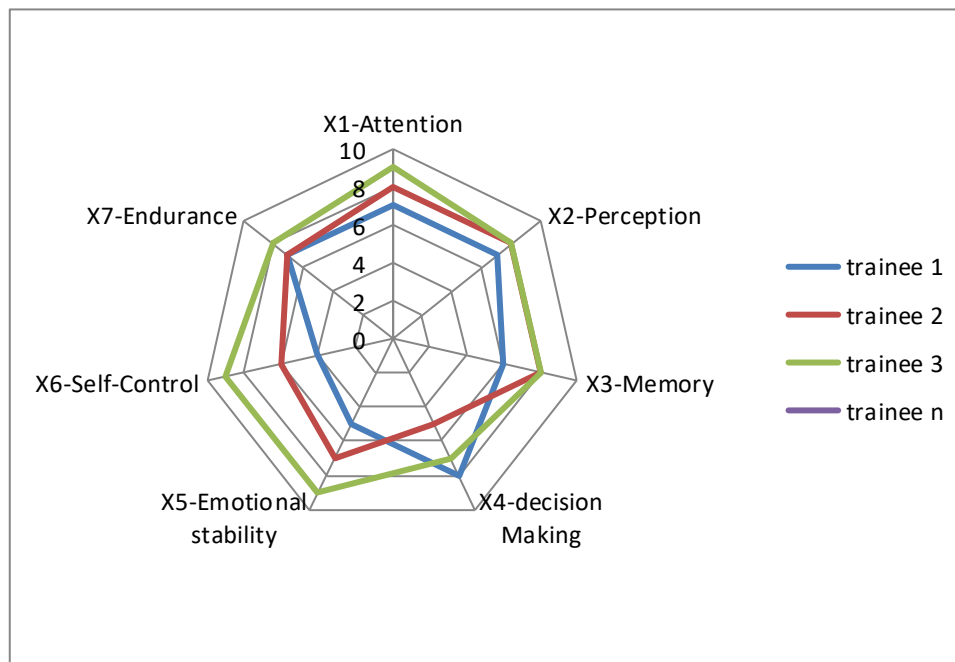


Figure 3. Layout of the chart of professional qualities of candidates for drivers.

For criteria, we will draw a diagram with symbols, with the worst values being closer to the center, and the best values being closer to the periphery. Gradation values do not matter, as long as you can see the change in indicators, for better or worse.

Connecting the points of readiness level located on the axes with a closed line for each student, we get a polygon that represents the polygon of professional qualities, where the vertices (n) determine the number of evaluation criteria. Based on the diagram, we determine the largest area, which corresponds to the best option. With this method of comparison, you can determine the best option for training a candidate for a driver, and include additional training hours, if necessary, depending on individual personal qualities.

3. Results and discussions

In accordance with the selected methods of evaluation of professional qualities of candidates in drivers underwent questionnaire survey to 120 people, including 90 people (the experimental group) were trained in the proposed methodology, applying the diagnostic competencies of 30 people (control group) was trained in the traditional form of training. Based on the results, groups were formed with low, medium and high indicators of readiness for professional activity. In the experimental group, training was carried out using simulator training and practicing professional skills related to driving a car.

The graph figure 4 shows a group with a low level of readiness after training in the proposed methodology passed the exam for the right to drive a vehicle at the first time 60%, control groups were trained in the traditional form of training, some of the students did not pass the exam.

The formation of training groups before the start of training, taking into account individual characteristics of the individual, using the results of psycho physiological examination (selection), allowed to identify candidates for drivers who need training to learn the skills of safe driving in order to obtain initial skills of driving a vehicle.

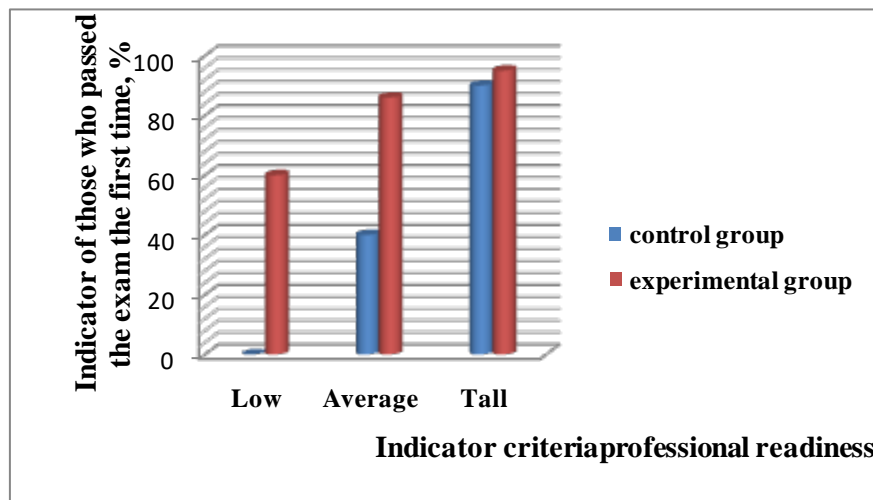


Figure 4. Comparative learning outcomes.

The method of expert assessment on safe driving was applied at the stage of theoretical and practical training in the training center "Vector" on the basis of which a study was conducted on the preparation of candidates for drivers of vehicles. As a result of the work done, the level of material assimilation has significantly improved, practical skills related to driving have improved, and it has become possible to assess the level of readiness of the listener for independent work, which has a positive effect in the field of road safety.

4. Conclusion

Improving the methodology for determining the professionally important qualities of a driver candidate will increase the level of professional fitness of drivers, which will undoubtedly affect road safety. Improving discipline, instilling skills of economic driving and instilling skills of careful driving will increase the overall culture of behavior on the road, will have a positive impact on reducing economic, environmental and social losses.

Acknowledgments

According to the results of the research and comparative analysis of the training of candidates for drivers according to the existing and proposed methods, the number of those who received a driver's license for the first time is 30% higher compared to the traditional form of training.

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