E-LEARNING MODEL FOR TRAINING OF DRIVERS IN TRAFFIC BASED ON FREQUENT MISTAKES ON THE PRACTICAL EXAM

Goran Jovanov[1], Jovica Vasiljevic[2], Nemanja Jovanov[3], Dejan Antic[4] and Djordje Vranjes[5]
[1]*University of Criminal Investigation and Police Studies-Republic of Serbia, Cara Dusana 196, Zemun-Belgrade, Serbia*
[2]*Secretariat for Public Transport-City Administration of Belgrade-Republic of Serbia, 27 Marta 43-45-Belgrade, Serbia*
[3]*"Union - Nikola Tesla" University Faculty of Business and Law-Belgrad-Serbia, Knez Mihaila 71-Belgrade, Serbia*
[4]*Road Traffic Safety Agency Republic of Serbia, Bulevar Mihaila Pupina 2-Belgrade, Serbia*
[5]*National Institute of Serbia, Vinca-Belgrade, Serbia*

ABSTRACT

This paper presents the previous experience in the licensing process of the examiners at the driving test in the Republic of Serbia, with an analysis of the way in which the examiners assess the polygonal actions. The analysis covers the most common mistakes that have been registered with the examiners as well as in the candidates in the training. The main groups of application of this model are only candidates for the training for passing a driving test. The material is a practical part of taking the driver's exam. Based on the database of errors in the work of the examiners and the candidates themselves, a database of electronic knowledge is modeled - (video material with comments) based on which the training model of the training candidate will be formed, based on frequent and observed errors. Further analysis of the database will be updated continuously in everyday work. Forming a database of errors is the first step in the model. At the same time, the selection of candidates with observed errors in the practical part of the training is formed. The formed target group independently examines the video material (as well as the examiner) evaluates its and the practical content of other candidates. A comparative analysis compares the observed errors of examiners and candidates. The collected data is analyzed and interpreted with the aim of identifying frequent errors both in training and in the practical exam itself. E content of the new training in the second cycle is enriched by documenting (video material with comments on past mistakes). After a short cycle of do-training with the application of the model, the newly acquired knowledge is checked by assessing the knowledge test based on the review of the simulated video with errors. The aim of this paper is to create a model of e-learning based on mistakes, which will annoy the creation of mistakes that a candidate creates in taking the practical part of the driving test.
We believe that the application of this model in constant work would create conditions for improving the quality of training, as well as easier learning model with the candidate. The result would be excellent quality training and a quality driver in traffic.

KEYWORDS

Database, Errors, Practical training, E-learning Model

1. INTRODUCTION

Having in the mind that the most important resource at the market today is information, there are more and more jobs which deal with collecting, creating, processing, distribution and warehousing the information. New technologies change our attitude toward life in short time intervals. New jobs are created, the old one are modified, the knowledge is more and more looked for and valued, intellectual jobs are overwhelming over the manual ones. Expert predictions talk about future demand of mostly the jobs requiring IT skills. In order to adequately respond to the requests of new jobs, the adequate education is required, because the IT knowledge and skills are not inborn, these are acquired by work and learning. The concept of today's school, according to many authors, is old fashioned and it needs to be changes, which is not surprising since it was created back in the 17th century by great European pedagogue, John Amos Comenius. At that time the school responded to the requests of informatics revolution and the needs of contemporary life. Pedagogues and educational theorists try to find a new model which would satisfy todays' and future needs of young

population. With the development of technology, it is necessary to change also educational methods which will use new technology and teach on how to use it. On the way to success, it is normal that the errors occur. Either they are big or small, we consider these to be bad or, even worse, we feel unsuccessful about them. The fact we do not know is that we actually learn based on the principle of efforts and errors – this is how our mind functions. Our attitude toward the errors is important, because they can be excellent tool for creativity and inspiration. Because of the mistakes, we have been criticized from our childhood, and if there had not been for them, we would not learn and develop ourselves. By studying complex systems, we can find surprising connection between those which are successful. Their success has been built in the manner of trying and making mistakes. It is very hard and extremely unpleasant to admit own mistakes. The world has become too unpredictable and complex for today's challenges and it is dangerous to be led by tested and ready solutions, as well as expert opinions. The mistakes should be accepted and appreciated. Based on them we will find out how to do something new. Let the mistakes be our journey to the success. The time in which we live and jobs we do every day demand from us flexibility, quick learning and adapting to situation. The jobs in which, once gained knowledge is applied in the same manner, are more and more rare.

In the Republic of Serbia, in the area of training candidates for drivers, the effectiveness of the Law, as well as by-laws which closely regulate this area, has brought significant changes as compared to current practice. Some of the most important ones are certainly the introduction of obligatory theoretical training and passing theoretical exam of candidates for a driver prior to the practical training, as well as licensing of personnel for training of candidates for drivers. The jobs of licensing of personnel for candidates training for drivers – which include driving instructors, theoretical training trainers and examiners – are by the Law trsuted to the Agency. In the focus of Agency jobs in 2014, and especially during the first half of the year, certainly were the jobs of licensing the examiners at the driving tests, because form July 1st, 2014, the obligation has become effective by which all of the examiners who want to practice these jobs must have the license for examiner issued by the Agency (Alimpić, Z., Bogićević, S., Dragutinović-J., N., (2013)).

In this work current experiences have been represented, in regards to the process of licensing the examiners in the Republic of Serbia, with the analysis of the manner in which the examiners evaluate acting on polygon. The analysis include the most common mistakes, differences in the manner of evaluation between the examiners, as well as the reconciliation with the predefined manner of evaluation in accordance with the relevant by-laws, for three polygon operations. The training is vital request in professional world and life at all. Driving schools and organizations spend significant amount of time and money in candidates/drivers training, in order to behave in accordance with the Law and regulations by their knowledge and attitude. Quality training helps in improving, reliability and safety of the traffic participants. Thru quality training and criteria, weakness and disadvantages can be identified so that additional improvements can be added too and the frequency of mistakes can be minimized. Practical part of the exam for the examiner is passed in the following manner: candidates for examiners watch on computers recorded driving of "candidate for a driver". As it has been very hard to provide and record the driving of real candidate for a driver, from organizational, time and technical aspect, the Agency videotaped experienced driving instructor and examiner who simulated the driving of candidate for a driver in a vehicle provid by the Agency and which is not the vehicle of any legal entity which trains the candidate for driving. Recorded driving practice include the driving at polygon and driving in traffic at public road, and detailed description of passing practical part of the exam for examiner is provided below. While evaluating, the examiner himself makes mistakes. On practical part of the exam, the task of a candidate for an examiner is to, during the period of 2 hours, watching video material on a computer, evaluate simulated driving of a candidate for driver who operates a vehicle of "B" category, using the rating list and evaluation form, in accordance with the Rulebook. **We are of the opinion that these mistakes are useful and the model of e-learning can be created based on mistakes.**

2. METHODOLOGY

Numerous researches have shown that a student better memorizes contents if these are shown as multimedia. The percentage of memorizing increases if the following are added to the transfer of information by reading: live word and motion picture, and 90% of successful rate happens if the motion is included, i.e. motoric activity which follows audio-visual perception (Mayer, R. E. & Anderson, R. B. (1992).).

Video material on practical part of an exam consists of 6 video clips of polygon operations and a video clip of traffic on public road, at total duration of not more than 25 minutes. A candidate for examiner watches video clips with the task to record, rate and write down the noticed mistakes in the rating list, write down total number of negative points and evaluate simulated driving of a candidate for examiner. Together with filling in rating list, a candidate must fill in evaluation form, also, which represents the explanation of their rating list. This means that each mistake recorded in the rating list has to be included in the evaluation form with detailed description, i.e. the comment which refer to a mistake made by a candidate for driver.

The evaluation of polygon operations in the exam form is made by a candidate for an examiner in the following manner:

1) by ***circling*** one of provided answers for each polygon operation;
2) in the filed ***Comment*** detailed description of mistake is provided, based on which a candidate has been evaluated;
3) in a part ***NNP*** the number of negative points is filled in, and the rating "not passed" ***NP*** is circled if such a rating is predicted for done mistake.

Figure 1. Screen shot of video clip for polygon operations (from the Agency gallery)

After polygon operations, a candidate for an examiner watches and evaluates recorded driving simulation of a candidate for a driver in traffic on public road, for which a screen shot of video material and content of exam form have specially been adapted. Video clip of traffic on public road is separated into five sectors, and each sector lasts for several minutes. A candidate for examiner evaluates the driving of a candidate for a driver in traffic on public road by writing down all found mistakes from the video clip in the exam form in each sector, together with recording the mistakes in rating list. The applied evaluation methodology provides us with the possibility to record noticed mistakes and, this way, to create mistakes/errors database. At the same time we will make the selection of examiners who have not passed the exam and thus we create targeted group of candidates for the application of new model of e-learning. Also, those candidates who have passed the exam and have had minimum number of errors should not be put aside. Those errors are also recorded. By comparative analysis of mistakes we come to frequent mistakes. They direct us to the causes that lead to the creation of mistakes, i.e. gaps in the training.

Material with mistakes, i.e. formed database represents the basis for e-platform. We approach to the creation of new video material with noticed mistakes. Simulated video material represents the correction in the form of additional training in a new cycle of knowledge creation.

Additional training with the presentation of material in virtual classroom, where candidates can see and record the errors. After new presentation with the accent on recorded errors, a candidate-examiner repeats the exam reviewing video material of practical part of the exam.

2.1 Methodology and Analysis of Polygon Operations Evaluation Manner

In this work the method of evaluation of three polygon operations has been analyzed at the sample of 178 candidates for examiner, who passed a practical part of the exam for examiner. Also, it is very important to point out that the analysis includes only those candidates for examiners who have taken a practical part of the exam for the first time. Analyzed period has been chosen because this manner of passing the exam has been applied in the licensing process for the first time, so the candidates for examiners have had minimal knowledge and experience on the manner and type of passing practical part of the exam, which enabled to the Agency to consider their real knowledge from the area of evaluation of the candidates for drivers at practical exam. The analysis has been done on percentage of candidates for examiners (using chosen sample) who correctly evaluated three polygon operations, two polygon operations and only one polygon operation, and correctly evaluated each polygon operation – individually.

Also, for all candidate for examiners who have not correctly evaluated some of the polygon operations (in accordance with the described manner of passing practical part of the exam for examiners and the manner of evaluation of polygon operations (Point 3), the 3 variables have been analyzed:

- If a candidate for examiner knows how to recognize the mistake (by circling one of the offered responses);
- If a candidate for examiner knows how to describe a mistake made by a candidate for a driver from video clip, i.e. if they know to explain what was wrong during operating on a polygon and
- If a candidate for examiner knows how to rate a candidate for driver correctly in accordance with the Rulebook.

Analyzed polygon operations are:

1) Driving forward with the change of gear and backward with the change of traffic line (Polygon operation 1)
2) Parking the vehicle horizontally, by driving reverse (Polygon operation 2)
3) Parking the vehicle under right angle, driving backwards (Polygon operation 3)

Performing each polygon operation has been defined by the Article 16 of the Rulebook, in the following manner:

Polygon operation 1 is performed in accordance with the situation from the Figure 2. A candidate for a driver from the starting field „I", speeds up a vehicle with the change of shift of gear and stops in stopping field „II", while horizontal projection of horizontal most elongated of front of the vehicle on the surface has to be in that field. From that position the vehicle moves backwards with the change of traffic line, passing thru the passing field.

„III" and by repeated change of traffic line is returned to the starting field „I", while whole vehicle stops in that field. While moving of the vehicle backwards, a candidate for driver uses driving mirrors, i.e. looks over shoulders/ while moving backwards from the stopping field „II" to the starting field „I" the vehicle can stop not more than 2 times and make one step of correction (one step of correction is vehicle moving opposite to given direction).

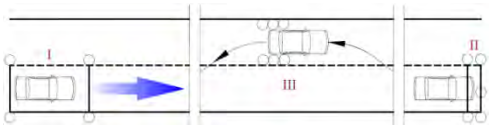

Figure 2. Polygon Operation 1 (Rulebook, 2012)

Polygon operation 2, is performed in accordance with the situation as shown in the figure 3. A candidate for driver starts by vehicle from the position „1" and moves moving forward in a straight line to the position „2", from where by one step backwards and not more than one step forward, stops the vehicle on a parking spot, while whole vehicle has to be in the field of parking spot.

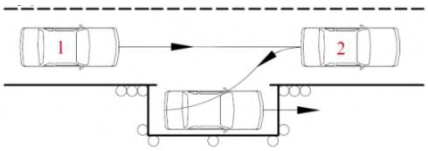

Figure 3. Polygon Operation 2 (Rulebook, 2012)

Polygon operation 3, is performed in accordance with the situation as shown in the figure 4. A candidate for driver moves by vehicle from the position „1" moving forward to the position „2", and occupies it in the manner that enables it to stop the vehicle at parking spot by moving backwards, while whole vehicle has to be in the field of parking spot.

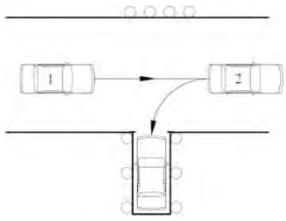

Figure 4. Polygon Operation 3 (Rulebook, 2012)

Also, the Rulebook defines that Polygon Operations 1 a candidate for driver performs in one attempt, while Polygon Operations 2 and 3 can be performed in not more than two attempts.

2.2 Theoretical Model of E-Learning based on Errors/Mistakes

In order for us to understand how technology, such as multimedia, can improve learning, we have to think of 5 principles of multimedia design of teaching instructions (Mayer, R. E. (1997), as follows:

1. Principle of multiple representation: it is better to represent the explanation in words and pictures than only words.

2. Principle of union: when providing multimedia explanation, it is better to represent relevant words and picture together, than separately.

3. Principle of divided attention: when providing multimedia explanation it is better to represent words as sound narration than only visually, as text on screen.

4. Principle of individual differentiations: mentioned principles are more important for students with less knowledge, as well as for students who orientate themselves better in the space.

5. Principle of coherency: when providing multimedia explanation it is better to use less, than a lot of unnecessary and redundant words and pictures. Wising to influence the examiners and their cognitive processes, these principles are applied in the preparation of the material for seminar aimed for the targeted group.

Former training model has been based on theoretical basis which have been supported by different rulebooks on passing the exams for examiners. Individual evaluation of canidate represents the essence which each candidate will recognize in themsleves, and these are the errors themselves know they make. The model will simply show to a candidate almost all errors created by this targeted error.

At the same time, the erros will show the weakness of training.

The model is based on strong database of noticed and frequent mistakes, made both by the examiners during evaluations and candidates themselves. .

The model in the structure represents the following steps which will be shown by an algorithm :

1. Candidate training
2. Exam – video clips review ta the practical part of exam.
3. Recording the mistakes/errors, both at candidates and examiners
4. Mistakes database
5. Comparative analysis of mistakes
6. Candidate selection
7. Creating simulated video material with showing mistakes in the operation/process
8. Virtual classroom with new simulated video material
9. Discussion / analysis of noticed mistakes by candidates – participants of virtual classroom
10. Repeating the exam from the Point 2.
11. Analysis of success

The Figure No.5. shows the algorithm of a model of e-learning based on mistakes.

ISBN: 978-989-8533-88-3 © 2019

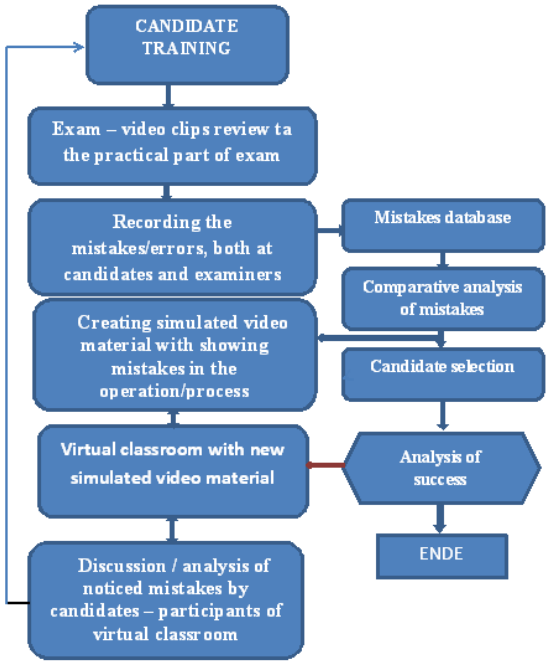

Figure 5. Algorithm of a model of e-learning based on mistakes

3. RESULT AND DISCUSSION

Out of 178 candidates for examiners, 6% (11 candidates) has not correctly evaluated any of analyzed polygon operations, while 84% of them correctly evaluated one, i.e. two polygon operations. All three polygon operations have correctly been evaluated by only 10% of candidates for examiners.

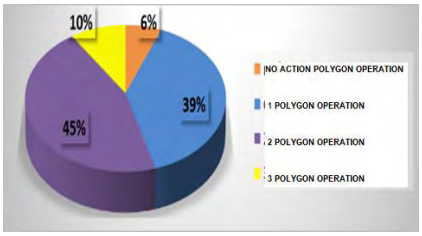

Figure 6. Percentage of No of Candidates for Examiners Who Correctly Evaluated Analyzed Polygon Operations

Polygon Operation 1 has been correctly, i.e. incorrectly, evaluated by almost equal number of candidates for examiners, and at the evaluation of Polygon Operation 2 and Polygon Operation 3 the percentage is significantly different. To be more precise, the largest number of candidates for examiners (87%) has correctly evaluated Polygon Operation 2, whole only 20% of candidates for examiners correctly evaluated Polygon Operation 3, i.e. 80% of candidates for examiners incorrectly evaluated this polygon operation.

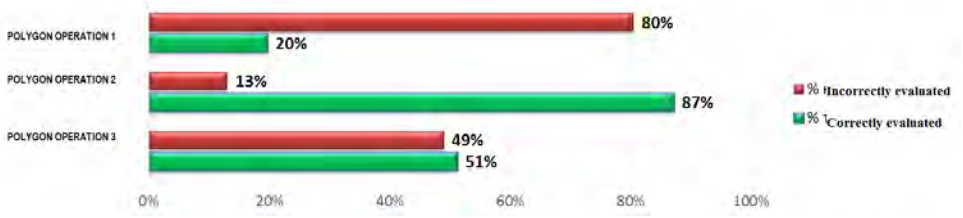

Figure 7. Percentage of Results of Evaluation of Polygon Operations

Polygon Operation 1

Out of 87 candidates for examiner who incorrectly evaluated Polygon Operation 1, the highest percentage of them (44%) knew to recognize the mistake made by a candidate for driver on video clip and knew how to correctly evaluate, but they provided bad explanation, i.e. did not know to precisely explain what kind of mistake a candidate for driver made. This can have as a consequence that the candidates for drivers may get from the examiners at their first real practical exam not so precise explanation of the mistake they have made.

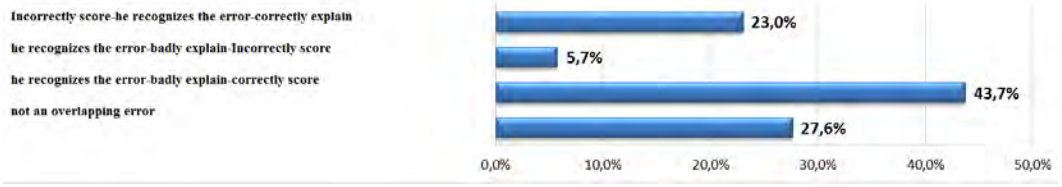

Figure 8. Graph Showing Analyzed Mistakes after Evaluation of Polygon Operation 1

Almost one quarter of candidates for examiners who incorrectly evaluated this polygon operation do not know how to correctly rate recognized and well explained mistake. To be more precise, 23% of candidates for examiners does not know that the step of correction when performing the Polygon Operation 1 is allowed and that for it a candidate for driver does not get negative points. This can also directly influence to the result of practical exam of a candidate for driver, i.e. candidates can be damaged, because it is not rae that they get from the examiners negative point for allowed step of correction. The fact a candidate for driver at video clip made polygon operation 1 correctly with one step of correction was not recognized by 28% of candidates for examiners, i.e. the responses have been that the candidate performed the operation incorrectly in some case without, and in some cases with the step of correction. .

Polygon Operation 2

Out of 23 candidates for examiners who incorrectly evaluated Polygon Operation 2, the highest percentage of them (875) did not know that a candidate for driver performed this polygon operation correctly from the first attempt. The situation some of the candidates for examiners think of as the mistake and negatively rate it is the one in which a candidate for driver, while vehicle is moving backwards and by wheel it “steps” broken center line on the polygon and after entering in the marked field of parking spot, moves the vehicle by moving forward (which is allowed by the Rulebook), after which the vehicle is stopped inside the marked field of parking spot.By this evaluation, a candidate for driver on practical part of the exam can be damaged because they can get negative point for correctly performed polygon operation.

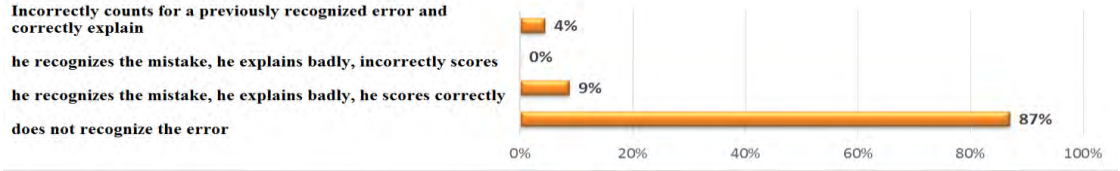

Figure 9. Graph Showing Analyzed Mistakes in Evaluation of Polygon Operation 2

Polygon Operation 3

Out of 143 candidates for examiner who incorrectly evaluated Polygon Operation 3, only two candidates for examiner knew to recognize that the candidate for driver on video clip incorrectly made this polygon operation. To be more precise, 141 candidate for examiner (99%) could not recognize that the candidate for driver at their first attempt used not-allowed step of correction while performing this polygon operation and that there was no another second attempt. The response provided by them was that the candidate for driver performed Polygon Operation 3 correctly from the second attempt, i.e. not-allowed step of correction they considered to be the second attempt. A candidate for driver did not go back to the starting position when performing this operation (Figure 9 - position „1“), and tried the second time, but they performed not-allowed step of correction. When they saw that from the first attempt the vehicle could not be parked under right angle from the first attempt in the field of marked parking spot, i.e. that they will hit the cones which were marking a parking spot, a candidate has, by moving forward, moved the vehicle only to the position which enabled them to try again by moving vehicle backwards and park the vehicle in the field of marked parking spot.

4. CONCLUSION

By the application of this model the examiner will understand in which manner they will recognize and explain a mistake made by a candidate. Created database of recognized, frequent mistakes leads to perfect knowledge of examiner. The application of this model on the candidate themselves is of great importance. The continuity of updating of mistakes and updating video material in the application will result in minimal conditions for errors/mistakes creation. With the help of all of the above mentioned, we enable to a candidate to virtually recognize the mistakes that emerge in traffic situation. The analysis and discussion of participant of virtual classroom will make the concept of examiners' self-confidence stronger. The model has been shown in this work as the concept, both graphically and descriptively. The innovative approach of represented model mirrors in unique form of several steps which gradually make the participant of the course being independent in their mastering over presented knowledge and skills. Key point in the application of model have the development of learning material, the activities which encourage explorative approach, the motivation, monitoring participants work and progress and the communication between participants and moderator. The materials for learning should gradually be transferred from complete information to starting information demanding further exploring. The testing of knowledge should be continued thru the application of knowledge in practice. It is necessary to elaborate proposed experimental research model by theoretical and practical applications from the aspect of knowledge management. This system uses a model for misconception detection and identification (MDI) and an inference system for the dynamic delivery of the learning objects tailored to learners' needs.More specifically, the MDI mechanism incorporates the Fuzzy String Searching and The String Interpreting Resemblance algorithms in order to reason between possible learners' misconceptions. Furthermore, the inference system utilizes the knowledge inference relationship between the learning objects and creates a personalized learning environment for each student (Troussas C.,Chrysafiadi K., Virvou M., (2019). Tools for learning analytics are becoming essential features of Learning Management Systems (LMS) and various course delivery platforms. These tools collect data from online learning platforms, analyze the collected data, and present the extracted information in a visually appealing manner. Representing the design-level concerns of such tools is one of the significant challenges faced by software developers. One way of overcoming this challenge is to adopt architectural perspectives which is a mechanism used by software architects to capture high-level design concerns (Arvind W. Kiwelekar, (2019).

REFERENCES

Alimpić, Z., Bogićević, S., Dragutinović-J., N., (2013). *Licensing of personnel for training candidates for drivers in the Republic of Serbia.* Road Traffic Safety Agency, Republic of Serbia

Kiwelekar A., LaddhaLaxman M., NetakSanil Gandhi (2009). *An Architectural Perspective of Learning Analytics,* Machine Learning Paradigms pp 115-130

Law on Road Traffic Safety (2009), *Official Gazette of the Republic of Serbia*, no. 41/09, 53/10, 101/11.

Mayer, R. E. (1997). Multimedia learning: Are we asking the right questions. Educational Psychologist, 32, 1-19.

Mayer, R. E. & Anderson, R. B. (1992). *The instructive animation: Helping students build connections between words and pictures in multimedia learning.* Journal of Educational Psychology, 84, 444-452.

Ordinance on the organization, implementation and manner of taking the driver's exam, keeping and the deadlines for keeping records of the driving test and the conditions to be met by the vehicle in which the driving test is conducted (2012), Official Gazette of the Republic of Serbia, no. 53/12, 93/13, 116/13 and 108/14.

Rules on the program for taking the exam for the examiner, the program and deadlines for the seminar, the manner of taking the professional exam and the examination of the knowledge test and the appearance and content of the license form for the examiner (2012), Official Gazette of the Republic of Serbia no. 21/12.

Rulebook on conducting exams, organizing seminars for improving knowledge and keeping a registry of issued permits (licenses) for examiners (2012), Official Gazette of the Republic of Serbia no. 53/12.

Troussas C., Chrysafiadi K., Virvou M., (2019, *An intelligent adaptive fuzzy-based inference system for computer-assisted language learning,* Expert Systems with Applications, vol 127, pp.85-96