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An assessment of traffic education and its examination system—an extended House of Quality approach

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The goal of this article is to examine traffic education and its examination system, using a new approach based on the House of Quality method. While every country has its own legal rules and requirements regarding how traffic education and examinations are conducted, there is a direct relationship between traffic education, its examination system and road safety. Therefore the quality of such a complicated process is of great interest for both stakeholders: the authorities and the citizens. These stakeholders both have their own objectives regarding the system, consequently increasing its complexity. This article investigates, as its case study, the system in Hungary. The House of Quality method has been expanded to provide a unique approach to examine the goals and objectives of both stakeholders, revealing similarities and differences and their interrelationships. Secondary data on the effectiveness of the traffic education and examination system are also analysed. Based on the HOQ model representations of the goals and objectives of the stakeholders regarding the traffic education and exam system, it can be established that the stakeholder points of view are closer to each other in the case of the test system than that of the education system. However, there are unsolved contradictions between the stakeholders that have to be handled, as opinions regarding the quality of the service and the criteria of the stakeholders' satisfaction are very diverse.

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Introduction

The late 1970s and early 1980s saw a change in administrative concepts in some Anglo-Saxon countries in order to rationalize public expenditure. In addition to the principles of economy, efficiency and effectiveness, new forms of state organization and new techniques of public administration were introduced. New Public Management (NPM) (Dunleavy et al. 2006; Frederickson, 1996; Hood and Peters 2004) was built on the efficiency-oriented business model of the private sector. Guiding values include consumer focus, competition between public service providers for consumer decision-making, the need for performance management in public service organizations, and a focus on service and results driven by consumer satisfaction (Hood and Peters 2004; Kolnhofer-Derecskei et al. 2019).

This article focuses on the Hungarian traffic education and examination system as a case study, using a new approach based on the House of Quality method. The statistical data and the case study refer to Hungary, but the situation is very similar in the case of other Eastern European countries, so it can be generalized for this region. In Eastern European countries, the traffic education and test systems are usually regulated by the state and centralized under a single governmental agency. The research of Talamini et al. (2020) “shows that drivers trained with rules enforcement are willing to reduce their efficiency in exchange for being compliant to the rules, thus leading to higher overall safety” (Talamini et al. 2020. 1.p.) The complexity of the analysis stems from the fact that there are two separate stakeholders in the system, citizens and government. However, they have their own goals, objectives, desires and perceptions of the system. As a result, the House of Quality method provides a perspective that is unique in its approach to examining these goals and objectives both separately and together, exploring their similarities, differences and inter-relationships (Pollitt and Bouckaert 2011; Prusty et al. 2017).

As digitalization becomes ever more important in the field of public service and e-governmental solutions emerge, many things need to be redesigned and methodologies modified. The House of Quality analysis can provide insight into the characteristics of the stakeholders which is indispensable in the reformulation of these processes in the future (Jeong 2007).

The research gap this paper would like to address is as follows: education and technologies involve several stakeholders, citizens and government. These stakeholders have different expectations hence the importance of discovering where the two parties concur regarding traffic education and the testing systems so that the right service can be developed. According to Akple et al “based on the findings, the research further posits that the National Road Safety Commission (NRSC) and road regulatory authorities should give more attention to signs that drivers poorly recognized and comprehended” (Akple et al. 2020, p. 1306) This research aims to identify the expectations of the stakeholders and propose a service quality that is acceptable to both sides. It focuses on the e-governmental solutions connected to the education and testing system of traffic rules, which is needed to obtain a driving licence and for the government to ensure road safety. Understanding and encouraging compliance with traffic rules would be a better solution than the impact of a deterrent approach (Varet et al. 2021). In the first part of this article, the theoretical background of traffic rules, e-government and House of Quality are discussed, then the research approach and model are explained. In the second part of the article, the statistical data regarding traffic education, examination and road safety is analysed. In the third part of the article, the Houses of Quality of both stakeholders are presented, regarding goals and objectives, then combined to show how they connect.

As every country has its own legal rules and requirements regarding traffic education and its examination system, the

following section will first briefly present the systems of three countries (USA, Germany and Australia). These systems partially differ from the Hungarian system examined later in the paper. In the United States, traffic education and examination systems are generally managed at a state level, meaning that each state has its own set of guidelines and procedures. According to the Governors Highway Safety Association, most states require new drivers to complete a driver’s education course, either in a classroom or online, where they learn the basics of driving, road signs, and traffic laws. After completing the educational component, aspiring drivers must pass a written test to obtain a learner’s permit, which allows them to practice driving under certain restrictions. The Department of Motor Vehicles (DMV) states that following a period of supervised driving practice, usually with a licenced adult, the individual must then pass a road test to demonstrate their driving skills. Upon successful completion of the road test, the individual is granted a full, unrestricted driver’s licence, although some states have graduated licensing systems that impose certain limitations on new drivers, as noted by the Insurance Institute for Highway Safety.

In Germany, the process of obtaining a driver’s licence is highly regulated and involves multiple steps. According to the German Federal Motor Transport Authority, aspiring drivers must first enroll in a certified driving school where they undergo theoretical and practical training. The theoretical part includes lessons on traffic rules, signs, and regulations, and is concluded with a written examination. According to the ADAC, Germany’s largest automobile club, after passing the written test, learners proceed to the practical driving lessons, which culminate in a practical driving test. Upon successful completion of both the theoretical and practical tests, the individual is granted a driver’s licence, which is initially probationary for new drivers under the age of 21, as stated by the German Road Safety Council.

In Australia, the process for obtaining a driver’s licence varies by state and territory, but there are some common elements. According to the Australian Government Department of Infrastructure, Transport, Regional Development and Communications, each jurisdiction has its own system for driver education and testing. Typically, new drivers must first obtain a learner’s permit by passing a written test on road rules, as noted by the New South Wales Roads and Maritime Services. After a period of supervised driving practice, learners can then take a practical driving test to move on to a provisional licence, as stated by VicRoads in Victoria. The provisional licence has restrictions, such as zero alcohol limits, and after a set period and age, drivers can apply for a full, unrestricted licence, according to the Queensland Department of Transport and Main Roads.

In order to identify and evaluate previous research in the field of traffic education and examination a systematic literature review (SLR) (Denyer and Tranfield 2009) was conducted using the Scopus database. For the first screening, the search terms Traffic and Rules were used and a total of 17,002 publications were found in the database. After that, the word Education was entered among the keywords, so the search was narrowed down to the search terms Traffic AND Rules AND Education. Thus, a total of 408 publications were found. From this, the scientific journal articles (Article) were filtered out, resulting in a total of 272 publications in the database. Since the researched topic mostly focuses on the field of Social Sciences, adding this filter produced a total of 96 publications. Finally, articles between 2000–2023 were selected, based on the assumption that publications older than this would be outdated due to the lack of technological background in the e-learning education topic. As a result, a total of 87 relevant articles were found, of which 37 were excluded as their subject matter took a different approach to the topic of this

article. The excluded articles were mostly on Covid, historical overview, agricultural science, or other social problems (poverty, migration).

After this screening 51 articles remained, which were classified into different categories based on their topic: 38 were placed in the (1) Safety category, of which 27 were related to technological or driving technique tests and another 6 were related to driving under the influence of alcohol, drugs or medication. Finally, 5 were related to the development of traffic conditions. A total of 13 articles belong to the topic of (2) educational development, of which one specifically deals with gaming-type education, one with regulation, and 11 with general development opportunities, the latter being directly related to the present research.

Shaaban (2021) assessed the knowledge of drivers of traffic law, fines and different driving situations analysing several variables such as driving experience. Naz and Scott-Parker (2016) investigated the obstacles experienced by parents in staying involved and engaged in their child's driver's licence process. In the study of Obregón-Biosca et al. (2018) an analytical method was proposed to measure the level of awareness that public transport infrastructure users have regarding safe transport practices. Caragata (2007) used a survey to measure the results of a driving education program for the elderly, while Kolarov (2009) aimed to modernize the professional capabilities of driving and traffic safety teachers. Elsayed et al. (2021) aspired to reveal the relative contribution of social factors to the compliance of university students with traffic rules, Benincasa (2015) investigated traffic rules and regulations teaching, while Akpe et al. (2020) studied traffic signs familiarity and comprehensibility among drivers. Rodwell et al. (2021) examined the parents' view on traffic education processes using the Goals for Driver Education (GDE) Framework. while Osarenren et al. (2019) investigated the perception of commercial drivers on Federal Road Safety Commission (FRSC) education and compliance with road traffic rules and regulations.

After the SLR, it is important to mention that the government (as a regulatory body) plays a significant role in the development of traffic education and exams, an important tool of which is digitalization and e-government solutions as well as process and service development solutions, such as the House of Quality (HoQ). These two areas are covered below.

Emergence of E-Government. Three main pillars of public governance models are distinguished. The first one is the traditional public administration model (the Weberian public administration), the second one is the managerial or market model (New Public Management, NPM) and the third one is the Governance and Hybrid model (Neo-Weberian State, NWS) (Aristovnik et al. 2022). The NWS emerged alongside NPM at the beginning of the 21st century (Byrkjeflot et al. 2018; Frederickson 1996; Stark 2002; Olewnik and Lewis 2008). The concept of a "small/minimal state" is promoted by the NPM, while the NWS promotes the concept of a strong state. NWS seeks to strengthen the state and public administration by restoring regulation and moral values (Olewnik and Lewis 2008).

The adoption of new technologies in the public sector is a major challenge for the organizations concerned. E-Government aims to improve the functioning of the government through the use of information and communication technologies. To this end, the focus is on transforming internal and external relationships through the use of technology, the Internet and the media, in order to optimize service delivery, citizen participation and government operations (Machta 1999). The adoption and use of e-government services in developing countries is currently a major challenge. The digital divide, poor e-government services

and lack of access to technology pose critical problems in this area (Joshi and Islam 2018). According to Jun and Ware (2011), E-Government is a set of technological tools and services that can be widely deployed in public sector organizations. However, even though the creation of such structures often requires a great deal of effort and the results may be uncertain, the progress achieved can be significant. Although not an easily achievable task, the benefits of more effective service delivery, stronger internal governance and better policy communication may make it worthwhile (Jeong 2007).

Information technology can play a key role in transforming governance systems, and its particular importance is in supporting and integrating current bureaucratic changes in the way citizens interact with other service users. The impact of information technology is not limited to the technological sphere, but also has a broad impact in the cognitive, behavioural, organizational, political and cultural spheres. In this new paradigm, known as digital age governance, new ideas and reform changes form a new coherent whole (Dunleavy et al. 2006).

House of Quality concept. The concept of HOQ (House of Quality) is a decision-making tool for planning and development, that enables the identification and translation of customer needs into requirements, thus facilitating the systematic evaluation of products and services to determine whether they meet consumer needs (Adiandari et al. 2020; Akao 1990; Alinizzi et al. 2020).

According to Yamamoto et al. (2005) the HOQ methodology originates from Japan as a methodology to improve product quality implemented in the car production business. Since its creation in Japan, the HOQ methodology is a widely used tool in marketing, planning, product design and engineering, production process development, production, etc. It gained even more attention after its introduction in the United States (Wu and Ho 2015), making its usage compulsory for automotive parts suppliers in QS 9000.

The literature suggests that quality houses are used in many areas. For example, Tang and Dinçer (2019) evaluate sustainable energy investments based on quality houses. Another area of application could be hospital management: Chen et al. (2015) innovatively combine the House of Quality (HoQ) measure model with a Synergy Entropy computing concept to offer a multi-level hospital management Synergy Entropy-House of Quality (HoQ) Measurement Model.

The House of Quality (Fig. 1) provides comprehensive information on customer needs and how these needs can be translated into design specifications. According to Alinizzi et al. (2020) the House of Quality helps to find answers to the following questions:

- What should be done related to customer requirements?
- How can customer requirements be related to the product requirements?
- What is the relationship between product requirements and the desired benchmarks?

The quality house itself consists of two main parts, the input from customers, i.e. the definition of customer needs (1) and the planning matrix (2). The next part is the technical requirements (3), which respond to the input from customers, followed by the customer needs context matrix (4). Companies must respond to customer needs; these are at the top of the matrix. (Chou 2020). After that the design targets can be realized (6). In this study, an extended version was used (Figs. 4, 6, 8, 10) of the basic HOQ. In the extended HOQ, correlation can be negative, positive or no correlation. The value of the relationship can be negative, neutral or positive.

Materials and methods

The methodology section of this paper first discusses the effectiveness of the traffic education and examination system based on the data of the Hungarian Central Statistical Office. Subsequently, the results of the primary research will show the stakeholder’s objectives and goals regarding traffic education and its examination system. Several conclusions can be drawn from the response given by the examinee during the test; this phenomenon shows one aspect of the anomalies in question. Figure 2 summarizes what factors influence the success or failure of the driving theory test. In the case of questions that are relatively / often mistaken, we can conclude either the wrong questioning or the wrong regulation. If the questioning is wrong, then two scenarios are possible: either the wording of the question is bad or the wording of the question is good, but the necessary knowledge is difficult to acquire. If it is a case of bad regulation, it needs to be changed.

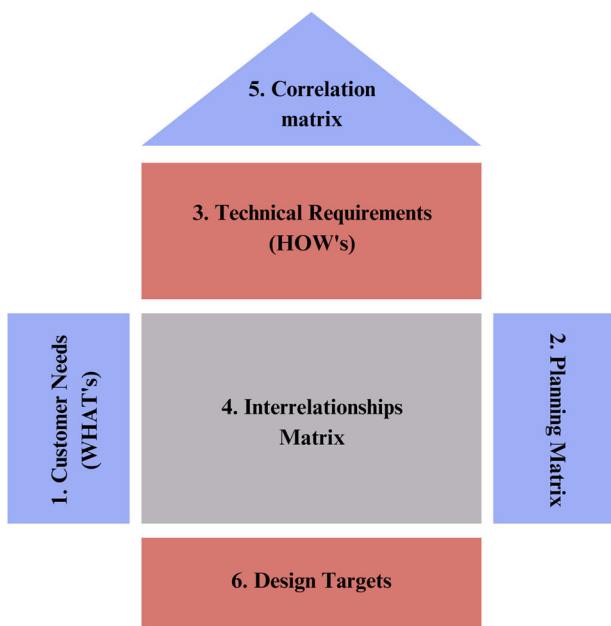


Fig. 1 House of Quality (Authors’ own creation).

From a success factor perspective, time is a key factor in the relatively often / often well-answered exam questions. If the candidate is able to answer quickly (and correctly), no action is required. However, if the candidate answers the question correctly but slowly, then either the wording of the question is bad or the wording is good, but it is difficult to acquire the necessary knowledge. Thus, there may be several triggers for the same response from the examinee. Therefore, it is justified to explore the topic in more detail and more depth, in order to be able to make appropriate changes.

Based on the above, the phenomenon of “information entropy” arises: “information entropy can be understood as the degree of uncertainty measured by the information necessary to eliminate it” (Ben-Naim 2019; Lindquist and Paquet 2000). It is in the candidate’s interest to learn the e-learning educational material to obtain enough information (neither more nor less than what they need) to pass the exam. This largely depends on the magnitude of the unknown (information entropy) of the questions to be answered during the exam. Machta (1999) explains in his study if the given event does not occur (i.e. the candidate does not get a question they would not be able to answer, the probability is 0) or the event that will definitely happen (i.e. the candidate gets a question that they can answer, the probability is 1), then the events that occur do not provide information. So, in this case, the “ideal state” outlined at the beginning of the study occurs (Ben-Naim 2019; Lindquist and Paquet 2000).

However, reality is seldom like this. In this study, the issue of information entropy is not discussed in further depth, but note that in the future it may be worth exploring further contexts of entropy, considering the issue of redundancy (signals do not carry information, can also be called expansiveness), which Machta (1999) says is often useful and necessary.

The Authors hypothesize that the use of information entropy would reveal further correlations between the uncertainties that arise between the curriculum and the exam. In the present study, the Authors are content with statistical analyses related to the e-learning and examination system (Fig. 3).

In conclusion, the interests of the clients and the government only partially overlap regarding driving licences. Customers aim to obtain a driving licence to avoid being penalized when driving a vehicle without one. The purpose of the government is for the citizen to have a driving licence. The driving licence assures the government that the driver has mastered the highway code. The subjects of this study are two stakeholders (citizens and

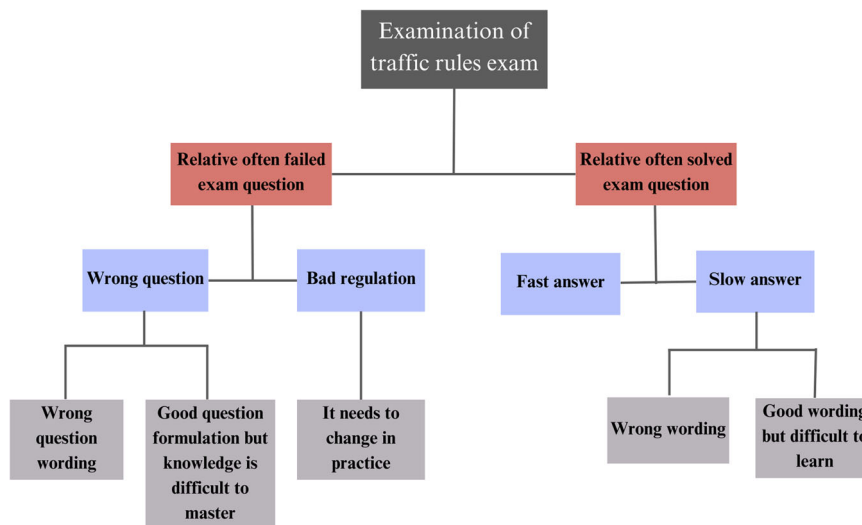


Fig. 2 Examination of traffic rule exam (Authors’ own creation).

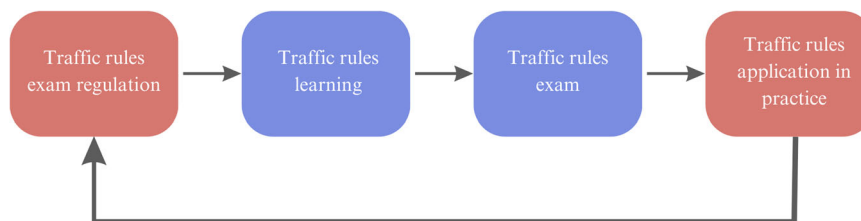


Fig. 3 Process of the traffic rules learning (Authors' own creation).

government) and two systems (e-learning system for learning traffic rules and the traffic exam). In this model, a HOQ is created from the interpretable sections, and then combined to reveal the similarities and anomalies to outline a “perfect” solution.

In order to prepare houses of quality, in-depth interview research and focus group research were conducted. The qualitative research (focus group and in-depth interview) was organized for both stakeholders (citizens and government). Since no similar research was available on the subject of traffic education and its examination system, the goals and objectives examined in the quality house were determined based on the results of the focus group research. Subsequently, the types of correlations between goals and objectives were summarized based on the results of the in-depth interviews.

In the case of focus group interviews, 2 homogenous and one mixed focus group were organized. 7–11 people participated in the focus group interviews. In the homogeneous focus group interviews, people working in government administration in the field of traffic examination and education were included. Citizens who used the traffic education and examination system within one year were included in the other homogeneous focus group research. The research was conducted in the Western Hungary region, with both stakeholders coming from this region. In the mixed focus group interview, participants from both types of stakeholders were included, to enable comparison of different opinions and identification of suspected anomalies. The preparation of the focus group interviews lasted from February 2020 to April 2020, after which the received data was analysed and used to create the goals and objectives of the houses of quality.

In the in-depth interview research, the respondents were asked (citizen and government) to define the relationships between the goals and objectives of the quality houses: there is a relationship, there is no relationship, there is a neutral relationship. Each stakeholder was asked about their own quality house. The obtained results were summarized according to the opinion of the majority regarding the investigated relationships. After that, the results obtained in the quality houses were analysed. The in-depth interview research was conducted between June 2020 and July 2020, involving 9 citizens and 6 government employees. The Hungarian Central Statistical Office data was downloaded from the KSH database in January 2020.

Drivers market analysis in Hungary. The first condition for obtaining a driving licence is reaching the age of 17, therefore the age distribution of the Hungarian population from this age was examined. The oldest holders of driving licences are in the over-80 age group. Outstanding values are found in the 40–50 to 60–70 age groups. Presumably, these age groups have the highest proportion of driving licence holders.

Based on KSH (the Hungarian Central Statistical Office) data the distribution of members of Generation Z by number is as follows: The 25-year-old age group has the most members with 122,605 people, whilst the 17-year-old age group has the fewest

with 97,442 people. Thus, the number of driving licences will presumably decrease in the future as the number of Generation Z members also shows a declining trend.

For the total population, the number of those who do not complete the first year of primary school is the highest in the over-75 age group at 8527, while the lowest is in the 15–19 age group at 1651.

Population by education. To obtain a driving licence, eight completed primary school years of education are required. In the KSH database the number of people with at least eight primary years of education is the highest in the 35–39 age group (803380 people) and the lowest in the 70–74 age group (384177 people). From the point of view of the study, the question arises: is there a correlation between the length of time taken to complete primary school, mandatory to obtain a driving licence, and the success of the exam? In the present study, this question is only raised, and in a further research it will be examined in more detail.

The number of people with at least a high school diploma was the highest in the 30–34 age group (463832 people) and the lowest in the 18–19 age group (98 753 people), although in the latter case only two years were examined.

The number of people with a university or college degree is the highest in the 30–34 age group (214,124 people) and the lowest in the 70–74 age group (50,159 people).

In the following, the topic is narrowed down to the examination of data related to the education of those Generation Z members of the 15–19 age group who are over 17. 1651 people did not complete the first year of primary school, whilst the largest number of people completed eight grades (570580 people) and 98753 people have a high school diploma.

Among the possible educational qualifications of the 25–29 age group, a college or university degree (171113 people) is readily available. Obtaining a first degree is most typical for this age group. The number of those who did not complete the first year of primary school was 2819, while 407057 people had a high school diploma, and most of them (601180 people) completed eight years of primary school.

The traffic education and examination system in Hungary. This chapter presents the statistical analysis of traffic education, the theory test and safety. One of the world's most pressing social issues is the high rate of road accidents. Accidents happen for various reasons, such as mechanical or technical failure, drunk driving or other health problems. Additionally, many accidents occur due to driver inattention, and most are caused by the interaction between pedestrians and drivers.

Increased road safety training and awareness are believed to reduce accidents. According to the Authors' opinion, in Central and Eastern European countries, positive benefits could only be achieved through regular instruction and discipline, so great emphasis must be placed on education and enforcement of traffic rules.

The working hypotheses are as follows:

- If someone knows the highway code, they will not cause an accident.
- The state must be able to prove it protects those who know the traffic rules.
- The driving licence is important to both stakeholders but in different ways.
- If everyone sticks to the rules, then there are fewer accidents (except for those due to natural disasters and technical failure).

Students can choose between two forms of traffic rule education: attendance or e-learning education. In this study, the latter was examined. The e-learning system used for learning is structured on a module-by-module basis, with a set time frame for students to master the curriculum and pass a test. At the end of each module, there are checklist questions, and after learning the full curriculum, the student must complete a full set of questions. Having completed the practice questions, the theory exam can be taken in person on a computer at the test centre.

During the learning process, the student prepares for the exam completely independently. If the exam is failed, the student can purchase an additional time frame for learning. Successful completion of the test does not guarantee that the student will pass the exam.

The distribution of successful and unsuccessful exams by number from 2017 to 2020 indicates that in each year there were more than 200000 exams conducted by the authorities from which more than 60% of the participants passed the exam. The age distribution shows that more than 60% of the participants were under 30 years old each year.

As explained earlier, a computer-based attendance exam is possible after a successful test. After passing the exam, the student can start practical driving. In the event of failing the exam, the student must pay for a retake. More than 70% of the participants pass the exam at first attempt while 20% of the participants pass it the second time and 5% pass it the third time. The rest of the participants need more than three attempts to pass the exam successfully (KSH).

From 2017 to 2020 an increasing number of students used the online form of education before taking the exam while only a small number of participants tried to pass the exam without formal education of the traffic rules.

In the following, the consequences of inadequate knowledge and application of road traffic rules are presented. This analysis aimed to assess the importance of education and examinations for the community as well. A large part of the traffic rules are clear and understandable for the general public. These include, but are not limited to, rules related to right of way, speed limits, reporting of traffic signs and zero tolerance. However, regarding the rule of choosing a relative speed or a speed appropriate to road and visual conditions, its application also depends to a large extent on the driver's subjective judgment. While offences in the first group are relatively clear, those in the second group are not. It can also cause anomalies during the acquisition, examination and application of traffic rules if the regulations are not clear. Hereinbelow, the article presents and analyses multi-objective, time-series data on road accidents. With this, the goal is to present the connections between education, exams and the application of traffic rules.

Results based on HOQ

In this research, two different Houses of the Quality models were used. The two stakeholders in this market were analysed: the learner driver (customer) and the traffic authorities. The goals

and objectives of both stakeholders are very different. The learner driver wishes to obtain a driving licence as easily as possible. The authorities want to enforce traffic rules.

Steps for building the House of Quality. In this study the HOQ model is used (Akao 1990; Alinizzi et al. 2020).

The following research questions were defined:

- What are the expectations of customers in connection with the driving licence examinations?
- What are the expectations of the authorities?
- What discrepancies can be identified between the two stakeholder groups?

The goal is to analyse the expectations of the two stakeholder groups, and identify discrepancies. For this reason, two HOQ models had to be built, one for the customers and one for the authorities.

Stakeholders. Two different goal groups were identified: the first is the customers, the second is the authorities. In this present research, Generation Z represents the range of customers. The Authors consider the generation-based approach to be justified as within generations, members are connected by cohort experiences in addition to age. How does Generation Z relate to obtaining a driving licence and owning a car? Some of the members of Generation Z (born between 1995 and 2010) are currently at an age when they can already have a driving licence and even own a car.

How motivated are they to obtain a driving licence or to work to buy their own car? It is well known that "Generation Y doesn't live to work either," and there are certainly members of Generation Z who cannot even imagine at the moment going into the office, to the same job every day. The question arises that if young people of Generation Z want a driving licence, what are their expectations regarding the online traffic exam? According to the literature, age and generational influences were clearly reflected in the transport habits and preferences studied (Bahadorestani et al. 2020; Jun and Weare 2011).

Customers' expectations weighting. In the HOQ model, the stakeholders—the customer and the authorities—represent two different poles of the phenomenon. Customer expectations were identified based on qualitative research. The primary source for the government proposals is the legal background. Government Decree 1/1975. (II. 5.) Joint Declaration on Road Traffic Rules—has been amended several times. Due to the introduction of new traffic signs, modifications have been made relatively frequently.

The intention of the legislator was to establish the most precise regulation possible for the changed traffic conditions. The downside of this approach is that prospective drivers need to learn 400–500 different traffic signs for the exam and apply them properly in practice.

Society expects the government to protect its physical integrity, while at the same time empowering the government to take action against irregularities (Government Decree 104/1997. (VI. 18.) and Government Decree 172/2014. (VII. 18.) in the National Legislation Database; Herke et al. 2020).

Road safety and integrity are important public interests. A prerequisite for safe and smooth transport is that traffic rules are kept by everyone alike. It is also necessary for transport participants to be responsive and tolerant with each other (Government Decree 2/1984. (I. 29.) and Government Decree 228/2012. (VIII. 23.) on the National Legislation Database).

According to the regulations, everyone who participates in road transport is obliged (Government Decree 289/2009. (XII.

18.) and Government Decree 447/2016. (XII. 16.) on the National Legislation Database)

- to comply with legal provisions relating to road traffic and the protection of the road and its environment.
- to comply with the provisions of traffic signs and the instructions of those entitled to direct and control traffic.
- to travel in such a way as not to endanger the safety of people and property or to unreasonably obstruct or disturb others.

The driver of the vehicle must not use a hand-held mobile phone while driving. The driver of a two- or three-wheeled vehicle that is not a car must not use a hand-held mobile while driving, including stopping for traffic reasons.

A person may drive a vehicle (Government Decree 104/1997. (VI. 18.) and Government Decree 289/2009. (XII. 18.) and Government Decree 5/2013. (I. 16.) on the National Legislation Database)

- with a valid driving licence specified by law,
- and is not prohibited from driving the vehicle,
- is in a position to drive safely,
- is not under the influence of a substance which impairs their ability to drive,
- and is not under the influence of alcohol from the consumption of alcoholic beverages.

The law also regulates the conditions for the participation of vehicles in transport specifying the need for a valid official authorization regarding type, licence plate, technical safety and environmental characteristics.

Requirements for design/product characteristics (HOW?). The evaluations shown in the HOQ model are based on focus group research for both target groups. According to Horváth et al. (2022), the HOQ can be used to compare the goals and objectives of citizens and government, emphasizing the positive and negative relationships between them. The methodology also provides an extensive statistical background analysis on the topic of road safety. As a planning and monitoring technique, it proposes a set of measures to assess the current relationships between stakeholders' goals and objectives and to assist in the design and development of these systems. The proposed criteria can help to parameterize the design elements. As we begin to tighten the framework, each of the criteria can be used to determine which elements need to be reconsidered or even excluded from the design to increase the effectiveness of the system for the benefit of both stakeholders. Using the HOQ, the goals of both stakeholders in education and testing were compared.

The results can be seen in Fig. 4, where the following notations were used to express whether there is a positive (+/●), negative (-/○) or neutral (0 / ▽) connection between the goals and objectives of the stakeholders and also between the objectives themselves.

Figure 4 represents the goals and objectives of drivers regarding the traffic rules education system. As we can see multiple goals and objectives are connected in a positive way (30) with each other and there are only a few negative (2) relationships. However, there are numerals neutral (24) connections where the goals and objectives are not directly linked to each other.

Figure 5 shows the frequency of the different connection types regarding citizen goals in traffic rule education. As we can see G2 (It should be quick) has the highest number (6) of positive connections, while G7 (Be up to date) has the highest number (6) of neutral connections. Citizens identified the speed of the service as a very important factor in terms of customer satisfaction;

however, being up to date is of no consequence from their perspective. The highest level (7) of positive connections is O1 (It should be easy to use any device). The highest level of neutral (7) connections is O6 (All citizens should receive state support).

Figure 6 represents the goals and objectives of the authorities regarding the traffic education system. In this case, there are fewer goals and objectives in general but almost all of them are connected either in a positive way (4), negative way (3) or in a neutral (2) way with each other.

In the case of government G3 (Minimizing education and maintenance cost) there are only negative connections towards the objectives. According to Fig. 8 government objectives regarding education have both negative and positive connections. Both have one negative (1) connection with the "Minimizing education and maintenance cost" goal, which clearly shows that service development can not be achieved without additional cost (Fig. 7).

Figure 8 represents the goals and objectives of citizens regarding the traffic examination system. As we can see multiple goals and objectives are connected in a positive way (13), and a neutral way (7) with each other. There are no negative (0) relationships.

As we can see on Fig. 9 G2 goal (Use simple and clear example) has only neutral connections which means that the examination is important for prospective drivers, but the connected objectives do not serve this purpose actively. The results of the examinee's objectives regarding the test show that their opinion is more or less the same. It seems that they were not able to clearly identify the necessary objectives to improve the examination system.

Figure 10 represents the goals and objectives of the government regarding the traffic rules examination system. In this case, there are almost the same number of goals and objectives but several of them have positive (6), neutral (6) and negative (4) connections.

As we can see in Fig. 11 G3 (Automation of the entire examination system) and G4 (Maintaining the current course of the examination system) are conflicting. It means that the authorities want to achieve the improvement of the service without any meaningful changes.

As we can also see in Fig. 11 O2 (Collect as many fees as possible from participants), O3 (The examination points should remain in the current form) and O4 (The need for human resources should remain in the process) government objectives regarding examination were equally neutral, while O1 has a positive connection towards the goals.

Discussion

At the current stage of this study, it can be said that the HOQ method is suitable for performing comparative studies. The HOQ model was selected because through this approach based on the input of the stakeholders, the current conditions of a given service can be mapped and a more ideal future version can be designed. However, it can also be seen that further research is needed to improve the quality of the process.

According to the house of quality comparison, there are several major points where the goals and objectives of the two stakeholders are in zero or negative connection with each other. This would require further analysis in the future.

It is questionable how the interests and goals of citizens and the government in relation to road safety can be reconciled. For example, in Serbia the leading causes of death among young people are drunk driving, speeding, drug use, and aggressive driving (Pešić et al. 2022). Is it possible to create a system in which both stakeholders are satisfied, and at the same time traffic safety is not compromised, but rather improved? The topic of traffic education and its examination seems especially pertinent

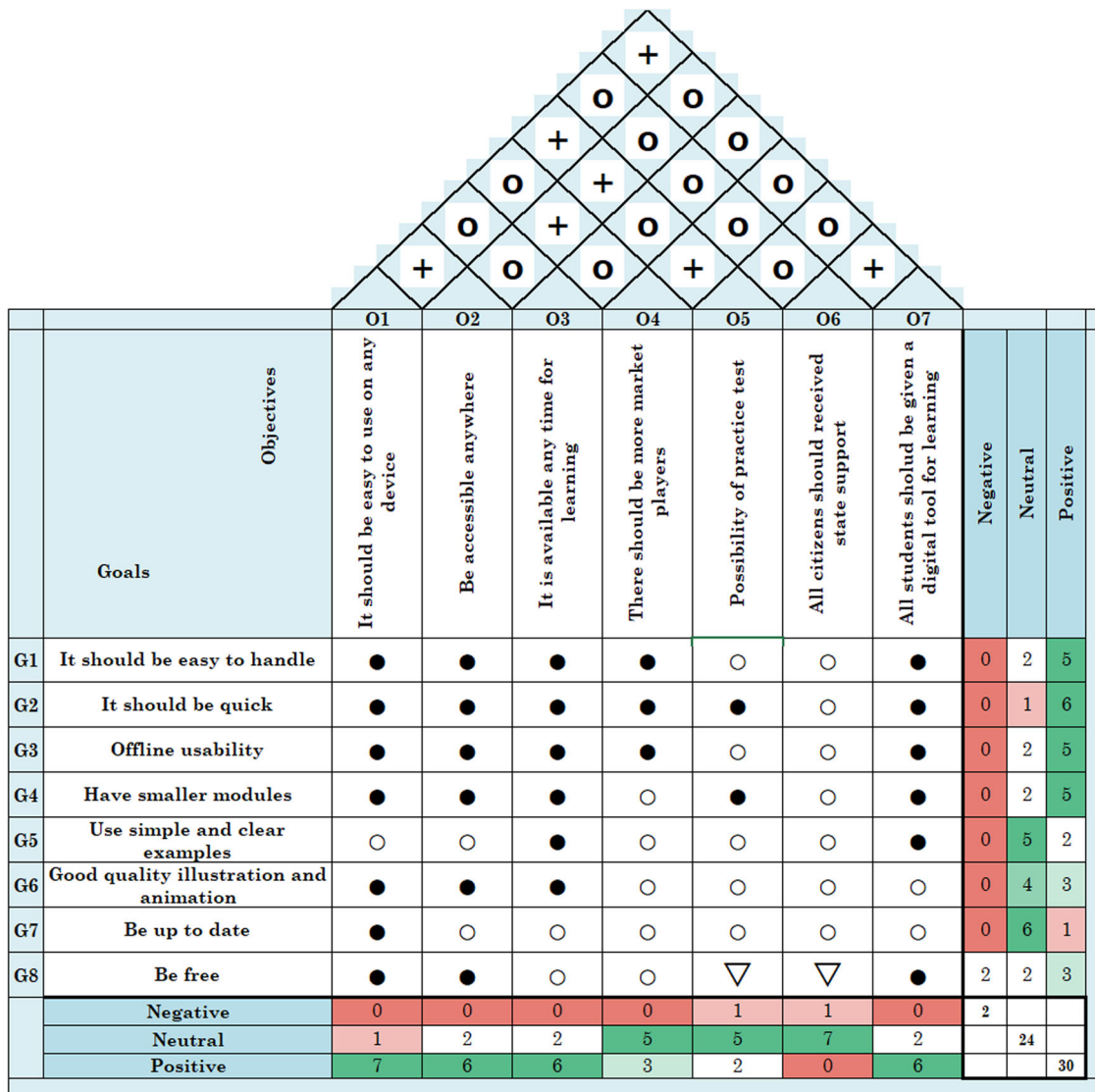


Fig. 4 House of Quality citizen goals and objectives regarding traffic rules education (Authors’ own creation based on qualitative research).

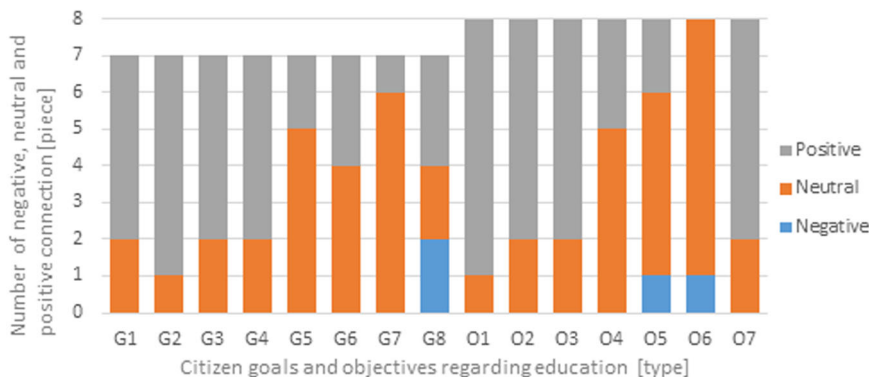


Fig. 5 Citizen goals and objectives connection types regarding education (Authors’ own creation based on qualitative research).

due to major developments in the field of self-driving cars, given that these too have to abide by the rules in the future.

The positive connection of the government regarding the education system is higher (76%) than the connection of the citizens (53%). This means the government is able to define more

suitable objectives to serve its goals than the citizens are. Hence citizens are more neutral (43%) than the authorities. As the education service was created by the authorities in the first place this might explain why they are able to overview the service more clearly and define aligned goals and objectives.

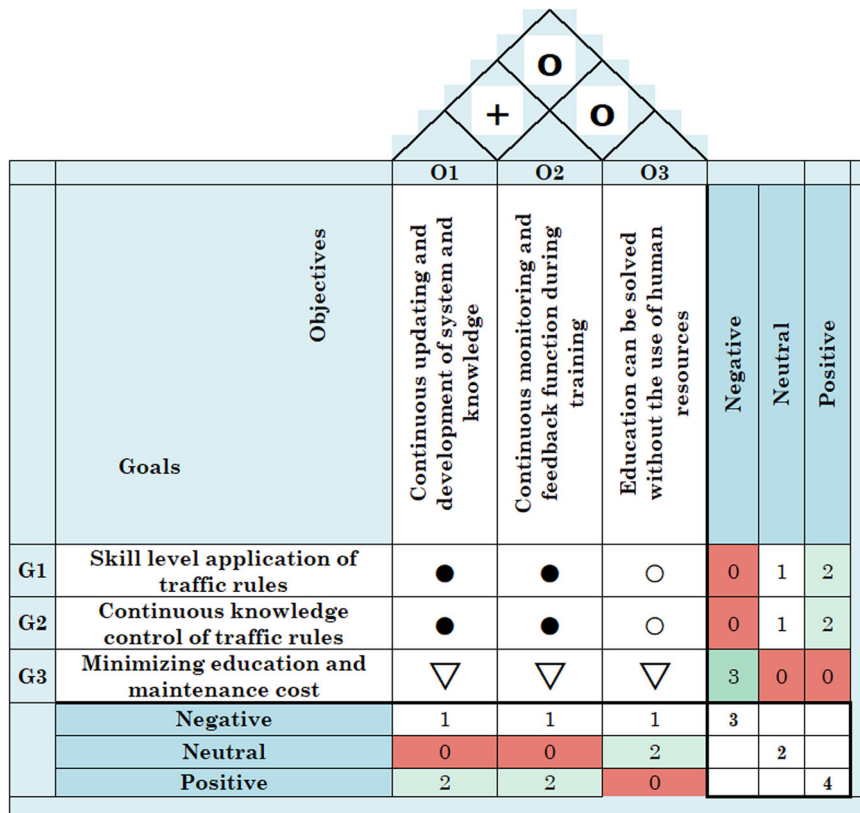


Fig. 6 House of Quality government goals and objectives regarding traffic rules education (Authors’ own creation based on qualitative research).

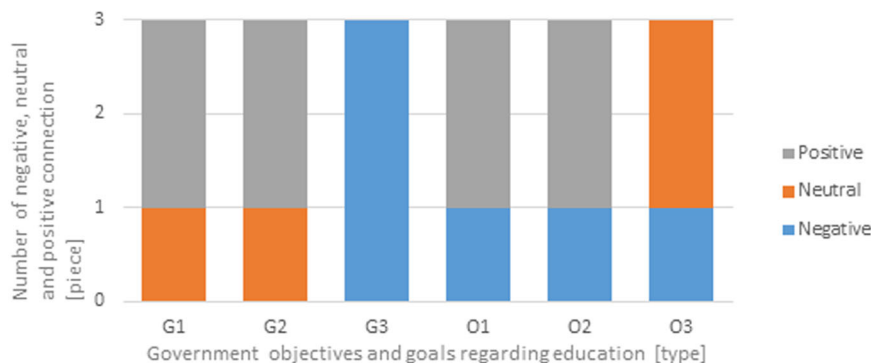


Fig. 7 Government goals and objectives connection types regarding education (Authors’ own creation based on qualitative research).

The positive connection of the citizen regarding the examination system is higher (65%) than the connection of the government (38%). This means in this case that citizens are able to define more suitable objectives to serve their goals than the government. Hence the government is either neutral (37%) or even negative (25%), while the citizens have a similar opinion. Despite the fact that the examination service was created by the government in this case citizens are able to align their goals and objectives more clearly (Table 1).

According to the results, it seems the improvement of the exam itself is more important for the citizens than for the government, while the improvement of the education system is of higher priority for the citizens.

The limitation of this research was that the data of the HOQ model was collected by qualitative methods (focus group interviews). An extension of the research would require the application of quantitative methods to gain more insight. After the

theory exam, data would be collected from the candidates regarding the quality of the education and examination system. A large database could be built and used to draw representative conclusions. Other aspects of the service quality, like the existing legal framework and its possible changes, could also be considered for future research.

Conclusion

This article focused on the goals and objectives of citizens and government in relation to the education and testing of traffic rules. By using the House of Quality model, the article compared these, identifying positive and negative correlations between them, while also providing a comprehensive statistical background analysis. The research focused on traffic education and e-government solutions related to examinations. People need a driving licence to drive a car. For the authorities, a driving licence means knowledge of the highway code and traffic safety. The two

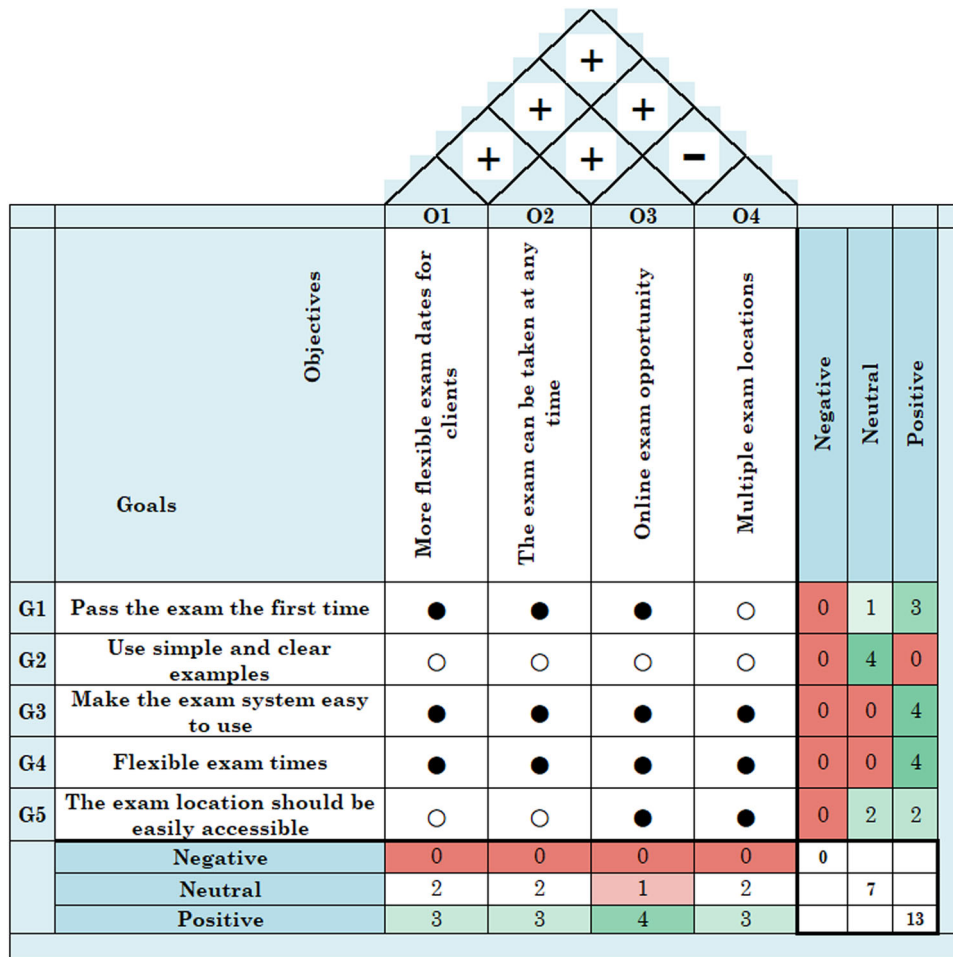


Fig. 8 House of Quality citizen goals and objectives regarding traffic rules examination (Authors' own creation based on qualitative research).

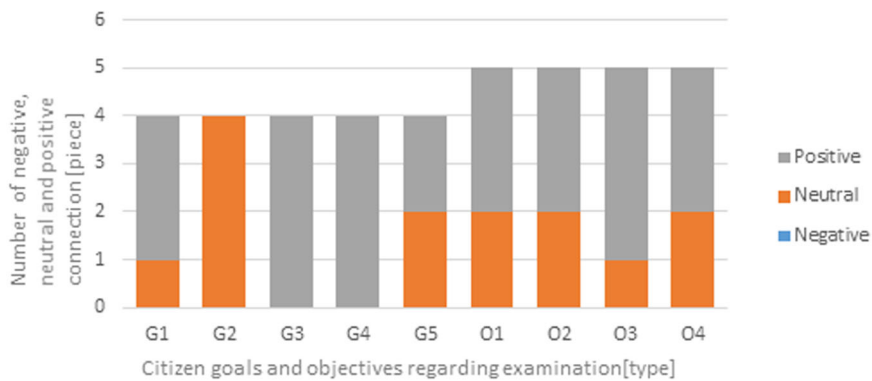


Fig. 9 Citizen goals connection types regarding examination (Authors' own creation based on qualitative research).

stakeholders have different perspectives and interests so it is questionable whether they can be reconciled with each other.

As we can see, the relationship between government and citizens is twofold. While the government wants to ensure that all road users know and obey traffic rules to minimize the number of accidents on the roads, the main objective of the driver is to use vehicles on the roads legally, and learning the rules is the only means to achieve this objective. When we compare HOQ models of citizen and government education objectives and goals, it can be clearly seen that the satisfaction of the citizens depends on a more complex criteria system than the satisfaction of the

government. Likewise, when we compare the HOQ models of citizen and government examination objectives and goals we can see almost the same number of goals and objectives. It means that the quality of the traffic examination system for the government and citizens is equally important.

Based on the HOQ model representations of the stakeholders' goals and objectives towards traffic education and its examination system we can conclude that viewpoints are closer to each other in the case of the examination system than that of the education system. Opinions regarding the quality of the service and the criteria for stakeholder satisfaction are far more diverse.

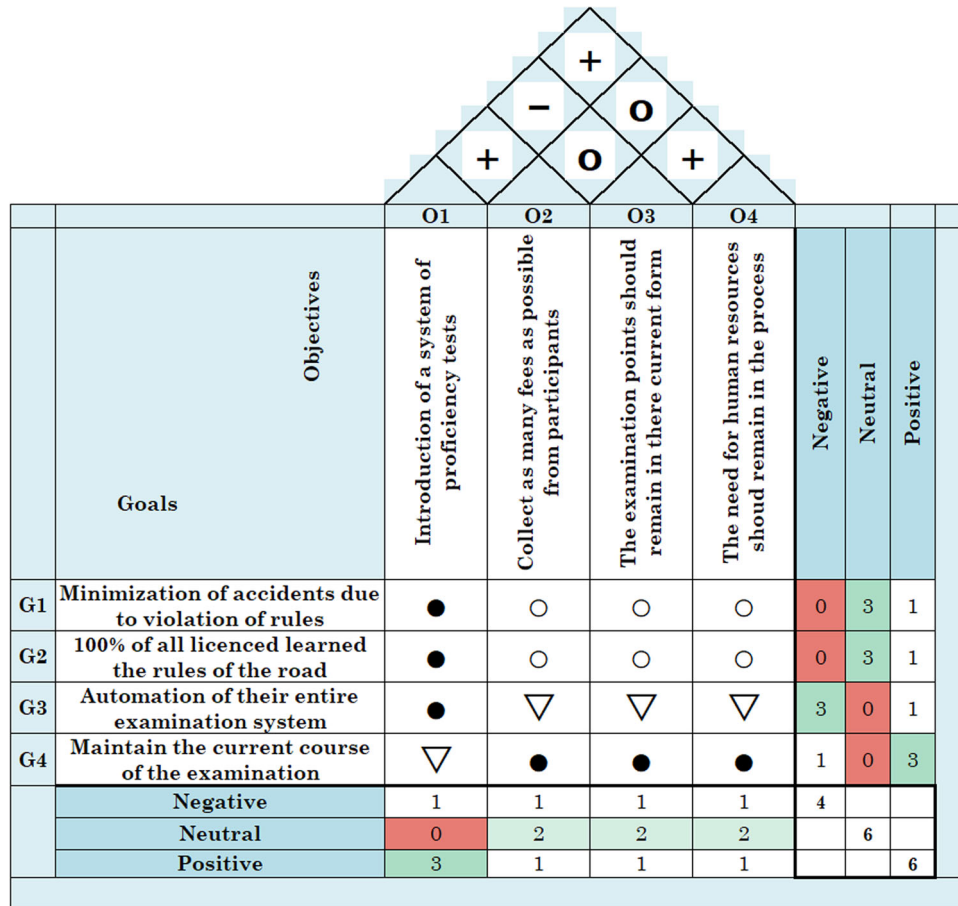


Fig. 10 House of Quality government goals and objectives regarding traffic rules examination (Authors’ own creation based on qualitative research).

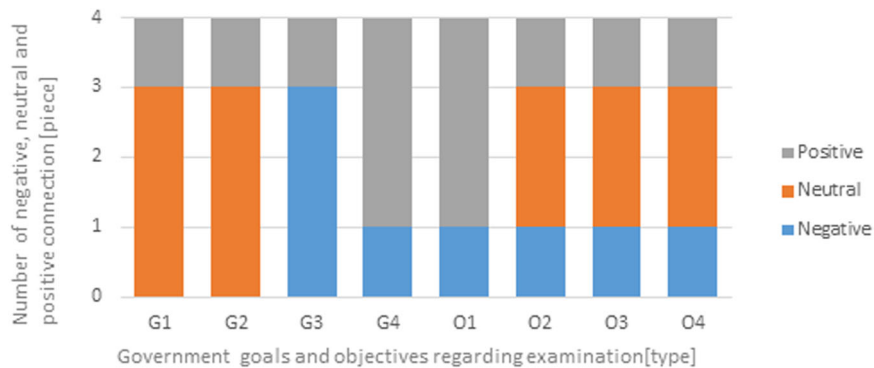


Fig. 11 Government goals and objectives connection types regarding examination system (Authors’ own creation based on qualitative research).

Table 1 Citizen and Government connection ratio regarding education and examination (Authors’ own creation based on qualitative research).

	Positive	Neutral	Negative
Citizen connection ratio regarding education	53%	43%	4%
Government connection ratio regarding education	76%	24%	0%
Citizen connection ratio regarding examination	65%	35%	0%
Government connection ratio regarding examination	38%	37%	25%

Data availability

All data generated or analysed during this study are included in this published article.

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Author contributions

LB and BEB collected and analysed the data and interpreted the results. LB, BEB and PF designed the study and ZSCSH provided resources. BEB did the literature review, LB did the visualization and PF provided supervision.

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Competing interests

The authors declare no competing interests.

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