EDUCATIONAL EXPERIENCES IN THE RAILWAY INDUSTRY

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Abstract: *The safety of railway users depends to a large extent on the preparedness of the workers, which means that the human factor plays an important role. In the evaluation system of human reliability, the quality of training and preparation for tasks appears as a critical element. In order to strengthen this key factor, we aimed to examine the educational characteristics in the railway industry. Among our sub-goals was mapping teaching methods, learning aids and skills required for teaching. We carried out primary research and used analysis of variance to examine the differences between the groups. Based on the results, the instructors pay attention to creating a supportive atmosphere, are committed, have a dialogue with the students and strive to transfer the expertise necessary to perform practical tasks. On the other hand, there can be significant differences in sharing the knowledge material since they do not have a common note, and the technical books are also relatively old. In order to transfer uniform and up-to-date knowledge, they feel a great need for a common note. We recommend coordinating and developing the body of knowledge to which attention is drawn in domestic primary research and international literature. Respondents primarily use professional materials for self-improvement, and we also recommend participating in skills-developing training that supports the creation of an adaptive atmosphere.*

Keywords: *teaching methods; learning aids; teaching skills*

JEL Classification: O15

1. Introduction

Education plays a particularly important role in industries such as railway transport, where the safety of people every day depends on the preparedness of the workers. Cao et al. (2022) draw attention to the fact that railway transport is developing faster

and faster, so safety must be given special attention, railway safety and accident prevention are extremely important. In this, the human factor has a prominent role since planning, installation, and maintenance are still tasks subject to the human factor (Ciani et al., 2022). Human reliability is critical in the security assessment of most complex systems. Many international standards and technical reports agree that human reliability is a central consideration in making rail-related systems safe. An essential part is the safety culture, communication, attentiveness within the organization, training, experience and knowledge of the task. The latter three factors also play a critical role in the human reliability evaluation system developed specifically for the railway industry (Rangra et al., 2017).

Therefore, training and teacher preparation play a key role in the tasks. Despite the fact that many studies focus on the issue of the added value of teachers, even today, we only have limited knowledge about why some teachers are more effective in promoting human capital than others (Thijssen et al., 2022). The transfer/mastery of the course material can be achieved with innovative solutions and experience-based education efficiently and effectively. According to Benedek (2021), school processes, content development, development of learning resources, teacher preparation, teacher training and continuing education have determined the quality and dynamics of this innovation.

The research aims to support the work of railway instructors in order to improve teaching efficiency. We are looking for the answer to what teaching methods, learning aids, and methods used to develop instructors can help them. We review the current research results with a literature analysis and explore the current teaching practice by conducting primary research. After that, based on the knowledge of the literature and empirical experience, we propose to improve efficiency.

2. Research design and Methods

Regarding education development, the literature sets a double goal for educators. On the one hand, it focuses on creating a positive atmosphere in the training room, and we will present this research first. On the other hand, it calls attention to the actualization and international coordination of the knowledge material in the railway industry, illustrated after the works emphasizing creating a supportive atmosphere.

2.1. Creating an atmosphere that supports learning

Coe et al., (2020) aim to help teachers make better decisions to improve their effectiveness. It sets four priorities to encourage learning. These four overarching

dimensions contain a total of seventeen 'items'. Each 'element' represents an activity in which it may be worth investing time and effort to develop a specific skill, competence or improve the learning environment. He emphasizes that teaching cannot be reduced to various techniques. However, empirical experience confirms that, ultimately, the effort to develop competencies and a supportive environment led to the development of expertise.

We present a brief description of the four dimensions (Figure 1) based on the work of Coe et al. (2020):

- First dimension: Understanding and mastering the taught content.

It is crucial to have a deep knowledge of the content, that is, the instructor should be aware of the connections, misconceptions and obstacles. Give students relevant tasks that help them understand the theory better by generating multiple analogies and practical examples.

- Second dimension: Creating an environment that supports learning.

The instructor should strive for a mutual relationship with the students based on mutual respect, avoiding negative emotions. Promoting student motivation should also take place through the experience of competence, autonomy and connection. The feeling of 'it is okay if I try' should be encouraged, and the students should believe they can change what causes success or failure. The instructor should foster a positive atmosphere of student-student relationships in order to promote cooperation.

- Third dimension: Maximizing the opportunity to learn.

It means efficient management of time and resources in the training room. Have the instructor give clear instructions, so students know exactly what to do. Set clear expectations for expected behaviour for everyone and apply them consistently. It draws attention to the reinforcement of positive student behaviour and the use of routines to ensure that the transition from one task to another is carried out smoothly so that they know what to do even if disturbing events occur.

- Fourth dimension: Carrying out activities that activate student thinking.

In order to be structured during the teaching process, the learning goals and reasons should be clarified, and the essential ideas and main milestones should be indicated. Connecting new ideas with what was previously learned and asking questions are important to stimulate student thinking. Encourage continuous practice to gain more solid knowledge and avoid forgetting. It should also stimulate the development and application of independent learning.
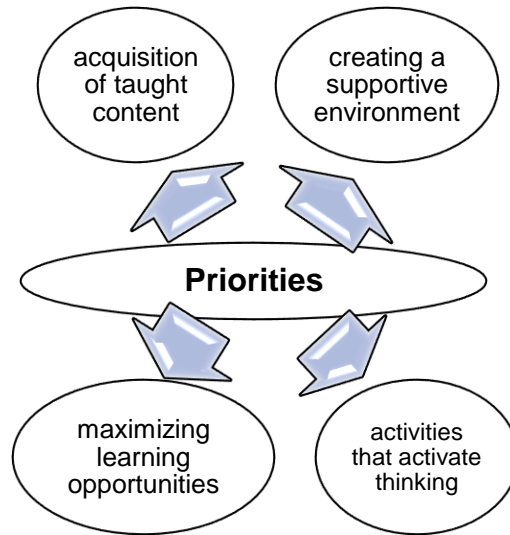
Figure 1: Priorities for encouraging learning
Source: Own editing

Coe et al., (2020) created a five-part framework for understanding which factors help educators design training, similar to the four dimensions of Hart (2022). Organizational climate, autonomy, trust, clear goals and instructions, and psychological safety also play an important role in this system. Pusztai et al. (2022) also draws attention to the importance of a sense of belonging. Extensive relationships with instructors and fellow students reduce the risk of dropping out and increase the chances of persistence. According to the formulation of the theory of student integration, it serves as a significant protective factor if the student has a partner with whom he can share his problems, ask for help with his studies, and rely on in other areas of life, i.e. he has integrated well. He also emphasizes the importance of a supportive atmosphere (Konstantinidou and Kyriakides, 2022). There is a need for instructors to listen to students' ideas and respond appropriately, provide extra help and be empathetic. To improve self-assessment errors, for example Kun et al. (2022) recommends increasing the frequency of test writing. In addition to practice tests and more thorough preparation, this solution can primarily reduce the errors caused by underestimating students' performance. According to Caldarella et al. (2020), students think of a great instructor who has eyes in the back of his head and can see even when standing with his back. A vital role is if the teacher gives praise and positive reinforcement to support the desired behaviour, even with a look or gesture, so the students feel they are being watched. Konstantinidou and Kyriakides (2022) also, clarity of the instructions is essential, as it positively affects

the student's active learning activities in the classroom. This can also be helped by reorganizing the instructor's preliminary thinking. In terms of learning aids, based on teacher reports (Hsu and Halpin, 2022), although the teachers initially rely predominantly on textbooks and the previous teaching materials of their courses when organizing the courses, during subsequent consultations, several teachers report that they reorganize or reduce the content of the course material covered, to leave more time for critical thinking and active learning. To confirm this, (Zólyomi, 2020) states that implicit learning (which happens outside of consciousness and is inaccessible to consciousness) sometimes proves to be more effective than explicit (conscious) learning. Looking at the example of university students (Csók, 2020) , based on the research results, those who graduated from theory-oriented training highlighted their employment difficulties, so it may be worth putting more emphasis on curriculum development, including the synthesis of theory and practice, which can also help self-employment. In addition to incorporating practice, online learning opportunities can also support the activation of students. (Benedek, 2021) studies these methods, it aims to make learning more enjoyable in addition to imparting knowledge. He proposes open-source content development as a solution. During the pandemic, the need for mass access to educational content via the Internet increased, triggering the need for innovation. Thus, they aimed to involve interested students/teachers in compiling open-access teaching materials. Another innovation opportunity appeared in the form of cloud services, providing the back-end storage capacity necessary for the success of the process.

The creation of a supportive atmosphere, therefore, plays an important role. However, it is essential that the 'other leg' of education, i.e. the professional content, also serves the students' interests.

2.2. Updating railway professional knowledge material

Coe et al. (2020) presented in the previous subsection is interwoven with the need for the instructor to be professionally impeccable, for which it is essential that he has not only extensive but also fresh, current knowledge. With up-to-date knowledge, he can provide a clear picture of opportunities and threats. Profound professional knowledge also positively affects the instructor-student relationship, increasing trust in the instructor through expert power (Kay and Saucier, 2020). They help effectively manage time and resources in the classroom and structure teaching processes. According to Sweller et al. (2019), the structuring of the content, the solution of partial tasks and the presentation of practical examples greatly help 'newbies'. In other words, students who do not yet have routines benefit from it. Those who have

been in the field for a more extended period of time can learn more from solving one complete problem without breaking it down into subtasks, in which the transfer of the instructor's practical experience can be helpful. The teacher must therefore adapt the tasks to the students' needs.

There is a great need for current sources, but according to (Andersen, 2020), in recent years, instead of the development of specialist books, more attention has been paid to the professional training of teachers. Of course, this is also very important, but in the old technical books, for example, task orientation is less present than in the new ones, even though this would be extremely important for competence development. However, the fact that a book has a new edition but almost unchanged content is not a solution. An actual update is needed. Bakken et al. (2021) draws attention to the fact that the textbook tasks do not change over time, the new edition books are very similar to their previous versions. Unfortunately, it is ignored that students should be prepared for a resilient attitude since we live in a rapidly changing world. On the one hand, they conclude that there may be differences in updates by discipline as each professional community develops its own 'genre' norms. On the other hand, the curriculum design is also influenced by the assessment practices, i.e. what kind of test the students have to take to determine their mastery of the content. If the assessment requirements do not change, they do not feel the need to change the textbook either, which, unfortunately, can preserve the fact that outdated knowledge is being taught. This has harmful effects, as students may have limited opportunities for development.

Häußler and Borrmann (2021) draws attention to the fact that there is limited industry-specific knowledge regarding railway infrastructure planning. Khabarov and Volegzhanina (2022) emphasizes the importance of standardizing the educational content of the railway profession. The common problem is that people (employees and partners) misunderstand industry documents, which hinders effective communication between interacting parties. Equally urgent is the issue of harmonization of multilingual industry documentation. According to Hughes et al. (2019), the main problem is that multilingualism makes it challenging to coordinate the content of hazard and accident reports from all over the world this information could improve safety. Khabarov and Volegzhanina (2022) Developing web applications such as intelligent educational agents is proposed to eliminate this problem. The basic condition for this is the standardization of educational content. This kind of coordination can be achieved by synthesizing person-centered and digital solutions.

The positive atmosphere, combined with the current professional content, can support the students in acquiring the necessary knowledge and possessing the competencies essential for safely completing tasks.

3. Material and method

The survey took place online (on the Google questionnaire platform) and consisted of a questionnaire that took about half an hour to answer and related to educational experiences.

The questionnaire contained Likert scale questions; multiple-choice questions, i.e. questions with predetermined answer options; and so-called open-ended questions that can be answered freely.

We placed a control question in the questionnaire, which measured the automaticity of answering the questionnaire. After the middle of the education questionnaire, 20% of the respondents did not pay attention. During the data analysis, we did not consider the numerical answers of the inattentive respondents but only the textual answers, where their adequacy could be checked.

The questionnaire was filled out among the railway's professional trainers and those designated by the company groups involved in the investigation.

174 people filled out the questionnaire in total, of which 4 are employees of MÁV-HÉV, 19 of MÁV, 50 of MÁV-Start and 101 of Rail Cargo Hungária company groups. The gender distribution was 148 men and 26 women. The average age was 49 years (standard deviation=8.4 years), the youngest respondent was 25, and the oldest 72.

As we have already written, we placed a control question between the numerical answers in the middle of the questionnaire to check whether it was filled out automatically. The question was, 'Would you mind writing 32?' This answer was given in 135 cases; in one case, the person entered 33. In the other 38 cases, there was not nearly this number, so the answer can be considered automatic, in these cases, the numerical answers of the respondents were not taken into account during the analysis, only the text answers, where the conscious answer can be checked.

The final sample includes the data of 136 people, 114 men and 22 women, of whom 4 are employees of HÉV, 15 of MÁV, 35 of MÁV-Start and 82 of Rail Cargo Hungária. In the case of comparisons between companies, this suggests caution because, in the case of a smaller sample, a more significant measurement error is possible if they do not represent the population well. The average age was 48 years (standard deviation=8.5 years), the youngest respondent was 25, and the oldest 72. Looking at the company groups, it seems that the respondents are younger in the case

of Rail Cargo Hungaria and somewhat younger in the case of MÁV (on average 45.8 years and 47 years respectively) than the respondents of HÉV (52 years) or MÁV-Start (50.1 years).

Typically (median), they had 7 years of teaching experience, there were 0 and 48 years between the answers. In the case of Rail Cargo Hungária, the respondents typically have less teaching experience (median=5 years), the respondents of MÁV (10 years) and MÁV-Start (14 years), while the respondents of the HÉV company group typically have the most teaching experience (19 years). Regarding education, 59 are practical, 9 are theoretical instructors, and 68 are both.

4. Results

Regarding questions about teaching methods, we asked them to indicate how often the listed teaching methods are used on a five-point scale. Based on the answers, the generally most commonly used teaching methods are conversation (4.28), material illustration (4.07) and practical teaching (4.26). The lecture (3.69), individual task (3.12), situational exercise (3.41) and, slide show, series of pictures, video (3.33) are also typical. The conversation, therefore, appears with the highest average value, which can also be beneficial in terms of employee satisfaction since, according to Kotsis and Darnai (2022), it can be increased mainly by a direct, good relationship with colleagues. The increased focus is on the retention of skilled labour (Gergely and Pierog 2016).

Based on the data in Figure 2, there are significant differences between the company groups in the frequency of some teaching methods used by instructors. Group projects, situation exercises and simulations are also more common in the case of HÉV. The video illustration is HÉV and MÁV Start during the presentation and slide show. These differences are not statistical (with the help of analysis of variance and Bonferroni test) in the case of HÉV (limited interpretation due to only 4 respondents) but can be verified in the case of MÁV Start and Rail Cargo Hungaria. The fact that presentations and visualizations are less common in the case of Rail Cargo Hungaria is justified by the fact that there are proportionally more instructors who are exclusively practical (65%). Among other answers, feedback and error analysis appeared several times.
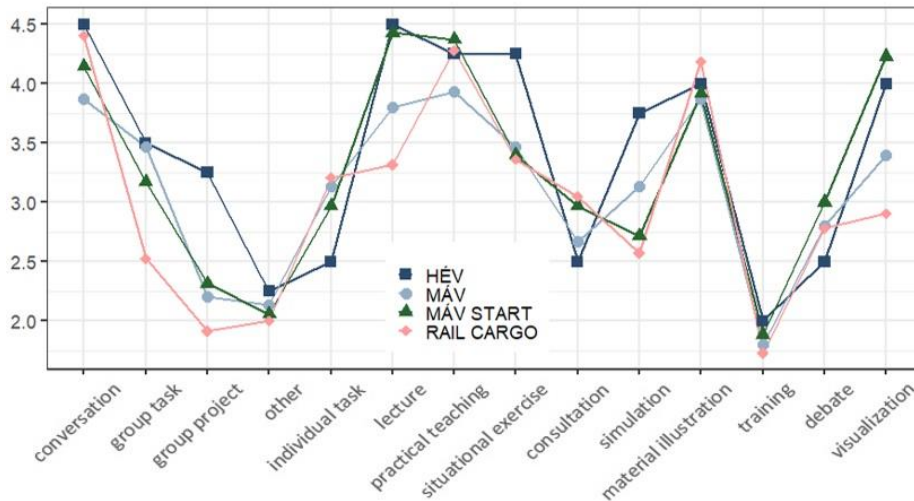
Figure 2: Average values of the application of educational methods per company
group
Source: Own study, n=174

Instructors often use auxiliary materials found on electronic interfaces (3.84) and extracts and notes of the training material (3.83) as learning support tools (Figure 3). Among the other answers, technical books appear (often it appears that they are old technical books), case studies, the experience of other colleagues, videos, and self-made diagrams. Applying all these is significantly more typical for MÁV Start instructors ($p<0.05$). They would find it helpful to have a uniformly designed note (4.3). According to (Häußler and Borrmann, 2021), creating industry-specific knowledge would also greatly help on an international level, meaning that Hungarian employees' demand for this is not unique. (Khabarov – Volegzhanina, 2022) goes even further and urges the international standardization of the literature. In addition to the technical books, the solutions used by the respondents (case studies, experiences, videos and diagrams) can also be extremely useful, the empirical results of (Hsu - Halpin, 2022) also show that during the initial consultations, the technical books are more the basis, and later on the promotion of critical thinking is given more space. According to the first dimension of (Coe et al., 2020), it is also essential to supplement the theoretical material with these experiences. If the provision of electronic aids is not the result of the scarcity of written literature, according to (Benedek, 2021), it can make learning more enjoyable. Involving students in curriculum development can be of further help.
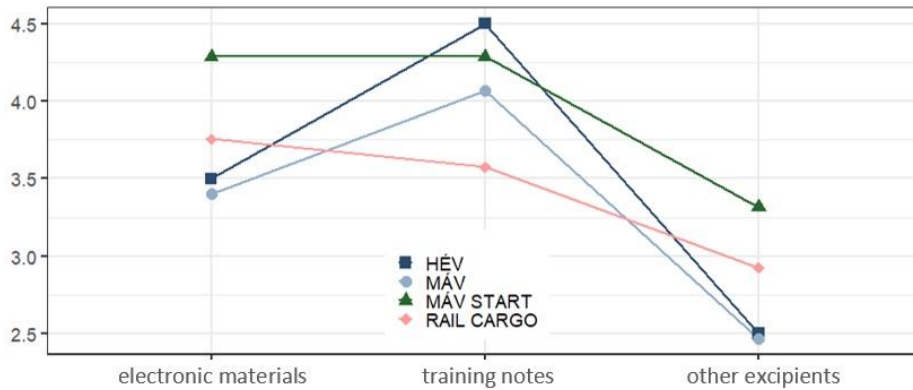
Figure 3: Average values of the use of different learning aids per company group
Source: Own study, n=174

In the assessment of skills important for education (Figure 4), on average, considering all instructors, the highest scores are professional knowledge (4.91), professional experience (4.82), communication skills (4.7), problem-solving thinking (4.68), commitment, responsibility (4.57), conflict management (4.57), flexibility (4.49) and creativity (4.37). Knowledge of pedagogical, teaching and learning methods is also considered necessary (all average=4.2). The professional experience emphasized by (Coe et al., 2020) in the first dimension is therefore felt to be the most important. In addition to deep professional knowledge, the communication and problem-solving necessary to create a supportive atmosphere appear in several dimensions as essential features. In the second dimension, it appears as a facilitator of encouragement, in the third dimension, it appears in the formulation of precise instructions, and in the fourth dimension, it appears in the clarification of learning goals.
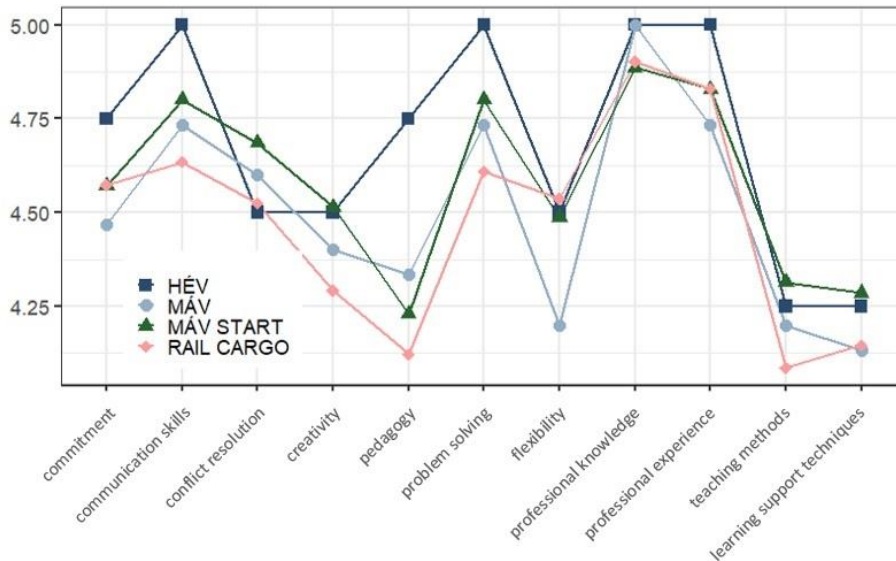
Figure 4: Average ratings of characteristics considered important during education by company group.
Source: Own study, n=174

Regarding the factors considered important during education, the opinion of HÉV employees seems to be different (it can be interpreted in a limited way due to only 4 respondents), but there are no statistically verifiable differences in this question between the company groups $F(3, 132) < 1.69$, $p < 0.18$.

For self-development (Figure 5), instructors mostly use specialist books (3.88) and professional Internet portals (3.73), and professional training and lectures are also typical (3.65). There is a significant difference between the company groups only in the case of Internet portals presenting pedagogical methods ($F(3, 132) < 2.66$, $p < 0.05$).
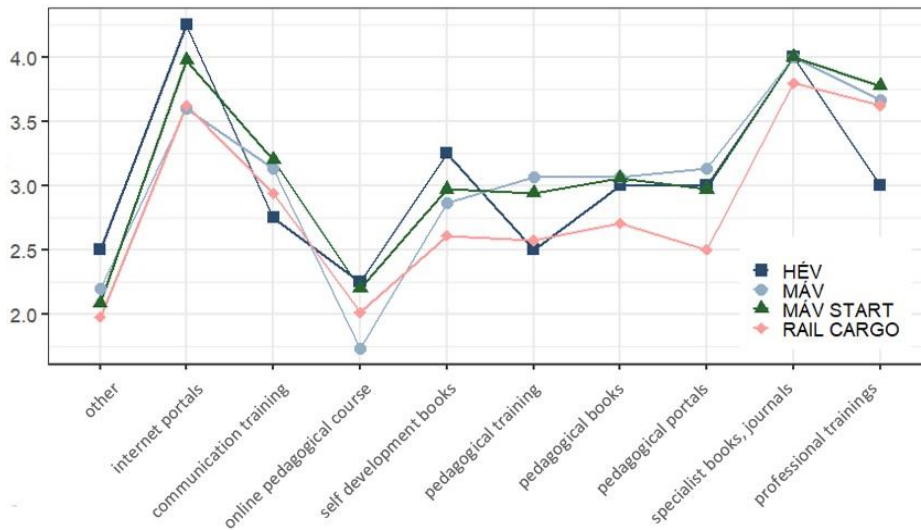
Figure 5: The average values of the various methods used for self-improvement per company group
Source: Own study, n=174

The need for background support is also felt for these results, as they mainly rely on internet portals for self-development. According to (Hart, 2022) and (Konstantinidou – Kyriakides, 2022) it is crucial to ensure the appropriate organizational climate, so it is worthwhile to put further emphasis on the development of the helping areas by organizing skills training in addition to professional training.

5. Conclusions

The railway trainers form a part of all the trainers. Inserted into the global picture, it is therefore equally important to pay attention to creating a supportive atmosphere and the availability of up-to-date technical literature.

In our submitted but not yet published manuscript on teacher personality, we suggested that the importance of self-knowledge should be drawn to the attention of railway teachers, as many teachers are unaware of their self-image. This question is vital since the image of a person can influence the teacher-student relationship and interactions. As a further research direction, let us formulate whether they know exactly what needs to be developed within the communication skills considered necessary by the respondents.

There is very limited industry-specific knowledge regarding the railway industry. Our research results also confirmed the importance of updating the content.

Moreover, industry documents are often incomprehensible even to professionals, which hinders effective communication. It is no coincidence that the researchers in

this work emphasize the importance of international standardization of multilingual railway vocational education content. This could help harmonize the content of hazard and accident reports, improving safety.

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