Research into the factors that influence the passing rate and costs of the “bevelvoerder” education of the Oost Six safety regions in The Netherlands

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ABSTRACT,

The Netherlands Fire Service, responsible for fire departments across the country, is organized into twenty-five safety regions tasked with fire prevention, crisis preparation, and disaster response. The bevelvoerder education, crucial for qualifying commanders, is managed by Stichting Brandweeropleidingen BOGO (BOGO) for six specific safety regions: IJsselland, Twente, North and East Gelderland, Gelderland-Middle, Gelderland South, and Flevoland. The Institute for Safety (IFV) outlines the qualifications for the bevelvoerder role, which includes directing crew members during various incidents and ensuring safety. The core research question researches the factors influencing the passing rates and the associated costs of the bevelvoerder education in the Oost Six safety regions. By identifying these factors, the research aims to provide actionable recommendations to improve passing rates and offer a clearer picture of the financial investment required for the program. The research is conducted by using a mixed-methods design, with quantitative research in the form of analysing assessment forms, and qualitative research in the form of interviewing candidates that successfully completed the education and teachers and instructors that teach the programme. The worst scored criterium for VR is criterium 3.6, which is about time-tempo of the incident, the feeling of the interviewees was that they questioned whether the examiners did in fact score the candidates on the level of novice professional, this feeling aligns with that criterium 3.6 is the worst scored criterium. Improvements could be made in the form of provision of correct materials, incorporating more firefighting theme in the assessment, making the ELO more user friendly and not incorporating too much learning goals in the lesson plans. The actual costs are higher than expected and are calculated based on the average amount of re-examinations within the safety regions.

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Keywords

Firefighter education; passing rate; commander education; safety regions; bevelvoerder; blended learning; dual learning; exams

1. INTRODUCTION

'Decisive, knowledgeable and helpful', that is the slogan from The Netherlands Fire Service (Brandweer Nederland, 2024). The organization is responsible for all the fire departments in The Netherlands and makes sure that there is a 24/7 service for those in need. The Netherlands is divided into twenty-five safety regions, their task is to prevent and fight fires, to prepare for risks and crises, and to coordinate, manage and respond to disasters and crises (Ministerie van Justitie en Veiligheid, 2023). All organizational charts from the safety regions look slightly different, however in all of them the fire department holds a place. Within The Netherlands Fire Service four different knowledge domains are distinguished: Fire, Technical Assistance, Incident Response to Hazardous Substances, and Water Incidents (Van Lieshout & Brandweer Nederland, 2020).

Each of the safety regions is responsible for their own education. There are different providers of firefighting education in The Netherlands, one of these providers is Stichting Brandweeropleidingen BOGO (BOGO), this organization provides the education for the 'East Six' safety regions; IJsselland, Twente, North and East Gelderland, Gelderland-Middle, Gelderland South and Flevoland (Stichting Brandweeropleidingen BOGO, 2018). One of the educational programs the BOGO provides is the 'Bevelvoerder' programme. A bevelvoerder is the commander of a fire brigade. The IFV, The Institute for Safety, the institute responsible for disaster relief and public crisis management in the Netherlands (Security Delta, 2023) composed a qualification file for the bevelvoerder function. The characterization of the function is described as follows: 'The bevelvoerder directs crew members to fight the incident: fire, technical assistance, hazardous materials, or water incidents. In the mentioned cases provision of services may be involved. He secures all safety aspects during the incident. The situation on site determines the tasks to be performed. When combating the incident, he has the standard packing of the fire engine and/or support vehicles to his disposal' (Clusterwerkgroep Repressie & Instituut Fysieke Veiligheid, 2017). To work as a bevelvoerder, a person must be officially qualified with a diploma. To receive a bevelvoerder diploma, a person must pass three theory-exams and two practical-exams. One practical exam is a fire exam, which is done by a real-life simulation at a training base. The other practical exam is an incident response to hazardous substances and technical assistance exam, which is done using virtual reality, here candidates can face different scenarios. In appendix A there is a visual representation of the bevelvoerder education programme. The total study load of the bevelvoerder education is 388 hours, 233 contact hours and 155 self-study hours, including the work placement assignments (Stichting Brandweeropleidingen BOGO, 2023c).

Candidates that apply for the function of bevelvoerder first must undergo an assessment. In this assessment different competencies are assessed for. These competencies are described in the qualification file for the bevelvoerder function (Security Delta, 2023). The following competencies are described: *Accuracy*, meaning 'acting precisely, carefully and impeccably when performing work' (e-office.com, n.d.-a). *Stress-resistance*, meaning 'continuing to perform effectively when under time pressure and in the face of setbacks, disappointments or resistance' (e-office.com, n.d.-b). *Cooperation*, 'The ability to work effectively with others in order to achieve a shared goal - even when the object at stake is of no direct personal interest' (Competencylibrary.com, 2024a). *Problem solving* 'is defined as a process, used to obtain a best answer to an unknown, or a decision subject to some constraints' (Mourtos et al., 2004) *Leadership*, 'The ability to provide direction and guidance to a group of people and to encourage cooperation between team members in order to attain an objective' (Competencylibrary.com, 2024e). *Analysing*, meaning 'the ability to use a logical reasoning process to break down and work through a situation or problem to arrive at an outcome' (Performance Management Consultants, 2024). *Decisiveness*, 'The ability to make active decisions or to commit oneself by speaking one's mind and taking position' (Competencylibrary.com, 2024c). *Innovation and creativity*, meaning for innovation 'the ability to direct one's inquisitive mind toward initiating new strategies, products, services, and markets'(Competencylibrary.com, 2024d). And for creativity 'the ability to come up with original and innovative ideas and solutions, to adopt points of view outside the usual parameters' (Competencylibrary.com, 2024b). *Communication skills*, meaning 'the ability to achieve communicative goals in a socially appropriate manner' (Kiessling & Fabry, 2021). *Learning and reflective competencies*, meaning for learning 'the ability to absorb new information readily and to put it into practice effectively' (Competencylibrary.com, 2024f). For reflective competencies it means 'the ability to question oneself and others for the purpose of constructive further development, as well as to recognise underlying systems of behaviour, thought and values and to assess their consequences for actions and decisions holistically' ("Future Skills for the World of Tomorrow," n.d.).

According to the regional educational manager, the criterium to pass a theoretical-exam is a score of at least 70% (E. Bruns-Boxem, personal communication, March 17, 2024) In order to pass a practical-exam, the candidate must score at least 69 out of 100 points, with a maximum of four out of the twenty-five criteria deemed insufficient. Each criterium is scored as shown in table 1. The idea is that a candidate starts with a basic score of '3' and that this will be changed according to the candidates' performance during the practical examination. When any other score than a '3' is given, an examiner must motivate the assessment score. An example of an assessment form for the examinations is added in appendix E. When a candidate does not pass the exam, re-examination is necessary. Re-examination brings costs along with it, the safety regions do not have a clear picture of the amount of money spend on bevelvoerder education.

Table 1 possible scores during the exam

Numerical score	Corresponding label	Examiner must motivate assessment score
1	Largely insufficient	Yes
2	Insufficient	Yes
3	Sufficient	No
4	Excellent	Yes

According to annual report of the BOGO the passing rate for the two exams is 73,4% for the fire exam and 83.7% for the exam on incident response to hazardous substances and technical assistance (Stichting Brandweeropleidingen BOGO, 2023). This passing rate is significantly lower than other passing rates of educational programs that the BOGO provides according to the same annual report. It is unknown why this passing rate is significantly lower. This knowledge gap together with the knowledge gap previously mentioned that safety regions do not

have a sharp vision what it costs to educate a bevelvoerder leads to the following research question.

1.1 Research question

Based on the knowledge gaps mentioned in the introduction, this research will focus on answering the following research question:

"What factors influence the passing rate for the bevelvoerder education and what are the bevelvoerder education-related costs for the Oost6 safety regions?"

1.2 Academic and practical relevance

The aim is, that the result of the research will provide recommendations to the organization when it comes to the bevelvoerder education programme. It will give the organizations insight into what factors influence the passing rate of the education. The research will also show the organizations what the costs are for them to educate a new bevelvoerder. It will give the organizations a view of the actual money they are spending taking the re-examinations into account in the equation.

The academic relevance of this research is that there has not been any research into the bevelvoerder education. So, this research contributes to the literature in determining the factors that are influencing the passing rate of the education programme. It might be valuable for other safety regions, who have different suppliers for their firefighting education to do similar research.

1.3 Stakeholders and costs

In the following section more of the environment of the bevelvoerder education will be explained. First about the stakeholders, then about the costs. Specifically, the starting rates of the education and the re-examination costs.

1.3.1 Stakeholders

There are different stakeholders in the environment of a bevelvoerder education programme. In table 2, the different stakeholders and their roles are described.

Table 2 stakeholders and their role description

Stakeholder	Role description
Safety regions (IJsselland, Twente, North and East Gelderland, Gelderland-Middle, Gelderland South, and Flevoland)	Part of the twenty-five safety regions in The Netherlands. Are responsible for the education of new bevelvoerders.
NIPV	Netherlands Institute of Public Safety. It is the public knowledge institute for crisis management and fire services. With four core tasks; research, education, information, and support. Provides the examinations.
BOGO	Develops and provides fire fighter education on behalf of six safety regions.
Teacher	Is a licenced teacher, employed by the BOGO. Bevelvoerder courses are taught by one or two teachers per course.
Instructor	Is a licenced instructor, employed by the BOGO. During the course different instructors aid the teacher, around ten different instructors may be involved.
Bevelvoerder candidate	Is employed by the safety region. Candidate that has applied for the bevelvoerder function, has passed the assessment and has been granted a training place by the corresponding safety region.
Work placement supervisor (leerwerkplekbegeleider)	Is employed by the safety regions. Work placement supervisors are people that have been assigned to the bevelvoerder candidates. Their job is to help the candidates in training at their own fire stations. The candidates must do certain exercises which are graded by the work placement supervisors.
Route counsellor (trajectbegeleider)	Is employed by the safety region. The route counsellors are guiding the candidates through the education. They help when a candidate encounters certain difficulties or arrange for re-examinations and further training when necessary. They guard the progress of the candidate in the education and facilitate if possible.

1.3.2 Starting rates

When modelling the costs of the education, multiple costs must be taken into consideration. First there is the starting rate, this depends on the type of course this can either be an evening course or a daytime course, and on the size of the class. An overview of the corresponding costs is shown in appendix I (Stichting Brandweeropleidingen BOGO, 2023b). The candidates get paid for the education; this is a rate of €16.65 per hour.

1.3.3 Re-examination costs

When candidates do not pass the examination moments, additional costs will be charged for the re-examinations. The additional costs per type of examination are mentioned in table 3 (Stichting Brandweeropleidingen BOGO, 2023b).

Table 3 Costs for re-examination

Type of test/examination	Costs
Practical re-examination virtual reality	€640 per candidate
Practical examination virtual reality external	€690 per candidate
Practical re-examination fire	€1.870 per candidate
Practical examination fire external	€1.920 per candidate

When candidates have a re-examination, the get paid their hourly wage. According to Eline Bruns-Boxem the re-examination takes about four hours on average (E. Bruns-Boxem, personal communication, March 17 2024).

2. THEORETICAL FRAMEWORK

Theory has been studied on the topic of education methods, learning environment, instruction, feedback, human factors in test taking and cost modelling. These factors came forward in the literature review. In the literature there was no research relating to firefighting education, so this research focussed on general education. The elements that came forward as being important in education where thus explored more in depth. The ones that were applicable to the environment of the bevelvoerder education were mentioned in the following theoretical framework.

2.1 Education methods

The bevelvoerder education is based on blended learning and dual learning. In the following sections these learning methods will be explained.

2.1.1 Blended Learning

According to Zhang et al., a blended form of learning is more effective than purely online or offline teaching methods. Bringing out the positive aspects of online teaching; flexibility, portability, repeatability, and efficiency. But also, the advantages of offline learning; a positive learning atmosphere, real-time monitoring and adaptation, and immediacy. Further results indicated numerous significant relationships between taking online courses and student engagement (Zhang et al., 2023). Students taking more online classes were more likely to engage in quantitative reasoning, but also less likely to engage in collaborative learning, they also reported less exposure to effective teaching methods compared to the more traditional educated students (Dumford & Miller, 2018). Educators that create blended learning courses should pay attention to all five engagement elements: social, cognitive, behavioural, collaborative, and emotional engagement. Also self-efficacy for digital technologies appears to predict the student engagement for those five engagement elements (Getenet et al., 2024).

2.1.2 Dual Learning

Dual learning is alternating between learning at the educational institute and in your work environment. Learning in the work environment is called workplace learning, at the fire service, the workplace is most often the safety region or the fire department. The goal is that tasks are learned in a realistic context and environment (Ruijten, 2023). Work-based learning contributes to the development of non-cognitive abilities, as experience, participation in the work environment, and communication with colleagues are all elements of development (Khine & Areepattamannil, 2016). The main characteristic of dual education is that theoretical education takes place within the educational institute, while a company provides practical training. Collaboration with mentors and more experienced colleagues, and joint projects, play a crucial role in the process of acquiring knowledge and becoming an expert (Pogatsnik, 2018). According to research by Kocsis and Pusztai, (2021), dual education had a positive effect on their communication skills, independent work, teamwork and sense of responsibility and that students in dual education are more successful than their counterparts in traditional education.

2.2 Learning environment

2.2.1 Learning climate

Hancock found that students achieve more poorly in environments with academic competition, the same is true for environments where a high level of strict rule enforcement and high severity of punishment is taking place. These environments also have a negative effect on the motivation of students (Hancock, 2001). Research also found strong evidence for a positive relationship between an open classroom climate and enjoyment, with in turn knowledge being positively predicted by enjoyment (Graf et al., 2024). “Organisational support for learning or learning-supportive climate (involving provision of material resources for learning, as well as material and nonmaterial incentives for learning) seems to enhance employees’ positive competences such as self-efficacy for learning, beliefs for learning capabilities, positive attitudes toward learning, intentions as well as actual participation in learning and developmental activities”(Maurer et al., 2003). Three aspects of learning climate are distinguishable, facilitation learning climate, appreciation learning climate, and error-avoidance climate (Nikolova et al., 2014). “Facilitation learning climate concerns employees’ perception of the organisational policies and practices aimed at providing access to educational resources, while appreciation learning climate maps the perception that pertains to the material and immaterial incentives for employees’ learning behaviours. Error-avoidance climate can be described as a climate that sustains a working atmosphere dominated by fear or anxiety of making errors during work. This type of climate is embedded in the organisational practices regarding the tolerance for errors. Error-avoidance climate indicates a lack of psychological safety when errors in the work process are made” (van Dyck et al., 2005). The study by suggest that companies that want to enhance their employees’ KSAOs (knowledge, skills, abilities and other characteristics) should invest in creating a leaning-supportive organisational climate (Nikolova et al., 2016).

2.2.2 Learning culture

According to research, all of the following influences contribute to learning, to fully understand learning in the different sites, all these dimensions have to be considered and their interrelationships; “the positions, dispositions and actions of the students; the positions, dispositions and actions of the tutors; the location and resources of the learning site; the syllabus or course specification, the assessment and qualification specifications; the time tutors and students spend together, their inter-relationships, and the range of other learning sites students are engaged with; college management and procedures, together with funding and inspection body procedures and regulations, and government policy; wider vocational and academic cultures, of which any learning site is part; wider social and cultural values and practices”(Hodkinson et al., 2007). Creating a good learning culture is by accommodating a variety of learning styles and validating the core principle of adult learning, that adults learn best when they are in control of their own learning. They need to be treated as capable of self-direction. Shaping, influencing and deciding this potential does not work in a control-driven environment (Conner, 2004).

2.3 Instruction

Instruction giving and receiving are not just verbal phenomena, it is also the use of eye-gaze, gestures and other embodied actions, and the moment-by-moment integration of written materials. Instruction giving and following are two sides of the same coin (Markee, 2015). Improving facets of instruction like clarity, structure, and the presentation of cognitively activating tasks can be assumed to contribute to perceived control, control which in turn contributes to motivation (Pekrun, 2006). It seems to be the case that experienced instruction givers use globally the same features at the beginning of a lesson when they talk about how to complete tasks, like similar information structure and grammatical resources. These instructions at the beginning of a class are interactional, not monologic. In these instructions, non-verbal parts of communication are vital (Markee, 2015).

2.4 Feedback

Feedback plays a role in the learning process. Feedback on success and failure directly influences students retrospective

appraisal on achievement outcomes (Pekrun, 2006). Other research, that analyses feedback in written instruction concludes that feedback does increase what is learnt. By waiting with giving the feedback (answer) until after the candidate tries to answer the questions, the candidates must engage more with the process, which may lead to higher motivation when they answer incorrectly, or when they answered correctly, but were not sure of their answer. Feedback following incorrect answers probably has the greatest positive effect (Kulhavy, 1977). The focus of feedback is important for it to be effective, according to Hattie and Timperley, the focus can be on the task, on the processing of the task, self-regulation, or the self. Feedback works best when there is faulty understanding, when there is too little knowledge, it is better to give additional instructions instead of feedback (Hattie & Timperley, 2007). The assumptions of the control-value theory imply that cumulative failure feedback weakens students' sense of control, so contributes to the development of achievement related anxiety and hopelessness (Pekrun, 2006). When negative feedback does not correspond with a candidates self-assessment, it can cause strong emotional reactions, this may lead to the rejection of the feedback (Schartel, 2012).

2.5 Human factors in test taking

The following human factors in test taking are selected since they are applicable to elements of the bevelvoerder education. Some research shows that students who are test anxious do not achieve at a lower level compared to students who are not test anxious (Hancock, 2001). However other research shows that performance on tests varies as a function of whether people perceive the test as a good measure of their ability, and whether they are positively motivated to do well on the test (Sorrentino et al., 1996). Atkinson's theory of achievement-motivation received support for its basic assumption that success-oriented individuals, who score high on achievement motivation and low in fear of failure, will do better on tests compared to people who score low in achievement motivation and high in the fear of failure (Atkinson & Feather, 1974). Uncertainty plays a vital role in achievement, when a situation is judging people's ability for future career goals, then there is uncertainty about their ability or the future. This makes success-oriented people perform better and failure-threatened people score worse (Sorrentino et al., 1996). There are a lot of emotions that are involved in the learning process of a school environment, boredom, anger, anxiety, challenge, pride, and happiness. It is not clear how emotions and emotional regulation influences motivation, self-regulation and learning (Schutz, 2010).

2.6 Cost modelling

2.6.1 Method of cost modelling

Different methods of cost modelling exist, for example the estimation by analogy or analogous estimation is a cost estimation method that needs historical cost of activities to use those to predict costs of new activities. To use this method, it is important to be able to map the differences between past projects and projects for which the costs will be estimated. Based on the differences required adjustments must be made (Greves & Joumier, 2003). The most critical aspect of this model is the creation of a system or database where the historical knowledge is stored and clearly structured (Riquelme & Serpell, 2013). Another method of cost estimation is the bottom-up estimation looks at costs from the bottom upwards. A bottom-up approach uses detailed activity and input usage data from records or observations to estimate unit costs (Batura et al., 2014). Bottom-up costing may be easier to access compared to top-down costing. However, bottom-up costing is also considered to be more time demanding, specific to the setting and expensive (Wordsworth et al., 2005). The top-down estimation looks at costs from the top downwards. In a top-down estimation, the overall costs for each aspect/input are taken at a central level and then the costs are allocated through formulae to make an estimation of the unit costs (Flessa et al., 2011). The top-down method better captures underutilised resources, as it allocates total cost among all activities (Rupert et al., 2017). Research "suggests that when bottom-up and top-down methods are compared, bottom-up costing is likely to be more accurate, as it is assumed to capture more comprehensively the resources used in providing a particular service" (Hendriks et al., 2014).

3. METHODOLOGY

3.1 Research approach

The research is a mixed methods research. It incorporates elements of both quantitative and qualitative research to adequately answer the research question.

3.2 Quantitative research

3.2.1 Sampling approach

The population that this research focusses on is the population of bevelvoerders that have started their education from 2018 onwards. The reason that 2018 is chosen, is that before that the education programme was different from the programme now (E. Bruns-Boxem, personal communication, March 17, 2024). The data will have to be from bevelvoerders from one of the East Six safety regions, since they have the common educator, BOGO. The research includes all available assessment forms from these classes.

3.2.2 Data collection

The quantitative data is provided by the different safety regions. Each of the six safety region would provide all the assessment forms of the practical fire exam and of the practical incident response to hazardous substances and technical assistance exams. This had to be the forms from all the bevelvoerder candidates they educated within the last five years. The files should include all test scores and failed attempts of the candidates. These assessment forms were all submitted in a PDF file, thus must be made into a dataset to make it possible to analyse the data. The dataset was made using Microsoft Excel. In this dataset, there were various categories added based on the test data. Categories like year of starting education, safety region in which education was followed, class size, times it took for candidates to pass the exam, the amount of points scored on an exam, the amount of points scored per assessment criterium, and for the exam on incident response to hazardous substances and technical assistance which scenario the exam was. Safety region Gelderland-Middle was unable to provide the quantitative data for this research.

3.2.3 Data analysis

To analyse the collected data from the safety regions the data will be imported into R studio. Then will be checked in the data is normally distributed using a Shapiro-Wilk test, for the equality of variance test the Brown-Forsythe Test is used. Later in the analysis the data on the dependent variables level of skills, level of difficulty and level of intensity will be tested for correlation, on the independent variable Age. The way this is done depends on whether the data is normally distributed. If the data is normally distributed, then the Pearson Correlation Coefficient will be used. When the data is not normally distributed, Spearman's Rank-Order Correlation will be used. To test whether the different VR exam scenarios have a significant different mean a one-way ANOVA will be used when the assumptions are met, when the assumptions for the one-way ANOVA are not met, a Kruskal-Wallis test will be carried out. If the test finds a significant difference, a post-hoc Dunn-

Bonferroni test is done to analyse the exact nature of these differences. The same tests are done to find out if there is a difference between the means of the five different safety regions.

From the data, the percentage of exams passed in the first try will be calculated for each of the region, this is done by looking at all the first tries from a certain region and looking what percentage is a first-time pass. Another percentage is calculated, the percentage of passed exams from the total exams, this thus also incorporates the candidates that have not passed a second or third time. The average amount of tries that a candidate needs in order to pass an exam is also calculated for the safety regions, this is done by looking at the times a candidate passed in one try, adding the amount of candidates that needed two tries and so on, divided by the total amount of exams taken. Then the average amount of points for the exams are calculated using the data of all the exams for the regions. Last, the best and worst criteria are identified for the safety regions by calculating the average point score for each of the twenty-five criteria.

3.3 Interviews

3.3.1 Sampling approach

The population where this research focusses on are two separate populations. On one side there is the population of teachers and instructors that teach the bevelvoerder course for the BOGO. On the other side there is the population of bevelvoerder candidates. The research makes use of non-probability sampling, the samples for the interviews were selected in a non-random way (Vehovar et al., 2016). Only teachers and instructors that have taught a class in the last five years were selected. One teacher and instructor from each of the six different safety regions was selected, this was done based on names provided by the regional education manager for the corresponding safety region. The regional education managers also provided names of candidates of the bevelvoerder education based on the following criteria: the candidate must have passed for their bevelvoerder education in the last five years, they must be in one of the three age categories; 20-30 years old, 30-40 years old, or 40+ years old. The criterium for the last five years is important since the education was revised. The different age categories are selected since a candidate may have a different opinion on certain topics related to their age. The invitation that was sent to the interviewees can be found in appendix C.

To prevent others to change the view of the interviewees, called conformity bias (Padalia, 2014), the interviews were conducted one on one. Another bias that was considered was the acquiescence bias, meaning that the participant agrees with the interviewer just to get the interview over with (Javeline, 1999). This was avoided by framing open-ended questions.

This led to a total of thirty respondents to be interviewed. In reality a total of twenty-five respondents were interviewed. With personal circumstances for the respondents being the reason for two interviews to be cancelled, and two other respondents did not respond to the invitation. Safety region Flevoland was unable to provide a name of an instructor who wanted to cooperate with the research. From safety regions Twente, North and East Gelderland and Gelderland middle, all that were asked did in fact cooperate with the interview. From IJsselland, Gelderland South and Flevoland the respondents were not complete. A table with the distribution of the interviewees can be found in Appendix J.

3.3.2 Data collection

The goal of the interviews is to determine what factors influence the passing rate of the bevelvoerder education and what candidates, teachers and instructors' attitude was towards the education programme. The questions were based on the theoretical framework. For this research, the interviews were conducted in a semi-structural way. 'Compared to structured interviews, semi-structured interviews can make better use of the knowledge-producing potentials of dialogues by allowing much more leeway for following up on whatever angles are deemed important by the interviewee. And, compared to unstructured interviews, the interviewer has a greater say in focusing on issues that he or she deems important in relation to the research project' (Leavy, 2020). Most of the questions were qualitative questions, however there were also a few quantitative questions in the interview guide. The interview guide for both the candidates as well as for the teachers and instructors can be found in Appendix B. According to Johnson et al. (2019) an in-person interview, by virtue of their conversational and more detailed nature, are superior to telephone and online interviews. The interviews were thus held in person at the fire station the respondents worked at. The interviews were recorded, allowing the data to be transcribed. The interviewees signed a consent form that is in appendix D.

3.3.3 Data analysis

The qualitative data will first be transcribed from the audio file. In this research transcription is chosen so that data-analysis is manageable, it makes coding easier. After the transcription, the data will be coded in several steps through the grounded theory method. According to Siegle and University of Connecticut (2023), the first phase of coding is called open coding. In this phase, codes, also called labels are connected to text fragments. These codes indicate the main theme per fragment. Then the second phase, axial coding, meaning that assigned codes will be compared to each other and will be grouped together under an overarching code. It is not necessarily the case that a piece of code falls only within one overarching category. After the axial-coding stage, main categories within the research are formed. The last step is selective coding, where the various categories found in axial coding will be connected around one core category. To minimize observer bias, the data from two interviews, one from a candidate and one from a teacher or instructor has been coded by a colleague, who has experiences with coding interviews. The results of the coding were checked to be comparable and consistent. The information has been used to improve the coding in this research.

For the quantitative questions, the corresponding answers are given in certain types of data. Age is being given in a ratio scale, previous education is sorted into categorical scale, the rankings from one until five questions are ordinal data, and the questions relating to which safety region they work for is nominal data. This data will be made into a dataset and will be analysed for correlation in R studio like described in the quantitative research section.

4. RESULTS

The data from the dataset was imported and analysed in RStudio. In the following section the results from the quantitative research and the qualitative research can be found.

4.1 Quantitative research

In table 4, the results that were concluded from the dataset can be found. Different results were calculated, the percentage of candidates from the region that passed in the first try, the percentage of the total exams that were taken by the safety region and the percentage that is passed, the average amount of times a candidate from a certain region needs to pass the exam, the average point scored in the exams by candidates from a safety region, and the worst and best criterium in terms of average score of a safety region. The corresponding assessment criteria can be found in the example assessment form in appendix E.

Table 4 results of data analysis

IJsselland	VR exam	Fire exam
Passed first try %	81.40%	57.50%
Passed exams total %	82.00%	67.92%
Average amount of exams needed	1.19 exams	1.58 exams
Average point score in exam	71.28 points	70.05 points
Worst Criterium score	Criterium 3.6	Criterium 3.6
Best criterium score	Criterium 4.1	Criterium 6.1
Twente	**VR exam**	**Fire exam**
Passed first try %	74.47%	75.51%
Passed exams total %	74.60%	78.69%
Average amount of exams needed	1.34 exams	1.25 exams
Average point score in exam	70.87 points	71.41 points
Worst criterium score	Criterium 3.6	Criterium 3.6
Best criterium score	Criterium 7.2	Criterium 7.1 and 7.2
North and East Gelderland	**VR exam**	**Fire exam**
Passed first try %	70.37%	64.20%
Passed exams total %	76.19%	68.18%
Average amount of exams needed	1.35 exams	1.38 exams
Average point score in exam	70.94 points	70.17 points
Worst criterium score	Criterium 5.4	Criterium 2.4
Best criterium score	Criterium 6.1 and 7.2	Criterium 4.4
Gelderland South	**VR exam**	**Fire exam**
Passed first try %	84.91%	83.33%
Passed exams total %	84.75%	77.27%
Average amount of exams needed	1.11 exams	1.22 exams
Average point score in exam	71.15 points	70.95 points
Worst criterium score	Criterium 3.6	Criterium 2.4
Best criterium score	Criterium 6.1	Criterium 2.1, 2.3, 3.1, 5.1, 6.1, and 7.1
Flevoland	**VR exam**	**Fire exam**
Passed first try %	88.64%	74.42%
Passed exams total %	89.80%	79.63%
Average amount of exams needed	1.11 exams	1.28 exams
Average point score in exam	72.41 points	71.54 points
Worst criterium score	Criterium 3.6	Criterium 3.4
Best criterium score	Criterium 1.1	Criterium 6.1

The mean for the point total for the VR exam is 71.23, with a standard deviation of 2.86, and a 95% Confidence Interval that the real mean of the population lies between 70.92 and 71.55 and for the fire exam is 70.7 points with a standard deviation of 3.28, and a 95% Confidence Interval that the real mean of the population lies between 70.33 and 71.07. All average scores of the safety regions lie within the first standard deviation. The worst criterium for the VR exam is criterium 3.6, which is the worst criterium for all separate regions except North and East Gelderland. The best scored criterium in the VR exam on average is criterium 7.2. For the fire exam, the worst scored criterium on average is criterium 2.4, the best scored criterium is 6.1. Criterium 3.6 in the VR exam stands out in the fact that it is the worst criterium for all the regions but one. 3.6 is 'Makes decisions related to the dynamics (time-tempo) of the incident', a bad score here means that according to the exam committee the candidate should have acted quicker or should have different priorities in the deployment.

When it comes to the first-time passing rate of the exams, Twente (74.60%) and North East Gelderland (70.37%) score relatively low compared to IJsselland (81.40%), Gelderland South (84.91%) and Flevoland (88.64%) on the VR exam. For the first time passing rate of the fire exam, North and East Gelderland (64.20%) and IJsselland (57.50%) score low compared to Flevoland (74.42%), Twente (75.51%) and Gelderland South (83.33%). On average candidates need 1.24 times to pass the VR exam and 1.38 times to pass the fire exam, the average score of 1.58 exams for fire from IJsselland really stands out here.

In the data, the VR test, there are different test scenarios that a candidate can face. These scenarios all have a number, there are eleven different scenarios named 1 until 11. These are however not evenly distributed, as can be seen in appendix F. Interestingly scenario 7 is chosen more often than the other scenarios. To test whether the scenarios have significantly different mean a one-way ANOVA will be done. The score must fulfil the following assumptions: independence of observations assumption, normality assumption and the equality of variance assumption we use an alpha of 0.05. The research meets the independence of observations assumption, since no participant is in more than one group. The equality of variance assumption is tested by a Brown-Forsythe Test, with test statistics $F(10, 318) = 1.6$, $p = 0.105$. This high p-value, higher than the threshold of 0.05, indicates there is no significant evidence to suggest a violation of the assumption of equal variances. Thus, according to the Brown-Forsythe Test, the variances across the groups can be considered equal. For the normality assumption the Shapiro-Wilk test was used. All the different scenarios were tested for the normality assumption. Based on the outcomes of p-values higher than the threshold of

0.05 assisted with visual inspection, the tests indicate that the data does not deviate significantly from the normal distribution. For the ANOVA, the following hypothesis were used:

H0: There is no difference between the 11 categories of the independent variable scenario with respect to the dependent variable points.

Ha: There is a difference between the 11 categories of the independent variable scenario with respect to the dependent variable points.

Table 5 one-way ANOVA results

	Sum of Squares	df	Mean Square	F	p
Scenario	140.25	10	14.03	1.76	.067
Residual	2535.99	318	7.97		
Total	2676.24	328			

The outcome of the one-way ANOVA test can be seen in the table 5. The p-value of .067 is greater than the significance level of 0.05. This indicates that there is no statistically significant difference between the different scenarios, therefore the null hypothesis cannot be rejected.

To test whether the different safety regions have a significantly different mean for the VR exam and the fire exam, another one-way ANOVA test is carried out. The test fulfils the assumptions mentioned in the first one-way ANOVA test, the following hypotheses were used:

H0: There is no difference between the 5 categories of the independent variable safety region in terms of the dependent variable points when it comes to the VR exam.

Ha: There is a difference between the 5 categories of the independent variable safety region in terms of the dependent variable points when it comes to the VR exam. The results for the VR exam:

Table 6 one-way ANOVA results

	Sum of Squares	df	Mean Square	F	p
safety region	85.95	4	21.49	2.67	.032
Residual	2613.08	325	8.04		
Total	2699.03	329			

In table 6, the results of the one-way ANOVA can be found. The p-value of .032 is smaller than the significance level of 0.05. This indicates that there is a statistically significant difference between the different safety regions, therefore the null hypothesis is rejected. A post hoc test was performed in the form of A Dunn-Bonferroni test to compare the safety regions in pairs to find out which was significantly different. The Dunn-Bonferroni test revealed that there was a significant difference between the regions of North and East Gelderland – Flevoland ($p = .027$) and Flevoland – Twente ($p = 0.048$). The complete table from the Dunn-Bonferroni test can be found in appendix G.

For the fire exam the data does not fulfil the normality assumption for the one-way ANOVA, thus a Kruskal-Wallis test is conducted with the following hypotheses:

H0: There is no difference between the 5 categories of the independent variable safety region in terms of the dependent variable points when it comes to the fire exam.

Ha: There is a difference between the 5 categories of the independent variable safety region in terms of the dependent variable points when it comes to the fire exam.

The Kruskal-Wallis test results with a Chi-squared value of 13.4, df of 4, and a p-value of .009 indicate that there is a statistically significant difference in points across the 5 groups being compared (results in table 7). The exact nature of these differences requires additional post-hoc testing. The Dunn-Bonferroni-Tests table is in appendix H. Despite the significant difference in the Kruskal-Wallis test, no pairwise group comparison was significant in the Dunn-Bonferroni test; all adjusted p values were greater than 0.05.

Table 7 Kruskall-Wallis test

	Chi^2	df	p
Points	13.4	4	.009

To test whether a difference between the score in points per criterium between the safety regions is present. Per criterium a Kruskall-Wallis test was executed. By criterium 1.3 and 6.1 the test a significant difference between the categories of the independent variable with respect to the dependent variable, for criterium 1.3 $p = .002$ for criterium 6.1 $p = .001$. For these criteria, a post hoc test was performed in the form of A Dunn-Bonferroni test was to compare the safety regions in pairs to find out which was significantly different. For criterium 1.3 The Dunn-Bonferroni test showed that the pairwise group comparison of VNOG - Gelderland Zuid has an adjusted p-value of .004 which is less than 0.05, and thus, based on the available data, it can be assumed that the two groups were significantly different from each other. For criterium 6.1, The Dunn-Bonferroni test revealed that the pairwise group comparisons of VNOG - IJsselland and IJsselland - Gelderland South have an adjusted p-value less than 0.05 and thus, $p = .013$ for VNOG-IJsselland and $p < .001$ for IJsselland-Gelderland South. So based on the available data, it can be assumed that these groups were significantly different in pairs. This means that for these regions the score on these criteriums differs significantly, the source of the difference can not be concluded from this research.

4.2 Interviews

In the interviews two different motives to become a firefighter came forward. The first motive was development. Candidates wanted to develop themselves further both in personal life as well as in a professional manner. The other motive was that the fire station had a shortage of bevelvoerders. This meant that they were asked to do the education. Out of the seven interviewees that stated that they were asked to become a bevelvoerder, five said that at that moment they would have preferred to wait before starting the education since they felt that they did not have enough experience to become a bevelvoerder. All of them stated however that in hindsight sometimes coming in unexperienced proofed to be an advantage for them, since they did not have customs that they had to unlearn. They did see a difference with other candidates in their class, who were for example very experienced or doing firefighting as their day job.

All the respondents stated that their motivation level was high during the education. This is confirmed by the statements of the teachers and instructors who also all said that the candidates were motivated. Only two different elements were mentioned that were demotivating. One being education during Covid-19, the other element mentioned was failing exams.

The interviewees have different views of the assessment they had to do beforehand. The overall feeling was that it was more to test the intellectual ability necessary for the education. Six interviewees stated that they felt that the assessment was a good test for the competencies a bevelvoerder should have. The feeling with the assessment was however that it was not related to firefighting, the interviewees that stated this said that they would find the assessment better to test their competencies when it would be firefighting themed. The opinion of the teachers and instructors on the assessment was, that it is a good base to test the competencies and the different personality traits. One teacher stated that he did not think it was a good assessment, and that when candidates get a negative advice, they are still allowed to start the bevelvoerder education. More teachers and instructors mentioned they did not get to see the results of the assessments and thus cannot directly help the candidate with their development points.

Overall, the candidates scored their own digital skills for the bevelvoerder education a 4.29 average score. This is on a scale of one until five, with one being very unable and five being very able. The average score the candidates gave the level of difficulty of the education is a 2.86 and a 2.93 for intensity of the education, this was also on a scale of one until five, with one being very easy and completely not intensive and five being very difficult and very intensive. These scores are very average and mean that it is a good balance for the candidates.

The scores the candidates gave for level of digital skills, difficulty of the education, and intensity of the education were tested for correlation on the independent variable of age, a Spearman correlation analysis was done with the following hypotheses.

H0: There is no correlation

Ha: There is a correlation

Digital skills and level of difficulty both have little to no correlation as can be seen in table 8. However, age and level of intensity have a strong positive correlation of 0.82, with a significance level of <.001, which is below the threshold of 0.05 and means the null hypothesis can be rejected.

Table 8 Spearman correlation analysis

		Age	Digital skills	Level of difficulty	Level of intensity
Age	Cor.	1	0.12	0.28	0.82
	p		.682	.327	<.001
Digital skills	Cor.	0.12	1	-0.35	-0.06
	p	.682		.226	.848
Level of difficulty	Cor.	0.28	-0.35	1	0.4
	p	.327	.226		.16
Level of intensity	Cor.	0.82	-0.06	0.4	1
	p	<.001	.848	.16	

All candidates stated that they did not feel that people had the urge to be the best in their class, that they helped each other when necessary and that everyone has stronger and weaker points. The teachers and instructors confirmed this view. One thing they did mention was that some candidates did show macho behaviour. They managed this by asking questions that the candidates could not answer, to show them that they still have lots to learn.

Every single candidate, teacher and instructor felt that there was an open climate in the classroom. They felt the freedom to give feedback to others, to discuss moments and to make mistakes. The teachers and instructors stated that they created this freedom by mentioning at the beginning of the education the way that it will go. Thus, what the candidates can expect from them, but also by asking what they expect from the candidates. and by keeping it easy, open, and transparent, and not publicly humiliating candidates when they make mistakes.

The candidates felt overall that they did not always have the correct materials to their disposal. Often materials were missing. A teacher mentioned a case where he had to teach at a fire department where he was not familiar, he also did not have any candidates that were familiar there, and all the materials were locked away. Another candidate mentioned a case of materials that were missing on the fire trucks when they were practising realistically at the training base in Weeze. Also, when a teacher wanted a specialist team to give a lesson about specialistic technical assistance the safety region did not want to fund this. Many of the interviewees said it was due to their own effort, not the effort of the organization, that they did have the right materials.

Teachers and instructors stated that they give feedback in several ways. First, they let the candidate reflect on their own work. They mostly give spoken feedback to the candidates, involving other candidates in this process. They say to the candidates that they should give each other open and honest feedback, but that it must be positive, constructive feedback. Through these forms of honest, but positive feedback the candidates can help each other grow according to one teacher.

None of the candidates declare that they have actual fear of failure. They are all naturally nervous before the exams, but this is also something that keeps them on edge to perform well. One teacher mentioned that he once did have a candidate that had a real fear of failure. He said that he would talk to this candidate alone, and that he would try to give the candidate a little more confidence but was also honest to the candidate. That decision taking is particularly important as a bevelvoerder, and that if he could not overcome his fear of failure, that the job of bevelvoerder would not work.

The majority of the candidates, teachers and instructors find the exams representative of the competencies that the candidate should have at the end of the education. Some did state that they found the VR exam difficult to be realistic, and that they found it difficult to operate the joystick. Multiple times it came forward that they felt that the exam committee has an influence on the outcome of the exam. That one committee is much stricter than the next. Some teachers question whether all the examiners test the candidates on the level of a novice professional, like they should.

None of the candidates felt that their personal life has influenced their bevelvoerder education. However, some stated that the other way around, that their bevelvoerder education did hinder them in their personal lives. They said that they had to cancel their team sports, or that they did not have enough time to be social with friends.

In the section about subjects that need more or less attention, a lot of different answers came forward, most of the candidates stated that it was okay the way it is. Some of the candidates said that they were not ready for their local specialism, for example one candidate has a forest fire specialism in their local fire department. This is not taught in the bevelvoerder education by the BOGO. When this candidate finished his education, it was forest fire season, one of his first incidents was a forest fire where he felt he was not well enough prepared. Another subject that came forward is the lack of knowledge about solar panels, energy transition, fire prevention and construction. According to two teachers, in the beginning the information about leadership can be shortened.

One of the points of improvement is that the lesson plans from the BOGO need improvement. Some of the lessons have too much learning goals, where it is not realistic to achieve all the goals. Some of the lessons are also not interactive enough, meaning that the teachers and instructors all use different forms to teach. The teachers, instructors and candidates find that the ELO needs to become more user friendly. For those who prefer learning from paper it must be possible to print the ELO. A search function could also improve the ELO, since when candidates want to search for a specific term, it is difficult to find in all the lessons. In appendix L, the complete list of topics that were addressed in the interviews from this research can be found.

4.3 Cost modelling

To calculate the costs for the bevelvoerder education for the regions, the bottom-up method will be used. This methods takes into account the individual costs of the different aspects and adds them to get the total cost (Batura et al., 2014). The costs for the bevelvoerder education differ per region. To calculate the average cost to educate one bevelvoerder certain information is necessary. Several factors influence the cost, for the education to be a daytime or evening course, the starting rate is needed (depends on the amount of candidates), and the amount and costs of the re-examinations, these costs for the re-examination can be found in table 3 in section 1.3.3. To this the salary costs times the number of hours that the candidates spend on the physical moments of education need to be added. The time spend on examinations is also added times the hourly wage of the candidates. The different standard formulas based on size of class and daytime or evening course can be found in appendix K. This makes the general formula for the bevelvoerder education;

Costs for educating one bevelvoerder = Starting rate of the class + average amount of examinations VR * 640 + average amount of examinations fire * 1.870 + hourly wage of bevelvoerder candidates * 233 hours + average amount of examinations VR * 4 hours * hourly wage of bevelvoerder candidates + average amount of examinations fire * 4 hours * hourly wage of bevelvoerder candidates

This means that to save money the average amount of re-examinations for the VR exam and the fire exam needs to be brought down. Especially the fire exam has a significant impact on the price, since this is the most expensive re-examination. The safety regions do not have an influence on the starting rate, the hourly wage, and the number of hours spend on the physical education moments.

5. DISCUSSION

5.1 Conclusion

By analysing quantitative data and conducting interviews this research set out to answer the following question:

"What factors influence the passing rate for the bevelvoerder education and what are the bevelvoerder education-related costs for the Oost6 safety regions?"

The factors that influence the passing rate for the bevelvoerder education according to this research are: the examination committee, the region in which the candidate is educated, motivation, the lesson plans of the BOGO, user-friendliness of the ELO, and whether or not the candidates have the right materials to their disposal. The bevelvoerder education-related costs are influenced by the starting rate of the education, the costs for re-examination, the amount of re-examinations, the hourly wage, the length of the education in hours, and the amount of hours spend on examinations. In the following paragraphs this will be elaborated more.

The VR exam has a first-time passing rate of 79.48%, the fire exam 68.40%. On average, the candidates need 1.24 times to pass the VR exam and 1.38 times to pass the fire exam. The worst criterium for the VR exam is criterium 3.6, 'Makes decisions related to the dynamics (time-tempo) of the incident.' The best criterium was 7.2, 'Continues to function effectively under time pressure, setbacks, aggression, or disappointment in cooperation with multi-partners and other involved parties.' For the fire exam, the worst criterium was 2.4, 'Decides on a deployment tactic expressed in a final deployment plan that matches the deployment goals, prioritizes correctly, and minimizes risks as much as possible; decides if necessary to scale up and engage knowledge and resources' The best criterium was 6.1, 'Ensures a completion of the deployment (in relation to the scenario)'. These worst scored assignments are judging the candidates on their abilities to make decisions as a bevelvoerder, not scoring well on these criteria might be in relation with the feeling from the interviewees that the exam committee does not judge them on the level of a novice professional. It might also mean that the candidates need more practice moments.

The statistical tests showed that the scenario used for the VR exam does not have a significant influence on the number of points scored. However, the test did show that there is a significant difference when in points scored on the VR exam between North and East Gelderland – Flevoland and Flevoland – Twente. For the fire exam there was also a significant difference in point score for the safety regions, however here there was no significant difference between the groups in the post hoc test. All the criteriums were also tested for differences in scores between the safety regions. Only on criterium 1.3, VNOG - Gelderland Zuid and 6.1, VNOG - IJsselland and IJsselland - Gelderland South was a significant difference found.

According to the literature, academic competition does influence performance in a negative way (Hancock, 2001) However, in the interviews no case of academic competition came forward. The candidates did also experience an open classroom climate, which according to Graf et al. (2024) has a positive influence on knowledge.

Having the right materials to a candidates' disposal contributes to learning according to Hodkinson et al. (2007). The candidates, teachers and instructors did not feel that they always had the right materials to their disposal. The digital skills of the candidates were rated 4.29 out of 5 by themselves. This is a high score, meaning that the self-efficacy of the candidates is good. This high self-efficacy score contributes to learning (Maurer et al., 2003). There was a strong, positive relationship found between the independent variable of age and the dependent variable of intensity. This means that the older the candidate, the more intense the education is perceived.

Feedback was given in written form to the candidates, as well as in a verbal way. The teachers and instructors all stated that they

started with letting the candidates think for themselves. Giving feedback in this way increase what is learnt (Kulhavy, 1977)

In research by Sorrentino et al. (1996), was found that performance on test varies as a function of whether people perceive the test as a good measure of their ability, and whether they are positively motivated to do well on the test. The motivation of the candidates was very high, however the feeling that the assessment was a good test of their ability was not completely there. Candidates found that it was not firefighting themed, here improvements might be possible to give candidates more the feeling that the test measures their abilities in a good way. The exams were deemed representative of the competencies that the candidates need at the end of their education. But the feeling that the examination committee has a substantial influence on the exam result did come forward. The candidates, teachers and instructors questioned whether all examiners examined the candidates on the level of a novice professional.

Points of improvements were mentioned by the interviewees. They wanted more about solar panels, energy transition, fire prevention and construction and their local specialisms. A subject that came forward that could be shortened was leadership. Another point of improvement was the lesson plans the BOGO provides, some of these have too much learning goals, which are not realistic to achieve within a lesson. Besides the lesson plans, the ELO was mentioned, this needs to become more user friendly.

The costs for the education are influenced by several factors. First, it is influenced by the starting rate, the starting rate differs whether it is an evening or a daytime class and differs due to the size of the class. Second, the number of re-examinations has an influence on the costs of the education. This can be split in the number of re-examinations for the VR exam and for the fire exam. Third, the hourly wages and corresponding hours spend on the education have an influence on the total costs along with the hours spent on examinations with corresponding wages.

5.2 Theoretical implications

There has not been any research into the factors that influence the passing rate for the bevelvoerder education in the Netherlands. This research gives insight into the assessment criteria where candidates score well and not so well. Through the interviews the opinion of the candidates, teachers and instructors also becomes clearer. How they feel about the education. This research also provides information over the feeling towards the climate in the bevelvoerder education environment.

5.3 Practical implications

We see large differences in the exam passing rates from the different safety regions. IJsselland scores very well on the VR exam, whilst their fire exam passing rate is significantly lower. Here Gelderland South scores well for example. It might be a clever idea for the regions to come together and explain to one another how they approach the different exams. Teachers from different regions can exchange teaching methods and potentially provide new insights to other teachers.

The different safety regions can each see what their strong and weak assessment criteria are. The regions can provide this information to the teachers, who might be able to focus more on the weaker criteria, which may improve the passing rate.

This research recommends the safety regions to have the data of the test under own management. They might want to start registering test scores for the theoretical exams, since this is not done at all. When this data is in own management, the regions will have more insight in areas to improve on continuously.

Teachers mentioned they would like to have more insight into the assessment of the candidates. They must develop certain points with the candidates but are not allowed to see the results of the assessment. It might be an idea to ask the candidates whether they want to share their outcomes to better develop themselves during the education programme.

5.4 Limitations

During the study, several limitations presented itself, in the following section several limitations will be discussed. In a research like this it is impossible to completely eliminate all forms of biases. It proofed that it was very difficult for the safety regions to provide the necessary data for the research. Large portions of the data were not directly accessible by the regional education managers, for which they had to contact the BOGO. This resulted in the fact that for Gelderland-Middle no data was provided. For Gelderland South, the data was incomplete. Another factor that limited this research was that not all thirty candidates were interviewed. Some did not respond to my invitation, but it was also not possible for the regional education manager to find candidates willing to cooperate for the research.

Self-serving bias may apply to the responses by the interviewees. Meaning the tendency to perceive oneself in an overly favourable manner (Nikolopoulou, 2023). This may result in over-positive answers. Another bias that might apply is response bias, this might arise through candidates that want to finish the interview and thus do not take the time to answer completely, instead answering only in the quickest way possible to get the interview over with (Michalos, 2014). The interviews were conducted in person to minimize this bias. In the coding after the interview, researcher bias might arise. This is the unconscious influence that previous experiences, cultural background, and personal beliefs have on interpreting data (Pannucci & Wilkins, 2010). According to the NIPV, there is a macho-culture present in the fire department (Nederlands Instituut Publieke Veiligheid, 2023). This is something that might influence the answers of the interviewees. They might feel pressure answering vulnerable questions even when they answer anonymously.

5.5 Further research

Based on this research there is a recommendation to further research, some of the interviewees stated that there is a difference between examination committees. Beforehand this would have been incorporated in this research if the data would be available, but due to privacy this was not possible. Still, this is an important blind spot to look further into, what is the influence of the exam committee on the passing rate of the candidates. Is there a pattern to be found in the scoring of certain examiners? Another recommendation for further research is looking into the theoretical tests during the education programme. This data is not well kept, and little insight is possible, test scores are not stored, only whether a candidate has passed the test or not. This research would be to get a better understanding of how many exams it takes on average to pass the theoretical tests and what the implications are for this. Another recommendation for further research is looking into the candidates that got a negative advice from the assessment, how did the education programme go for them, did they succeed? And why did they get a negative recommendation? Another question arose in this research, why is scenario 7 in the VR test chosen more often? This is something that deserves attention. Also, in the result section, there was a significant difference found between groups on scores on certain criteria, this research cannot explain where this difference comes from, so this is something that can be researched and might lead to regions learning from each other.

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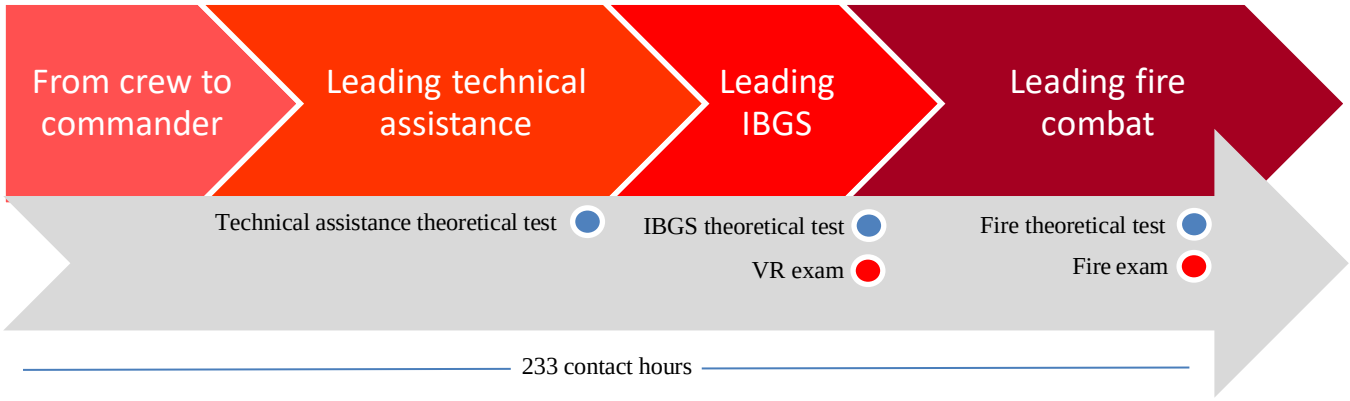
7. APPENDIX

7.1 Appendix A

Visual overview of the bevelvoerder education.



7.2 Appendix B

Interview guides candidates and teachers/instructors translated to English.

Interview with Candidates for the Commander Training Program

Introduction Questions

- What is your name?
- How old are you?
- What is your prior education?
- At which fire station are you employed?
- Do you have a permanent appointment or are you a volunteer?
- When did you complete the firefighter training?
- When did you start the commander training program?
- What was your motivation to pursue the commander training program?
- Do you feel that the competencies tested during the assessment match those of a commander?

Blended Learning

- The commander course was offered to you as blended learning. How did you experience that?
- The physical contact moments and the theory in the ELO (Electronic Learning Environment)?
- Were there any advantages or disadvantages for you in working with the ELO?
- Were there any advantages or disadvantages for you in working with the physical contact moments?
- How digitally skilled do you consider yourself to be regarding the skills needed during the training on a scale of 1 to 5, where 1 is not skilled at all and 5 is very skilled? (Creating LWPOs in the ELO)

Dual Learning

- How do you find the concept of learning workplace assignments that take place at your own post?
- Do you think that learning at the department provides a realistic environment for you to practice?

Learning Climate

- How would you describe the learning climate within the training?
- Do you feel that there was an internal drive for candidates to be the best of the class?
- Do you feel that there is an open climate in the class?
- Do you feel the freedom to make mistakes during the training?

Learning Culture

- How did you experience the guidance during the course? (from the teacher, instructor, training coordinator, own department, learning workplace supervisor)
- Where did you achieve the highest learning yield, in your work environment or during the training evenings? And why?
- Were the training evenings sufficient to pass?
- Did you have the right materials and resources at your disposal during your training?

Instruction

- Did the contact moments feel interactive?
- How did you experience the instruction from the instructor?
- Were the lesson evenings structured?
- How were you constantly involved in the lesson during the training evenings?

Feedback

- How did you receive feedback during the training?
- Have you ever found feedback demotivating?

Human Factors

- Have you ever suffered from performance anxiety?
- Do you find the exams representative of testing the competencies you need to master by the end of the training?
- How was your motivation during the training? What motivated you and what demotivated you?
- Has your personal life ever hindered you in your commander training?

Closing Questions

- Are there certain subjects during the training that you think are given too little or too much attention?
- How would you rate the level of the commander training on a scale of 1 to 5?
- How intensive did you find the commander training on a scale of 1 to 5?
- Is there anything you encountered during the commander training?
- What do you think are areas for improvement in the commander training?
- Is there anything else you want to tell me about the commander training?

Interview with Teachers/Instructors of the Commander Training Program

Introduction Questions

- What is your name?
- How old are you?
- Are you a teacher or instructor in the commander training program?
- What is your prior education?
- For which region are you working?
- Are you actively operational yourself?
- When did you complete the commander training program yourself?
- When did you start teaching in the commander training program?
- What was your motivation to start teaching in the commander training program?
- Do you feel that the competencies tested during the assessment match those of a commander?

Blended Learning

- The commander course is offered as blended learning. How do you experience that?
- The physical contact moments and the theory in the ELO (Electronic Learning Environment)?
- Are there any advantages or disadvantages for you in working with the ELO?
- Are there any advantages or disadvantages for you in working with the physical contact moments?

Dual Learning

- How do you find the concept of learning workplace assignments that take place at the candidates' own post?
- Do you think that learning at the department provides a realistic environment for the candidates to practice?

Learning Climate

- How would you describe the learning climate within the training?
- Do you feel that there is an internal drive among the candidates to be the best?
- Do you feel that there is an open climate in the class?
- How do you deal with candidates who make mistakes?

Learning Culture

- How do you experience the collaboration with other supervisors during the course? (teacher, instructor, training coordinator, own department, learning workplace supervisor)
- Where do you think the candidates achieve the highest learning yield, in the work environment or during the training evenings? And why?
- Are the training evenings sufficient to let the candidates pass?
- Did you have the right materials and resources at your disposal during the training?

Instruction

- Are the contact moments interactive?
- How did you experience the support from the instructors?
- Are the lesson evenings structured?
- How do you try to keep everyone constantly involved in the lesson during the training evenings?
- Are different learning styles addressed in the commander training program?

Feedback

- How did you provide feedback to the candidates during the training?
- Is there a specific method for giving feedback?

Human Factors

- Have you had candidates who suffered from performance anxiety?
- Do you find the exams representative of testing the competencies that the candidates need to master by the end of the training?
- How was the motivation of the candidates during the training? What motivated them and what demotivated them?

Closing Questions

- Are there certain subjects during the training that you think are given too little or too much attention?
- Is there anything you encounter while teaching in the commander training program?
- What do you think are areas for improvement in the commander training program?
- Is there anything else you want to tell me about the commander training program?

7.3 Appendix C

Invitation translated to English

Subject: Invitation to Interview about the Commander Training Program

Dear …,

I received your name from (Name of corresponding regional manager) and understand that you are willing to participate in an interview about the commander training program for my research. I am a student at the University of Twente, currently finishing my studies in International Business Administration. Additionally, I have been a volunteer firefighter in Ootmarsum for the past two years. My research focuses on the passing rate of the training program and the factors that influence this passing rate.

I appreciate that you are willing to take the time to help me further. I would like to schedule an appointment with you for the interview (± 45 minutes). I will come to a location of your choice, preferably the fire station where you work. This can be at any time of the day from (certain time period). Is there a moment during this week that fits your schedule? If you absolutely cannot make time in your schedule during this week, an alternative appointment can be arranged. Based on the responses from you and your colleagues, the appointments will be scheduled.

I look forward to your response or any questions you may have.

Kind regards,

Rachel Bloemen

Graduate Student, Fire Department Twente

7.4 Appendix D

Consent form translated to English

Purpose of the Study:

You are invited to participate in a research study conducted by Rachel Bloemen, an International Business Administration student at the University of Twente. The purpose of this study is to gain insights on the passing rate of the training program and the factors that influence this passing rate .

Procedures:

If you agree to participate, you will be asked to take part in an interview that will last approximately 45 minutes. The interview will be conducted at a mutually agreed-upon time and place.

Recording of Interview:

With your permission, the interview will be audio-recorded to ensure accurate transcription of the data. The recordings will be securely stored and will be accessible only to the researcher and the research supervisor.

Confidentiality:

Your participation in this study is voluntary, and you can withdraw at any time without penalty. Your name and any other identifying information will not be used in any reports or publications resulting from this study. Your responses will be anonymized to protect your identity.

Benefits and Risks:

There are no direct benefits to you for participating in this study. However, your participation will contribute to the advancement of knowledge in this field. There are no foreseeable risks associated with participating in this study.

Consent:

By signing this form, you agree to participate in this study and consent to the audio recording of the interview. You understand that your participation is voluntary and that you can withdraw at any time. You also understand that your responses will remain anonymous.

Participant's Statement:

I have read the information provided above and have had all my questions answered to my satisfaction. I voluntarily agree to participate in this study and to the audio recording of the interview.

Participant's Name: _____

Participant's Signature: _____

Date: _____

Researcher's Statement:

I certify that I have explained the nature and purpose of this study, the procedures, and the potential risks and benefits. I have answered all questions to the best of my ability.

Researcher's Name: _____

Researcher's Signature: _____

Date: _____

7.5 Appendix E

Assessment form example, same criteria for VR exam and fire exam.

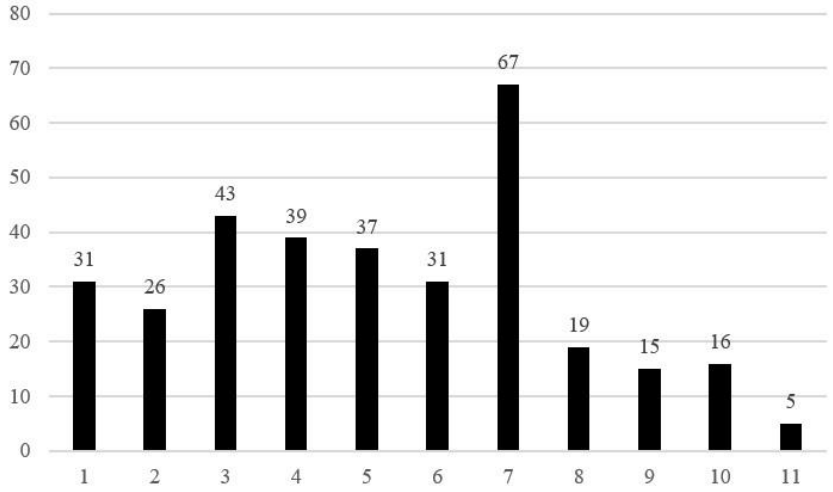
Assessment criteria	Points obtained: 70	Explanation
1.1 Collects relevant facts, consults information sources, and selects realistic scenarios after analyzing the initial information	Sufficient	-
1.2 Makes a realistic assessment of the escalation possibilities, decides if necessary to scale up and engage knowledge and resources, and motivates this	Insufficient	Escalation scenario: if I have victims, then I escalate. This is not the correct escalation motivation.
1.3 Shares risk scenarios, associated control measures, and preliminary approach with the team	Sufficient	-
2.1 Determines a safe staging area considering incident/environment/approaching units	Sufficient	-
2.2 Collects current facts and additional information and actively looks for 'What is different than I expected?'	Sufficient	-
2.3 Identifies relevant priorities and hazards, makes a realistic assessment of the extent and escalation possibilities, and shares these with the team	Sufficient	-
2.4 Decides on a deployment tactic expressed in a final deployment plan that matches the deployment goals, prioritizes correctly, and minimizes risks as much as possible; decides if necessary to scale up and engage knowledge and resources	Insufficient	Escalates only after 7 minutes upon arrival. Has a fully developed fire, victims, and a suicide victim.
3.1 Ensures an orderly and efficient layout of the work area	Sufficient	-
3.2 Translates the chosen tactic into concrete assignments for personnel and supporting units (e.g., rescue vehicle and HV vehicle)	Sufficient	-
3.3 Makes efficient use of available knowledge, skills, vehicles, and materials	Sufficient	-
3.4 Ensures personal safety for oneself and the team by responding to signals and observations and using (measuring) equipment and PPE	Sufficient	-
3.5 Considers the development of the incident and the possible occurrence of damage in the surrounding area (impact area)	Sufficient	-
3.6 Makes decisions related to the dynamics (time-tempo) of the incident	Sufficient	-
4.1 Gives clear and executable orders to the personnel	Sufficient	-
4.2 Provides clear further messages and a situation report to the control room at the right time	Sufficient	-
4.3 Cooperates with the second commander, OvD, AGS, other emergency services, and involved parties, and knows who is responsible for what (situation, what has been done, what is still ongoing, and what needs to be done)	**Largely insufficient**	Wants to place the responsibility for the rescue of the suicide victim with the police and ambulance service.
4.4 Shares new essential information directly with the team and other stakeholders	Sufficient	-
5.1 Checks whether orders are executed by personnel and adjusts if necessary	Sufficient	-
5.2 Checks whether the deployment goal is achieved and adjusts if necessary to match the dynamics of the incident	Sufficient	-

5.3 Oversees the consequences of the deployment and adjusts priorities/actions if the situation requires it	Sufficient	-
5.4 Monitors safe actions during the deployment; pays attention to risks for personnel, victim(s), and environment	Sufficient	-
6.1 Ensures a completion of the deployment (in relation to the scenario)	Sufficient	-
6.2 Transfers relevant aspects of his deployment tasks to the OvD/involved parties	Insufficient	Walks away during the handover of relevant matters to the OVD.
7.1 Continues to function effectively under time pressure, setbacks, aggression, or disappointment in relation to his own team	Sufficient	-
7.2 Continues to function effectively under time pressure, setbacks, aggression, or disappointment in cooperation with multi-partners and other involved parties	Sufficient	-

7.6 Appendix F

Distribution of the VR exam scenarios

Scenario	Times used
1	31
2	26
3	43
4	39
5	37
6	31
7	67
8	19
9	15
10	16
11	5



7.7 Appendix G

Dunn-Bonferroni test table for the points by region on the VR exam

		Mean diff.	Std. Error	t	p	95% CI lower limit	95% CI upper limit
VNOG	IJsselland	-0.34	0.484	-0.71	1	-1.77	1.09
VNOG	Flevoland	-1.47	0.488	-3.02	.027	-2.91	-0.03
VNOG	Twente	0.06	0.449	0.14	1	-1.26	1.39
VNOG	Gelderland Zuid	-0.22	0.458	-0.47	1	-1.57	1.14
IJsselland	Flevoland	-1.13	0.57	-1.98	.486	-2.81	0.55
IJsselland	Twente	0.41	0.537	0.76	1	-1.18	1.99
IJsselland	Gelderland Zuid	0.13	0.545	0.23	1	-1.48	1.74
Flevoland	Twente	1.54	0.54	2.84	.048	-0.06	3.13
Flevoland	Gelderland Zuid	1.26	0.548	2.29	.226	-0.36	2.87
Twente	Gelderland Zuid	-0.28	0.514	-0.54	1	-1.8	1.24

7.8 Appendix H

Dunn-Bonferroni test table for the points per region on the fire exam

	Test Statistic	Std. Error	Std. Test Statistic	p	Adj. p
VNOG - IJsselland	1.74	14.12	0.12	.902	1
VNOG - Flevoland	-38.49	14.78	-2.61	.009	.092
VNOG - Twente	-38.44	14.2	-2.71	.007	.068
VNOG - Gelderland Zuid	-20.25	20.77	-0.98	.33	1
IJsselland - Flevoland	-40.23	16.55	-2.43	.015	.151
IJsselland - Twente	-40.18	16.04	-2.51	.012	.122
IJsselland - Gelderland Zuid	-21.99	22.07	-1	.319	1
Flevoland - Twente	0.05	16.62	0	.998	1
Flevoland - Gelderland Zuid	18.24	22.49	0.81	.417	1
Twente - Gelderland Zuid	18.19	22.12	0.82	.411	1

Adj. p: Values adjusted with Bonferroni correction.

7.9 Appendix I

Starting rates of the bevelvoerder education from the BOGO (Stichting Brandweeropleidingen BOGO, 2023b).

Table 3 Starting rates of the bevelvoerder education programme

Type of course	Size of class	Costs
Evening course including examinations	12 students	€15.235 per candidate
Evening course including examinations	10 students	€16.300 per candidate
Evening course including examinations	8 students	€17.685 per candidate
Evening course including examinations	6 students	€17.570 per candidate
Daytime course including examinations	12 students	€15.805 per candidate
Daytime course including examinations	10 students	€16.870 per candidate
Daytime course including examinations	8 students	€18.225 per candidate
Daytime course including examinations	6 students	€18.140 per candidate

7.10 Appendix J

Table showing the interviewees.

Table 4 distribution of the interviewees

	20-30 years old	30-40 years old	40+ years old	Teacher	Instructor
Safety region IJsselland	0	1	1	1	1
Safety region Twente	1	1	1	1	1
Safety region North and East Gelderland	1	1	1	1	1
Safety region Gelderland-Middle	1	1	1	1	1
Safety region Gelderland South	1	0	1	1	0
Safety region Flevoland	1	1	0	1	0

7.11 Appendix K

The possible cost formulas for the class size and daytime or evening class combinations.

Costs of educating one bevelvoerder (evening class of six) = €17.570 + average amount of re-examinations VR * €640 + average amount of re-examinations fire * €1.870 + €16.65 * 233 + average amount of examinations VR * 4 hours * hourly wage of bevelvoerder candidates + average amount of examinations fire * 4 hours * hourly wage of bevelvoerder candidates =

Costs of educating one bevelvoerder (evening class of eight) = €17.685 + average amount of re-examinations VR * €640 + average amount of re-examinations fire * €1.870 + €16.65 * 233 + average amount of examinations VR * 4 hours * hourly wage of bevelvoerder candidates + average amount of examinations fire * 4 hours * hourly wage of bevelvoerder candidates =

Costs of educating one bevelvoerder (evening class of ten) = €15.235 + average amount of re-examinations VR * €640 + average amount of re-examinations fire * €1.870 + €16.65 * 233 + average amount of examinations VR * 4 hours * hourly wage of bevelvoerder candidates + average amount of examinations fire * 4 hours * hourly wage of bevelvoerder candidates =

Costs of educating one bevelvoerder (evening class of twelve) = €17.570 + average amount of re-examinations VR * €640 + average amount of re-examinations fire * €1.870 + €16.65 * 233 + average amount of examinations VR * 4 hours * hourly wage of bevelvoerder candidates + average amount of examinations fire * 4 hours * hourly wage of bevelvoerder candidates =

Costs of educating one bevelvoerder (daytime class of six) = €18.140 + average amount of re-examinations VR * €640 + average amount of re-examinations fire * €1.870 + €16.65 * 233 + average amount of examinations VR * 4 hours * hourly wage of bevelvoerder candidates + average amount of examinations fire * 4 hours * hourly wage of bevelvoerder candidates =

Costs of educating one bevelvoerder (daytime class of eight) = €18.225 + average amount of re-examinations VR * €640 + average amount of re-examinations fire * €1.870 + €16.65 * 233 + average amount of examinations VR * 4 hours * hourly wage of bevelvoerder candidates + average amount of examinations fire * 4 hours * hourly wage of bevelvoerder candidates =

Costs of educating one bevelvoerder (daytime class of ten) = €16.870 + average amount of re-examinations VR * €640 + average amount of re-examinations fire * €1.870 + €16.65 * 233+ average amount of examinations VR * 4 hours * hourly wage of bevelvoerder candidates + average amount of examinations fire * 4 hours * hourly wage of bevelvoerder candidates =

Costs of educating one bevelvoerder (daytime class of twelve) = €15.805 + average amount of re-examinations VR * €640 + average amount of re-examinations fire * €1.870 + €16.65 * 233+ average amount of examinations VR * 4 hours * hourly wage of bevelvoerder candidates + average amount of examinations fire * 4 hours * hourly wage of bevelvoerder candidates =

7.12 Appendix L

Completeness of the research with all topics that were questioned. Their influence is added when the influence is interesting.

Topic	Influence
Age	Does have a strong, positive relationship with the dependent variable of level of intensity.
Level of previous education	-
Feeling whether or not the assessment tests the candidates in an adequate way	Candidates have the feeling that the assessment could be improved making the assessment more firefighting themed.
Blended learning	-
Electronic Learning Environment (ELO)	Needs to become more user friendly.
Physical contact moments	-
Digital skills	High self-efficacy of the candidates on digital skills.
Learning workplace assignments	-
Realistic learning environment in the own department	-
Learning climate within the education	Perceived as good.
Drive to be the best of the class	No such feeling was felt.
Open classroom climate	Candidates felt an open climate.
Feeling the freedom to make mistakes	Candidates did feel the freedom to make mistakes.
Experiences in guidance	-
Feeling of highest learning yield	-
Whether the training moments were sufficient to pass	-
Right materials and resources to their disposal	Interviewees felt they did not have the right materials to their disposal, also not in lesson plans from the BOGO.
Whether or not the contact moments were interactive	These moments felt interactive for the candidates.
Experience of instruction	-
Structure in lessons	-
Feedback	Candidates did not perceive the feedback as demotivating.
Performance anxiety	-
Feeling whether the exam is representative for testing the competencies	This was the feeling, however the feeling that the examination committee does not test on the level of a novice professional did arise.
Motivation	Motivation of the candidates is high.
Influence of personal life	Personal life not on the education, but the education does have an influence on their personal life.
Subjects too much or little attention	More solar panels, energy transition, fire prevention, construction and local specialisms. Less about leadership.
Level of difficulty for training	Was rated an average difficulty score.
Level of intensity for training	Does seem to be influenced by age. There was a strong, positive relationship between the independent variable of age and dependent variable of level of intensity score.