Supported by the Interreg V-A Euregio Maas-Rhine programme.

Skills4You:

State-of-the-art Study.

Education in times of Corona

A comprehensive study on digital competency and differentiated instruction in secondary and higher education in the Euregion Meuse-Rhine

Executive summary

Four studies were conducted by the research partners of the Skills4You project. The main findings of these studies are presented in this state-of-the-art study: education in times of Corona.

Study 1:

- A qualitative study explored the experiences of teachers with digital technology during the Covid-19 lockdown, their future perspectives, and training needs for digital education.
- 42 teachers from around the EMR participated in online focus groups based on the principles of appreciative inquiry.
- Digital education had a high impact on the well-being of teachers and students.
- All teachers gained valuable experiences with digital technology during the lockdown and expressed intensions to continue using technology for teaching in the future.
- To continue using technology for education in the future teachers rely on the necessary support from their institutions and require the time to adjust and develop themselves.
- Policy plays a key role in the digitalization process by facilitating crucial factors such as the vision, adequate technical and practical facilities, professionalization and training, and a social connection with colleagues and students.

Study 2:

- The S4Y-SELFIE, an adapted version of the SELFIE, was used to measure the digital capacity of schools in the EMR
- The S4Y-SELFIE measures the organization of digital education, the use of digital technology for teaching and learning, and the technology beliefs from the perspective of school leaders, teachers, and students.
- Generalized data from 6 participating schools is presented, explored, and compared, followed by additional data from teachers and students.
- Building digital capacity relies on much more than just investing in infrastructure.
- Teachers mostly want to learn more about digital didactics, learning how to apply digital technology for learning in the classroom.
- Every school has teachers that are eager to innovate and adopt new technology for their teaching practices.
- Collaborative environments are valued the most to promote the use of digital technology and develop the necessary skills to do so.
- Inclusive policies for digital education are important to ensure equal opportunities for all students, as every school has some students that do not have access to digital technology for learning.

Study 3:

- Successful implementation of digital technology in education by teachers is dependent on both the organizational quality as well as the technology beliefs of teachers.
- This study explores teacher profiles based on their context, beliefs, and technology use using clustering over their responses within 14 dimensions, after which demographic data is explored to predict the classification of these teachers.
- Three meaningful clusters are presented and discussed. A distinction is made between satisfaction towards the context and engagement in technology use.
- The attitudes of the teacher prevail over the context for the use of digital technology. The unsatisfied engaged teachers use technology in their teaching despite their limiting context.
- It is not possible to predict the type of teacher based on gender, age, or work experience. Again, the attitudes, here expressed as confidence and innovation profile, as well as the school are reliable predictors for the cluster profile.
- Unsatisfied engaged teachers could play a crucial role in the digitalization process as their positive attitudes and critical view towards the context can identify barriers and potential solutions for further growth of their institutions.

Study 4:

- The outcomes of a qualitative study that focused on the pedagogical-didactical approach of differentiated instruction in vocational education settings in the EMR are discussed.
- Focus group interviews – structured around vignettes – were conducted with vocational education teachers and educational researchers.
- The study provided insight into which practices are considered important for effective DI in vocational education and how these relate to good practices identified in other settings.
- The conditions perceived essential for effective DI and challenges faced by teachers when DI is concerned, are discussed.
- The study also sheds light into the extent these practices, conditions and challenges are believed to be similar in offline, online and blended settings.

Table of Contents

General introduction

This state-of-the-art study presents the results from the research conducted within the Skills4You project, an Interreg Euregio Meuse-Rhine (EMR) project that was active from the beginning of March 2021 until the end of October 2023. The first work package of the Skills4You project, WP1: Study of digital skills4all under the responsibility of Hasselt University, has the goal to research the state of digital education and differentiated instruction in the EMR during the times of the COVID-19 crisis. The information gathered is useful for the development of suitable professional development interventions and training programs offered to the teachers and students in the EMR. During the duration of the project, the project partners have been informed on the proceedings of the research through internal reports. This has led to the development of the VERUDISE platform, a learning platform where teachers and students can find learning modules in digital skills, blended learning, and differentiated instruction. Each participating school had received a report with the state of their digital capacity which was used by school leaders and trainers from the consortium partners to develop training interventions suitable for the school's specific context and aimed at the identified needs.

This state-of-the-art study summarizes in four studies all the highlights of the research executed by Hasselt University and Maastricht University, with the generous support of the project partners CeCoTePe, Provincie Limburg, UCLL, Yuverta, and Jobs@Skills. The information is brought in an abbreviated and straightforward fashion aimed at the general public. However, each chapter is based on a study conducted with the aim of being published in a peer reviewed journal, which can be consulted for more details on the methodology and theoretical implications behind each study, once published.

Teachers' experiences with digital education in times of Corona – a preliminary research

This chapter is based on:

Vervoort, A., Gonzales Castellano, N., Schouteden, W., Gielen, M., Struyven, K. (under review). Exciting fors ome, terrifying for others – the complex interplay of teachers' experiences in SE and HE during COVID-19 hybrid and online education. *Computers & Education* [resubmitted after revisions].

1. Background

At the start of the Skills4You project in March 2021, the Covid-19 crisis had been surging for a year. Schools were still in lockdown, either teaching fully online or in hybrid, with partial online and partial physical presence. Teachers and students had to use digital technology to continue education. This led to a digital divide, with the reports of a lack of digital skills among teachers and students (Di Pïetro et al., 2020). The Skills4You project was proposed to support teachers and students developing their digital skills. However, with one year of distance learning ongoing, the situation could already have evolved since reports at the beginning of the crisis. It was found necessary to evaluate the current landscape to learn from teachers' experiences, identify training needs, establish a focus for the Skills4You project, and compare the three regions.

1.1. Objectives

In this preliminary research, the goal is to collect teachers' experiences with digital education during the Covid-19 lockdown and distance learning, look ahead to the future use of technology post-Covid-19, and eventually identify immediate training needs in digital competency.

We asked three main questions:

1. What were teachers' experiences with distance learning during the lockdown?
2. Looking to the future, what experiences in digital learning are valuable for your teaching practice?
3. What suggestions for future training in digital competency do you have?

2. Approach

To conduct this research, teachers from the Belgian and Dutch regions of the MRE were invited to join online focus groups. The research took place from May to July 2021. Data was collected using an online discussion board to which participants could add their responses in sticky notes. The data was later analysed by placing them in a mind map and connecting the themes that appeared in their responses (Noon, 2018). This revealed interesting results.

2.1. Participants

Teachers from around the MRE were invited through an open invitation sent to secondary and higher education institutions and through the project partners' networks. In total, 42 teachers participated. Table 1 gives an overview of the focus groups that took place, in what region, at what date, the number of participants, and the educational level they represent.

Table 1: Overview focus groups

Province	Date	Participants	SE or HE
Liège	18/05/2021	9	2 SE / 6 HE / 1 SE+HE
Liège	21/05/2021	9	4 SE / 3 HE /2 SE+HE
Limburg (BE)	26/05/2021	2	SE
Limburg (BE)	02/06/2021	2	SE
Limburg (BE + NL)	09/06/2021	3	HE
Limburg (BE)	10/06/2021	2	HE
Limburg (BE)	16/06/2021	1	SE
Limburg (BE)	29/06/2021	5	HE
Limburg (NL)	07/07/2021	4	SE
Limburg (NL)	08/07/2021	5	SE
		42	

2.2. Focus groups

The focus groups were organized around the three main questions following the appreciative inquiry methodology (Buchanan 2014). For each main question, sub questions were formulated focusing on a more specific aspect of the main question. All questions were placed in an online work environment in which the participants could add their response as sticky notes. This way, their responses were first collected individually in a written way. Figure 1 gives an impression of what that looked like. Later, the conversation was opened to discuss responses in group. All sessions were recorded and took between 1 and 3 hours in total, depending on the size of the group.

To analyze the data, all sticky notes were collected and thematically analyzed by placing them in a mindmap. Sticky notes that would show a similar response were placed together. This would form a theme. Sticky notes that would show multiple themes were placed in between themes. This would create a connection and, in some cases, lead to the creation of a new connecting theme. The result of this process gave an interesting overview of everything that was talked about during all focus groups.

Figure 1: example of sticky note responses

3. Findings

Results of the analysis are summarized into a simple figure, called the rotational discussion disk (Figure 2). Four main themes are identified (the outer circle), followed by six connecting themes (inner circles). The theme with the most connections was placed in the middle. A short summary of the results is provided with each main theme. The different connecting themes are shortly discussed within each theme.

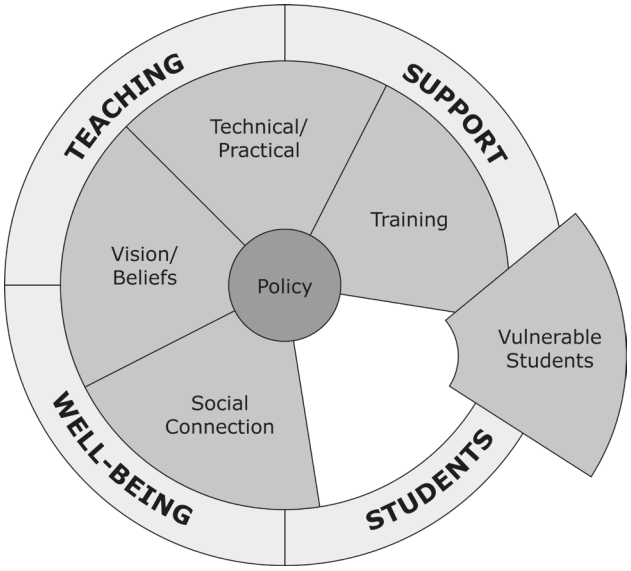


Figure 2: Rotational discussion disk

Health and well-being at work

- This theme concerns not only personal feelings of well-being, such as expressions of stress, anxiety, loneliness, and exhaustion; but also, the both negative and positive influences digital learning has on health and well-being at work.
- Reported negative consequences are related to stress, fatigue, loneliness, and increased work pressure.
- Positive side-effects are related to increased flexibility, creativity, and feelings of self-worth and satisfaction linked to increased challenges.
- The social aspect of digital learning needs guidance for both teachers and students to support social cohesion, engagement, and interaction.
- Teachers need a stable and reliable school policy that also has attention for their needs.
- Among the gains, online meetings and training are mentioned as an improvement to health and well-being at work.

Teaching

- This broad term refers to everything related to teaching itself, from the views and beliefs teachers hold, the didactics and methodology teachers use, to the influence digital learning has on the practice itself.
- Among the most positive experiences with digital learning, teachers experienced creativity and an impetus to revise their methods and course content.
- Learning goals were mostly obtained with the exception of practical learning goals in vocational education.
- Evaluation with digital tools gave both new problems as opportunities.
- The success of a digital learning environment is heavily dependent on the availability and quality of internet connectivity, devices, applications, space, and time.
- Actively supporting the social aspect of the online classroom seems to be a personal trait rather than a trained skill.
- A balance between collective harmony and allowing personal choice needs to be found so both unity as autonomy can coexist in the digital learning environment.
- School policy is needed to provide stability and uniformity. Teachers want to be included in the decision-making process.

Students

- Responses mentioning and describing the impact digital distance learning has had on students were categorised as such.
- Most students could participate.
- Dealing with the consequences of distance learning demands strong self-regulatory skills, motivation, and resilience from students.
- Especially vocational education witnessed participation problems with students, in some cases leading to drop-outs.
- Vulnerable students were the first to fall behind.
- Technological problems were used as an excuse for privacy and to mask difficult home situations.

Support

- The fourth major theme is related to institutional, collegial, or individual support teachers may or may not have received during distance learning. Answers within this theme either describe the situation or the desire for additional support.
- Schools from all regions took productive measures to support teachers during distance and online learning.
- A list of functional support measures is presented below.
- For future support, teachers have needs in terms of policy, technical and practical, and most importantly: time.
- In terms of training needs, teachers would like to see small group, size-fit, on-demand, problem-based training focused on didactic design skills of the blended learning environment.

Schools already took measures to support their teachers during the lockdowns. From the responses of teachers, the following support measures were identified as particularly useful and functional during the Covid-19 crisis.

Functional support measures

- Manuals on how to use tools or software
- Overview of potential tools, applications or tech-solutions
- Webpage with tips and tricks for online teaching
- Instruction videos
- Creating supportive team of teachers with affinity for ICT
- Hired ICT-support for hands-on problem solving
- Hired blended learning experts
- Establishing hybrid classrooms for mixed f2f and online lessons
- Team meetings for instruction on software functionalities
- Sharing experiences among teachers
- Sharing learning materials
- Observing colleagues teaching classes
- Practical examples from colleagues
- Q&A-sessions
- Work sessions guided by competent colleagues as part of in-service training.

Based on both the training needs and challenges mentioned by the participants, a list of training possibilities was created to further examine the training needs teachers might have.

List of training possibilities

1. Basic digital competence training - learning my way around the computer
2. Basic text processing skills (e.g. MS office, google suite,...)
3. Basic communication skills - improved online interaction and netiquette
4. Basic technology operating skills - learning more about hardware, cables, connections, camera's, digiboards, etc.
5. Digiboard operating skills - learning more about digiboards and their functions
6. Online teaching and presentation skills - teaching in front of a camera and speaking for an online audience
7. Online social connectivity - how to socially connect online and create a safe and trusted environment in online meetings
8. Digital design skills - creating lessons for blended learning
9. Digital design skills - creating explainer videos, webinars, and online presentations
10. Digital design skills - designing a digital learning environment
11. Digital design skills - creating an inclusive learning environment
12. Digital didactics - the didactics of the online and blended learning environment
13. Digital didactics - using technology to apply differentiation
14. Digital didactics - stimulating self-regulated learning through technology
15. Digital didactics - creating learning paths for blended learning
16. Digital didactics - choosing the right tool for the desired goal
17. Digital didactics - using digital technology for evaluation and tracking learning progress
18. Inspiration sessions - innovative technology for teaching and learning
19. Inspiration sessions - learning about new applications for learning
20. Inspiration sessions - practical examples of online and blended learning
21. Inspiration sessions - sharing experiences with digital learning
22. Online collaboration - improve sharing through digital technology
23. Online collaboration - co-creating in an online work environment
24. Safety and privacy - how to protect myself online
25. Health and well-being - prevention and improving online work and life quality

3.1. Comparison between regions

Overall no clear differences were seen between the three regions. There was a lot of overlap in answers; questions being answered in an identical or comparable manner for each region. For example, in every region the technical or practical problems were identical and time to prepare was everywhere mentioned as a need. Also, the variety in answers is comparable for each region such as the range in positive and negative experiences.

Only one clear difference between regions could be remarked, being the overall preparedness at the start of the pandemic and first lockdown in 2020. Teachers from the Netherlands reported a smooth transition, describing their institutions had already set up online accounts and were facilitating (parts of) blended learning even before COVID-19. Teachers from both Wallonia and Flanders were overall more negative about the transitions, describing a rougher transition where a lot had to be done in a short time with little to sometimes no support or clear instructions. This led to higher levels of stress and anxiety. However, one teacher from Flanders had an experience comparable to that of the Netherlands, saying their institution was also already experimenting with blended learning, enabling a smoother transition at the start of the lockdown.

4. Next steps

With this study, the Skills4You project gained valuable insight into the training needs based on the experiences of teachers with digital technology around the MRE. To implement training in a meaningful and sustainable way, this study highlights the following recommendations:

- The implementation of digital technology in education requires a systemic approach, considering a local context centralized around the school policy, the available infrastructure, and human resources.
- Since every school is unique, it is recommended to investigate the local context of participating schools and identify local needs as part of the professionalisation of these schools.
- Creating collaborative networks within and between schools is highly recommended as part of the professionalisation process, as these professional networks sustain durable change processes and increase the chance of training efforts to have a lasting effect.

5. Conclusions

Distance learning during the COVID-19 health crisis has created a great number of new challenges for teachers. The sudden switch to online teaching and learning had pushed many teachers to their limits. Once the initial stress and panic had laid down, most respondents experienced useful benefits from teaching with digital technology. Among the most positive gains teachers reviewed the content, learning goals, and teaching practices; became more creative through experimentation; and learned a lot more about the possibilities of digital technology. Among the most crucial challenges teachers expressed a need for clear and stable school policy that involves their voices in the decision-making process; a balance between teacher autonomy and institutional unity needs to be found; and as part of the practical and technical pre-requisites for digital learning, time was found to be a major issue. Teaching online had a huge impact on the social aspect of teaching and learning. Feelings of loneliness were reported as well as difficulties to connect and interact with students. Dealing with the consequences of distance learning demands strong self-regulatory skills, motivation, and resilience from students. Vulnerable students were hit hardest and received little consideration throughout the discussions. Overall, schools that were already in the process of introducing blended learning before the pandemic came out more positive compared to schools that did not. A list of training suggestions is proposed. As the context for every school is different, training is best organized by a differentiated approach, adapting to the local context, needs, and policy.

References

Buchanan, P. L. (2014). *Appreciative inquiry*: *A path to change in education*.

Di Pietro, G., Biagi, F., Dinis Mota Da Costa, P., Karpinski, Z. and Mazza, J., The likely impact of COVID-19 on education: Reflections based on the existing literature and recent international datasets, EUR 30275 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-19937-3, doi:10.2760/126686, JRC121071.

Noon, E. J. (2018). Interpretive Phenomenological Analysis: An Appropriate Methodology for Educational Research*? Journal of Perspectives in Applied Academic Practice*| Vol, 6(1).

Measuring the digital capacity of schools in the EMR – the S4Y-SELFIE

1. Introduction

The goal of the Skills4You project is to support digital learning in schools by providing training to teachers and students. As found in the preliminary research, training necessities can vary depending on the context of the target group. Many aspects can be considered when analysing the learning needs of an individual teacher or student, such as the school policy, the available infrastructure, their current learning status, as well as their attitudes towards the use of digital technology (Bingimlas, 2009; Tondeur et al., 2017). Learning occurs when learners find themselves in a rich learning environment that challenges and supports their learning, and they demonstrate an openness to learning. In the context of development of digital skills, this means there's a rich and supportive environment that challenges teachers and students to use digital technology, while they foster positive attitudes towards using digital technology for learning.

A rich and supportive learning environment is reliant on the infrastructure provided, the school's policy, collaborative environment, and internal technical, practical, and didactic support provided (Läänemets & Rostovtseva, 2015). An environment that challenges teachers and students to use technology depends on the school's vision and policy on digital education. A school that promotes technology enhanced learning, putting the use of digital technology on the forefront of their school's policy, challenges students and teachers much more than a school that is indifferent about the use of digital technology. It is therefore important to look at the school's vision and policy on technology use in education to assess what the training needs are in that specific school.

Attitudes towards technology use are crucial in the process of adopting technology for teaching and learning as they influence the course of action and decision-making process (Korthagen, 2004). While attitudes include the actions taken, technology beliefs specifically inform us on the thought process behind those actions. These beliefs can relate to the usefulness of technology, perceived challenges, confidence, and motivation teachers or students display towards technology use in education. Studies have shown that positive attitudes, driven by technology beliefs, lead to increased use of technology as well as openness to improve and learn (Tondeur et al., 2017).

The combination of a school's digital environment and the state of technology related attitudes and beliefs, can be referred to as the digital capacity of a school. By measuring the digital capacity of a school, it is possible to observe its digitalisation process and identify gaps where further improvement is possible.

2. Approach

To reliably measure the digital capacity of a school, it is important to approach it from different angles and include all stakeholders in the organisation. This means approaching school leaders, teachers, and students and using both qualitative and quantitative methods. This study focusses on the quantitative methods used.

2.1. The SELFIE

The SELFIE is a tool developed by the European Commission to measure the digital competency of an educational organisation based on the DigCompOrg framework (Kampylis et al., 2015). The framework considers several aspects related to the organisation of digital education, such as the leadership and governance, infrastructure, professional development, and the use digital technology for content creation, learning practices, and assessment. The SELFIE tool translates these areas by using statements that are answered with a 5-step Likert scale by school leaders, teachers, and students. This allows for insight into an organization's performance for each area and a comparison between the perspectives on that performance from each stakeholder's perspective. The results inform school leaders on the areas that need attention for further development and improvement to become more digitally competent. It also informs trainers on the strengths and weaknesses of a school to identify a focus for training in digital competency for teachers and students.

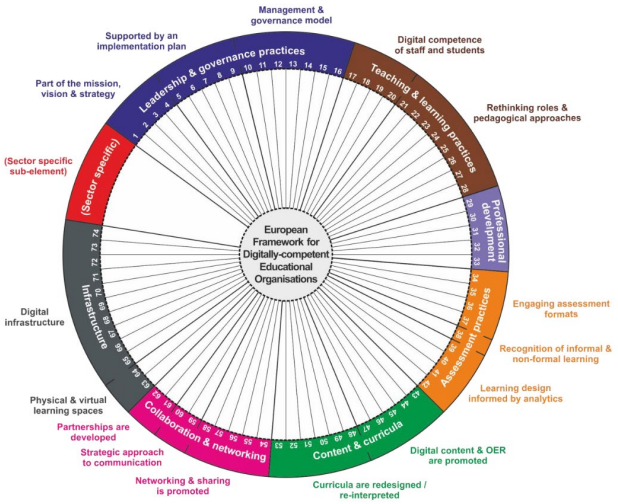


Figure 1: DigCompOrg model by Kampylis et al. 2015

2.1.1. SELFIE Adaptations

While the SELFIE is very suitable to measure the digital capacity of the organisation of the digital learning environment, it lacks the ability to measure teachers' and students' technology related attitudes and beliefs

necessary to estimate the full digital capacity of that organisation. Therefore, the SELFIE was slightly adapted in function of the Skills4You project to also measure technology beliefs. The preliminary research revealed other concerns related to the use of digital technology in education as well, that are not covered in the original SELFIE, such as the autonomy teachers experience, how well teachers work together and exchange experiences, or the online support that is available. In total 16 items were added to the questionnaire to cover these missing topics. The list of 25 training possibilities, one of the outcomes of the preliminary research results, was also added to the questionnaire to determine a focus for the development of training modules and interventions. The adapted version of the SELFIE was named the S4Y-SELFIE and covers the quantitative part of this study.

2.2. Participating organisations

The S4Y-SELFIE was sent out to all schools participating in the Skills4You project between January and June 2022. While it was intended all participating schools would first fill out the S4Y-SELFIE before receiving training interventions, a few schools indicated they had recently done a SELFIE. Therefore, they were excused from participating in this part of the research. Other schools did distribute the S4Y-SELFIE in their organisations, however, they provided insufficient response, making the data unusable as the collected results cannot be treated as representable for their organisation. Therefore, they have been left out of the analysis. Table 1 gives an overview of the participating schools and their respective response. To pseudonymise results, the names of the schools have been replaced by code representing their region and a following number. The regions represent Belgian Limburg (VL), Dutch Limburg (NL), and the province of Liège (WAL).

Table 2-1: Overview response to S4Y-SELFIE

School	Leadership	Teachers	Students	Included in analysis
VL1	3	51	220	Yes
VL2	5	72	187	Yes
VL3	3	29	264	Yes
NL1	1	11	126	Yes
NL2	0	14	121	Yes
NL3	2	9	8	No
NL4	3	13	17	No
WAL1	4	137	363	Yes
WAL2	0	2	31	No

Note: The table above represents the total number of responses after data cleaning.

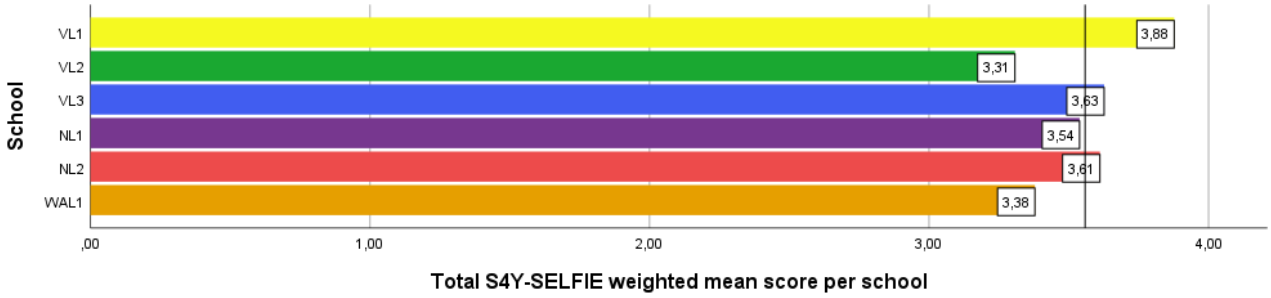
3. Results

Remark: Every school received a report containing their own results in September 2022. This report will only show generalized results to comply with GDPR privacy law.

The S4Y-SELFIE contains a vast amount of information from which the most relevant and interesting results have been selected for this report. The results will be presented in three parts. Part 1 contains the general results from the questionnaire for all areas. Comments with the plots will provide information useful for interpretation. Part 2 will show some data from the teachers' part of the questionnaire. Several interesting finds related to training are presented. Part 3 will show the students output with information especially relevant for creating inclusion in the digital learning environment.

3.1. Part 1: general school results

Let's start with the total score on the S4Y-SELFIE for each school.



School VL1 scored highest on the S4Y-SELFIE, suggesting it has the highest digital capacity compared to the other schools, while schools VL2 and WAL1 are the two lowest. The black line represents the total average score of all schools together. Schools VL3, NL1, and NL2 float around the average. To visualize the range of variance in scores within a school and to see the difference between schools, the error graph (figure 2) gives us more information on how different schools are from each other. We see that VL1 scores significantly higher than all other schools by a large margin, while VL2 and WAL1 are all significantly lower than the rest.

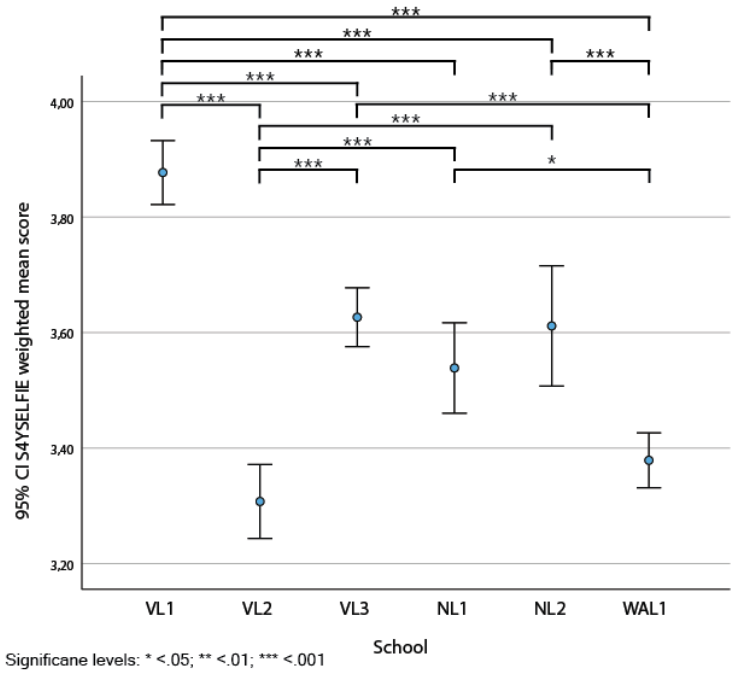
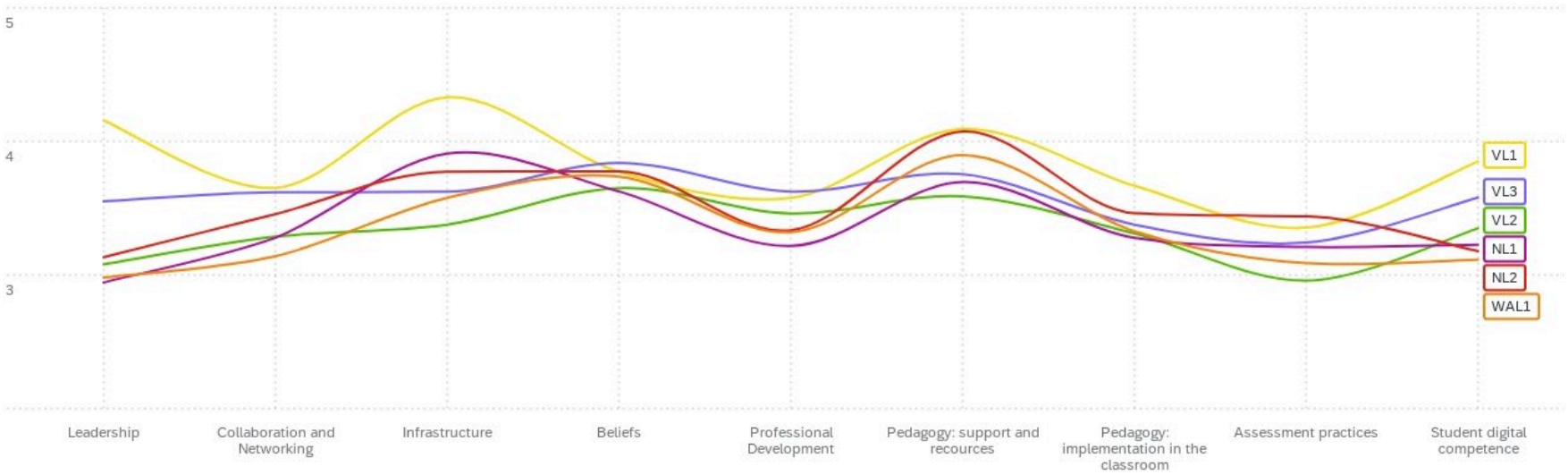


Figure 2: Error graph for S4Y-SELFIE per school with significant differences

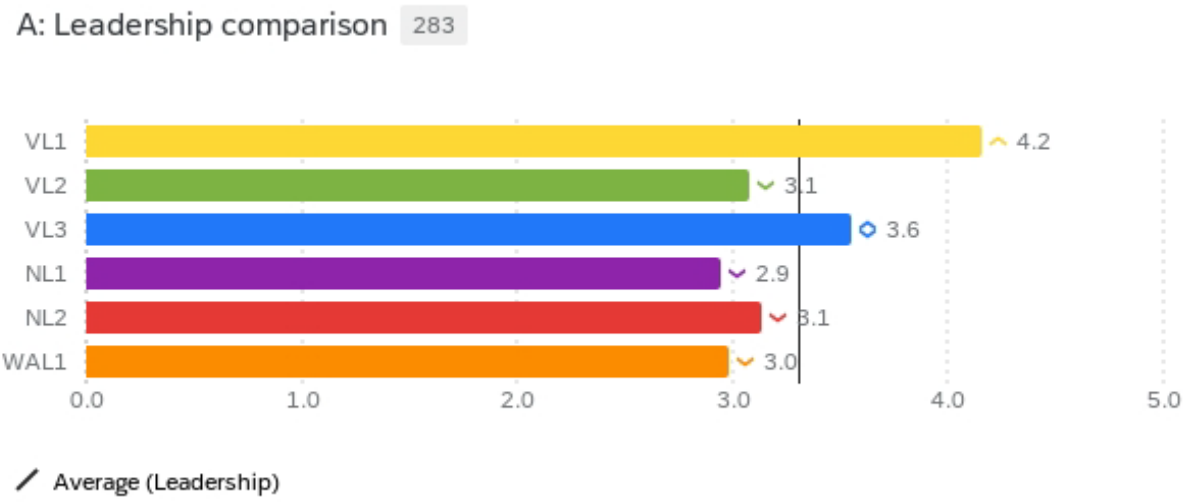
The next plot contains a general overview of the results for each school for each domain. Every line represents one of the 6 schools included in the analysis, connecting their average result for each domain.



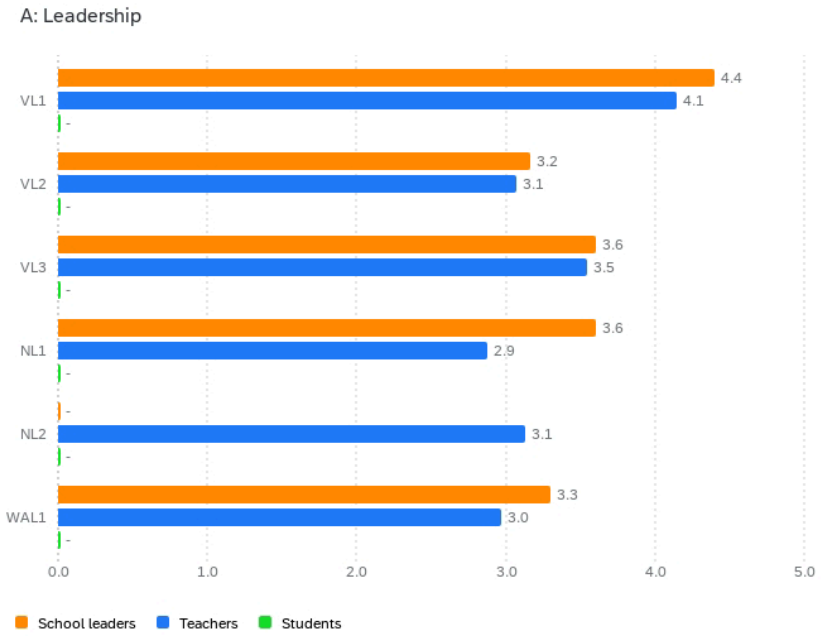
Looking at this graph, a few remarks can be made. No school is consistently high or low scoring over the different areas. While one school (VL1) scores high on some areas, it also dips under the results of other schools in other areas. This shows each school has their strengths and weaknesses. The wavier a line is, the more variation there is between the areas. This means a school is considered strong in some areas, while weaker in other. The straighter a line is, the more balanced their overall capacity is. The wider the lines are from each other, the more variance between schools, meaning schools differ strongly from each other (e.g. leadership); the closer they are, the more schools are alike (e.g. Beliefs). While this line plot already reveals some interesting results, breaking down each area individually will give more insight in the data.

Area A: Leadership

The leadership area evaluates the leadership quality, mainly by looking at how school leaders develop digital strategies and work together with teachers to implement them.



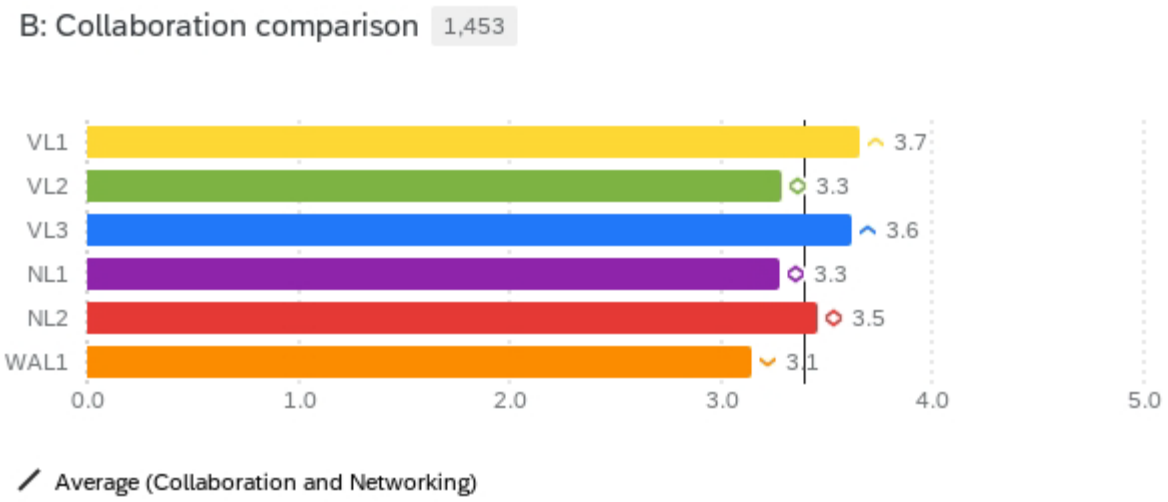
The black line is the total average score. This way it become visible what schools are above and below the average. In this case, VL1 is very strong in terms of leadership, VL3 is on average, and all other schools are just below, however very close together. The same results can be broken down between school leaders and teachers. Students did not receive these questions.



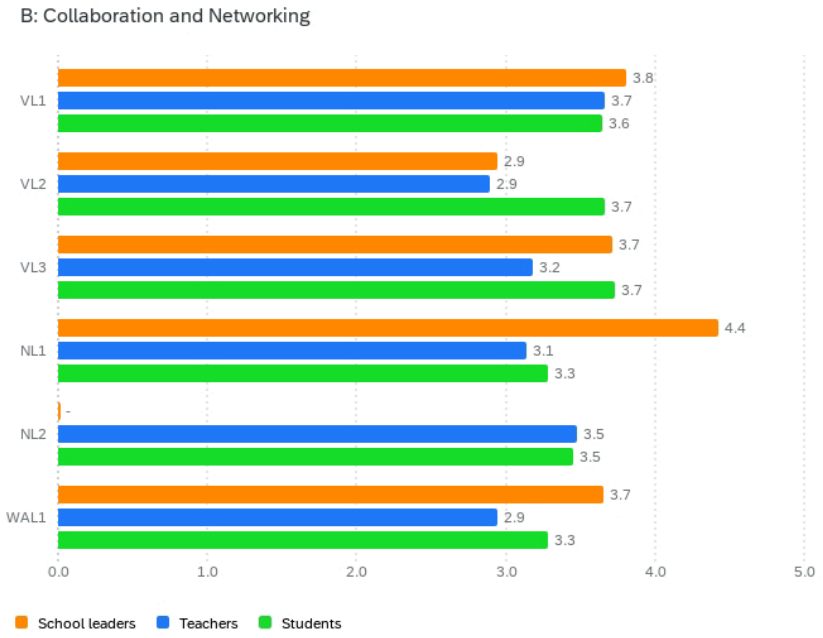
Breaking down the data like this, it becomes visible whether teachers and school leaders think the same about this area. The closer the two lines are together, the more agreement there is between the two parties. Especially in NL1, the school leaders seem to have a different perspective than teachers, while in Flanders in all three schools both parties seem to be on the same line with each other.

Area B: Collaboration and networking

The second area evaluates how well school leaders and teachers work together within their school and with other schools around the use of technology for education.

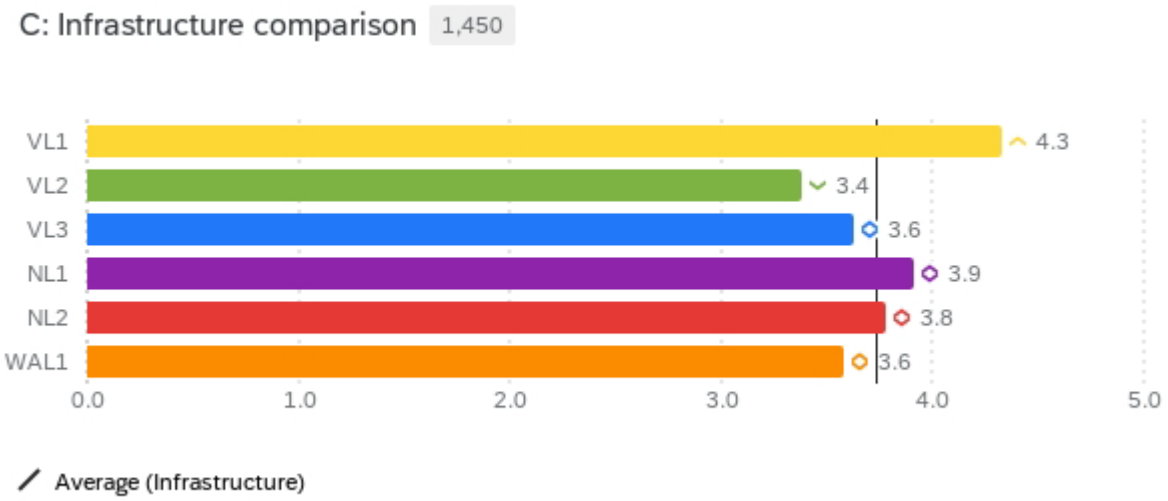


In terms of collaboration it is noticeable all schools are relatively close to each other, floating around the average. The results broken down per role again show some nuance. The students had less statements, as it was mainly focused around discussing the use of technology and helping each other, while both school leaders and teachers had more statements that are relevant for their position.

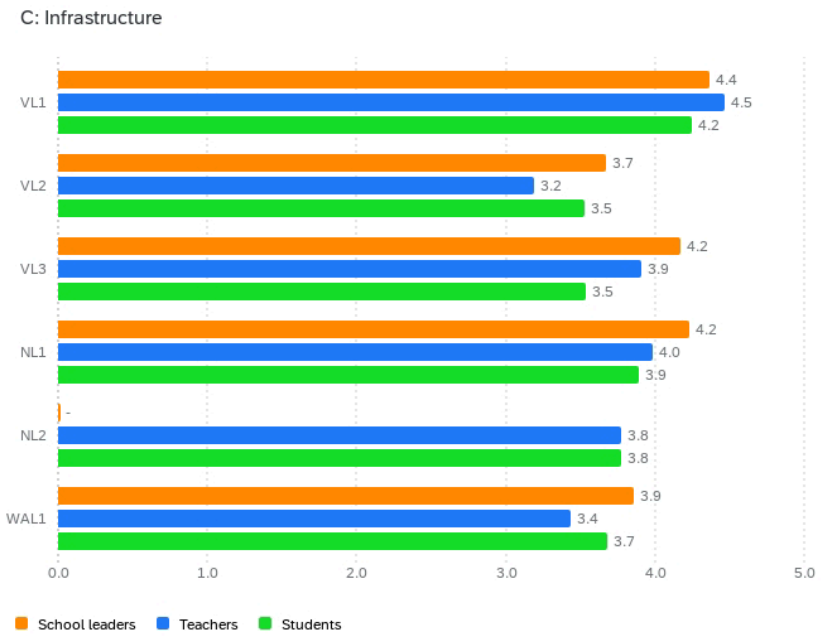


Area C: Infrastructure

The area infrastructure consists of a long list of statements, fourteen in total. The results every school received contained the full list, enabling them to identify gaps in their infrastructure. Here, only the average of all items is provided.

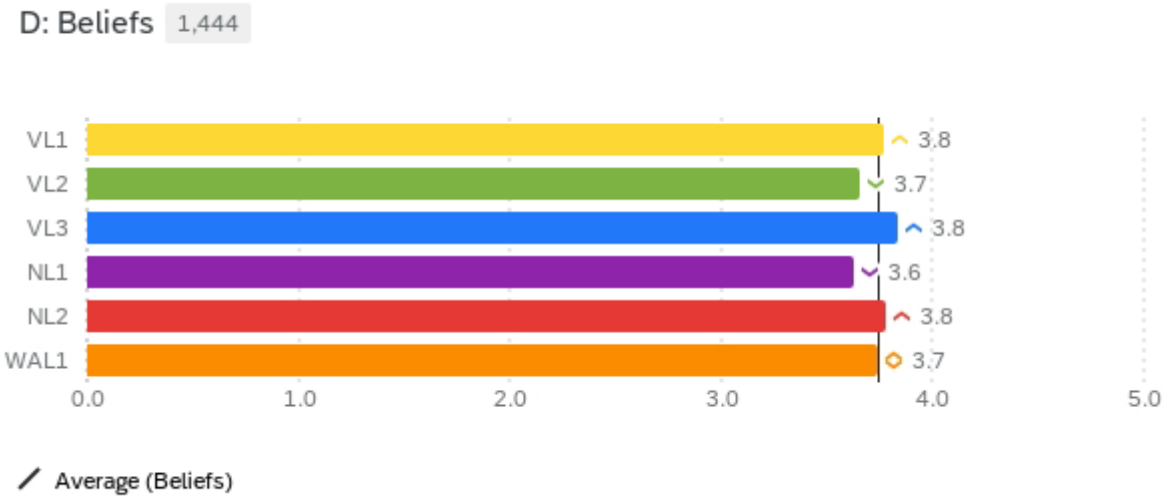


The balance between the different stakeholders is very different from school to school. Especially for this area it is important school leaders are aware how teachers and students experience the quality of the infrastructure, as they are heavily dependent on available infrastructure in order to use technology for education. Part of the infrastructure is in this case the available devices, internet connection, technical support, and ways to identify and support the digital gap.

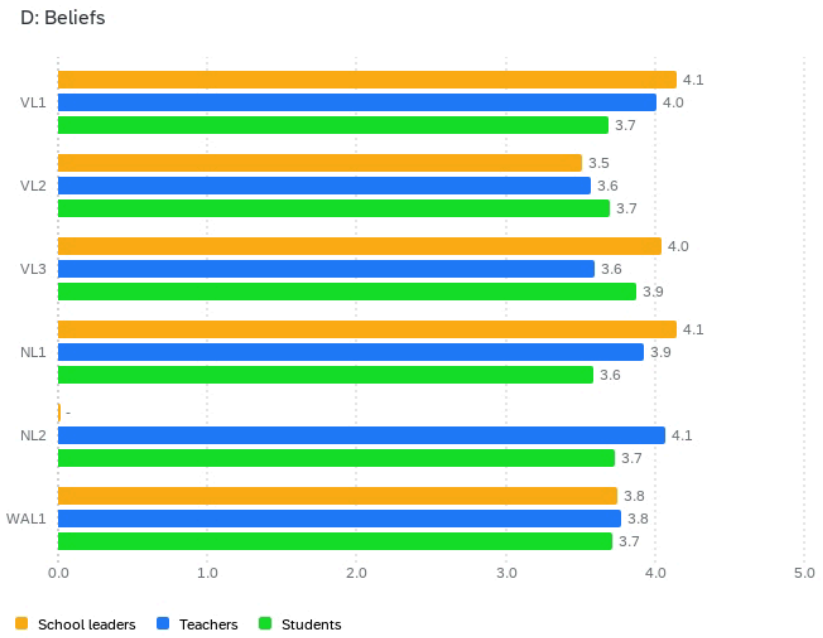


Area D: Beliefs

How do teachers think about using digital technology for learning? This is measured by the beliefs area, which informs us about whether teachers find it meaningful to use technology, their confidence in using it, and the personal barriers they might experience.

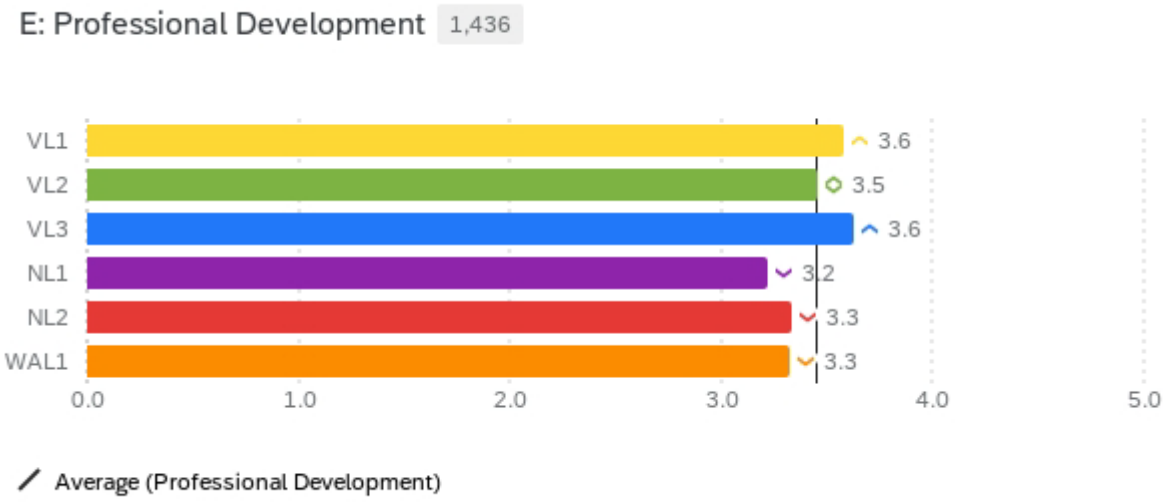


Seeing how close all schools are together in this plot, shows that the attitudes towards using technology is the same for all schools. If there are people with more negative beliefs, then these are balanced by people with positive beliefs. This means, from a perspective of human capital, there is an equal potential in every school to digitalize education in a meaningful way. Looking at the differences between school leaders, teachers, and students, the difference between highest and lowest group scores is only 0,5 (NL1). However, total scores are leaning towards the neutral score (3), meaning overall attitudes can be approved. Having a school leadership with more positive beliefs than its students and teachers is helpful to make a positive change. Only in school VL2 this is not the case.

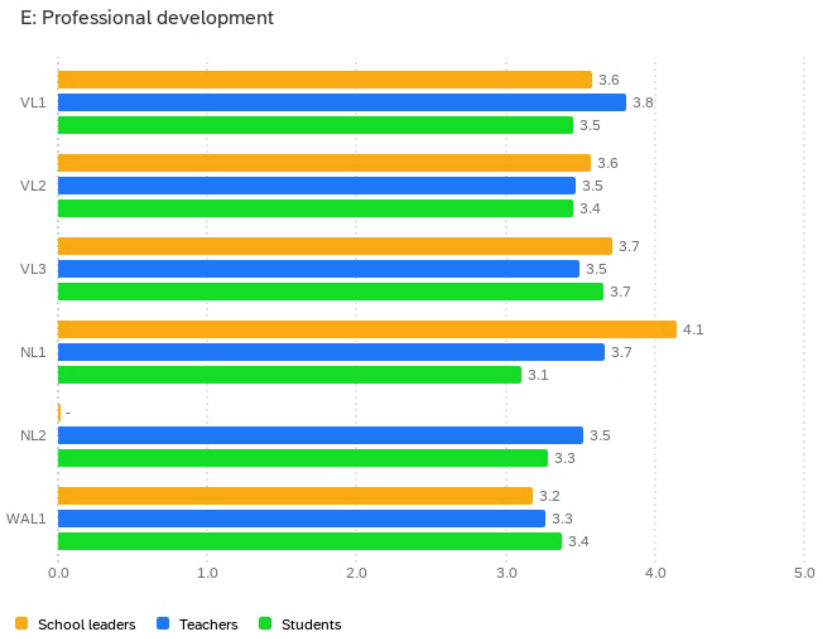


Area E: Professional Development

Professional development in education is essential in dealing with societal challenges and creating durable change. This area looks at whether teacher already have access to professional development, whether their needs are discussed, and their motivation to improve themselves. Students were asked whether they are motivated to learn and maybe already acted themselves.

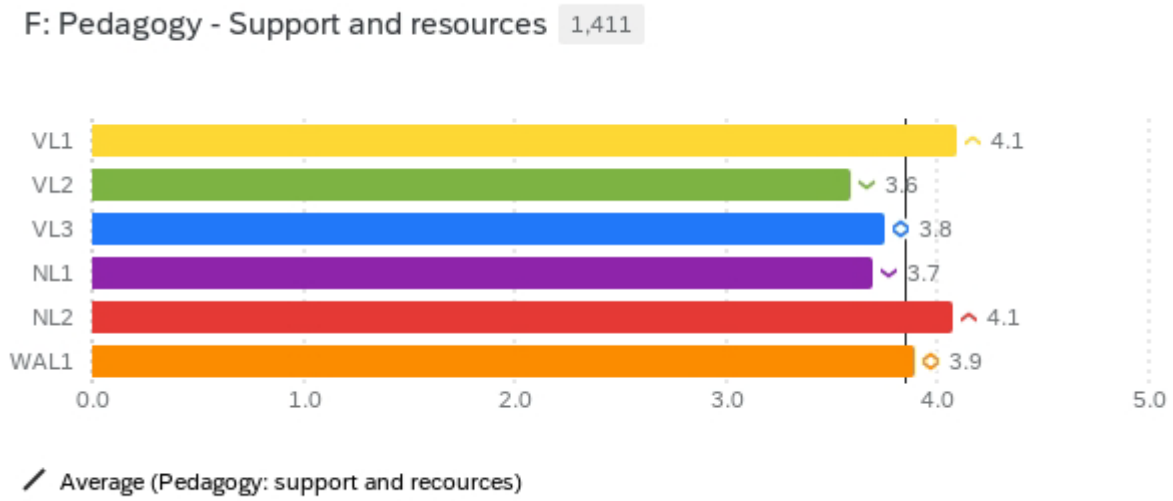


Comparing the schools, again the schools are relatively close to each other. However, they are quite close to the neutral score (3). Also, the Flemish schools seem to score slightly higher, though with a very small margin. There is room for improvement in either the access to professional development, or the willingness to participate. Schools can see the difference by looking in their own reports.

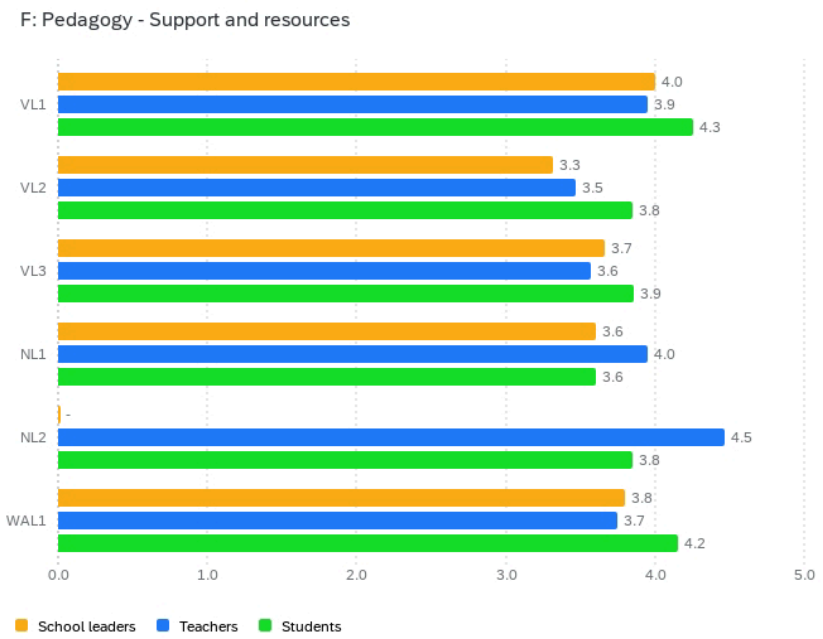


Area F: Pedagogy: Support and Resources

The next three areas are looking at how teachers are using digital technology for their lessons. This area looks specifically at how teachers use or plan to use digital resources as part of their lessons. This also includes using technology to communicate with students, or the use of virtual learning environments.

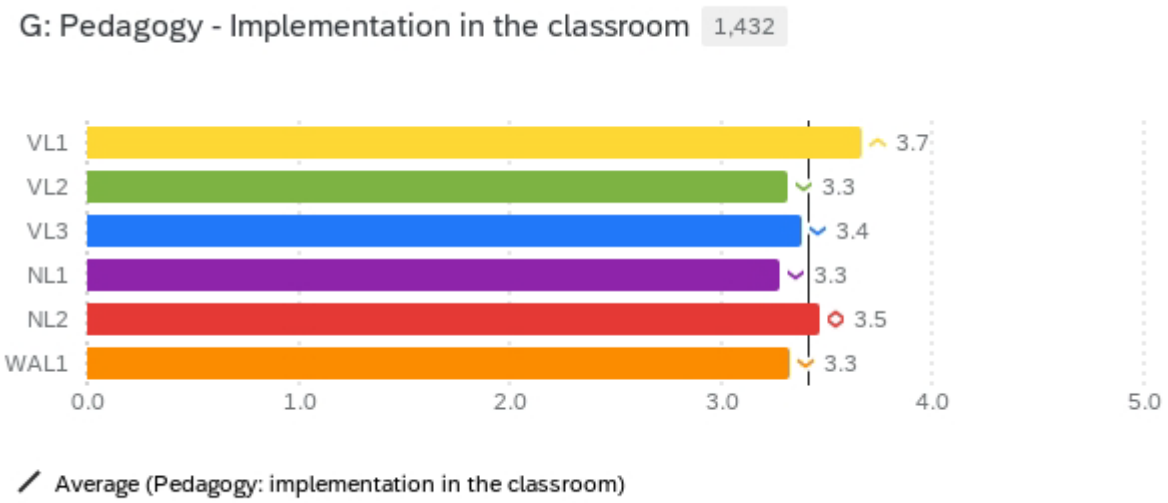


Overall the intensions for using technology is very promising for all schools. However, it is important to compare results from teachers and students, as both perspectives can be compared to see whether what teachers claim to do, is confirmed by students or not. This is a difficult comparison to make, as it cannot be known with certainty that the teachers who responded also teach to the students that responded. The only the thing that is known for sure, is that they come from the same school organization. Remarkable is that in Belgian schools, students are more positive than teachers, while in the Dutch schools the situation is reversed.

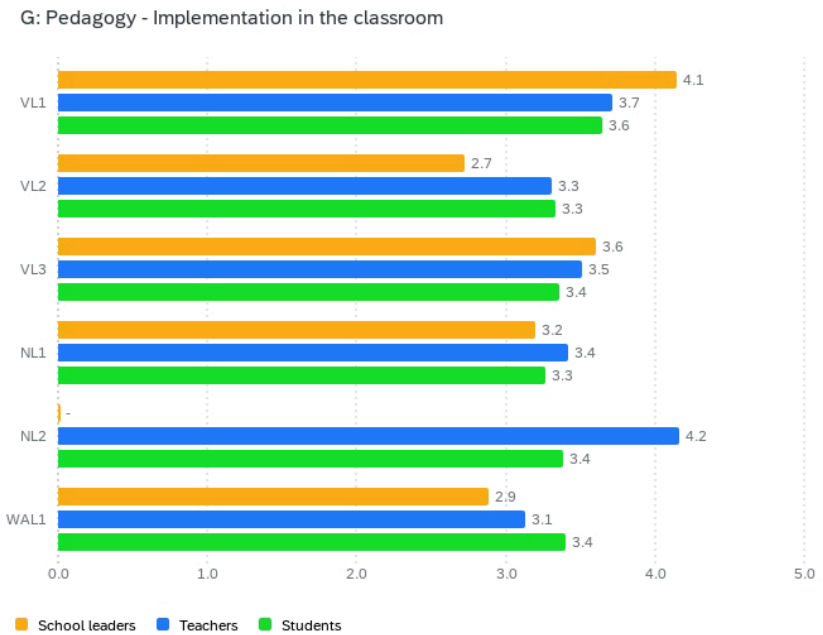


Area G: Implementation in the classroom

Preparing the lessons with technology is one thing, but using it in the classroom is another. Technology can be used to differentiate by adapting to the needs of the students, to increase students' creativity, and foster collaboration between students.

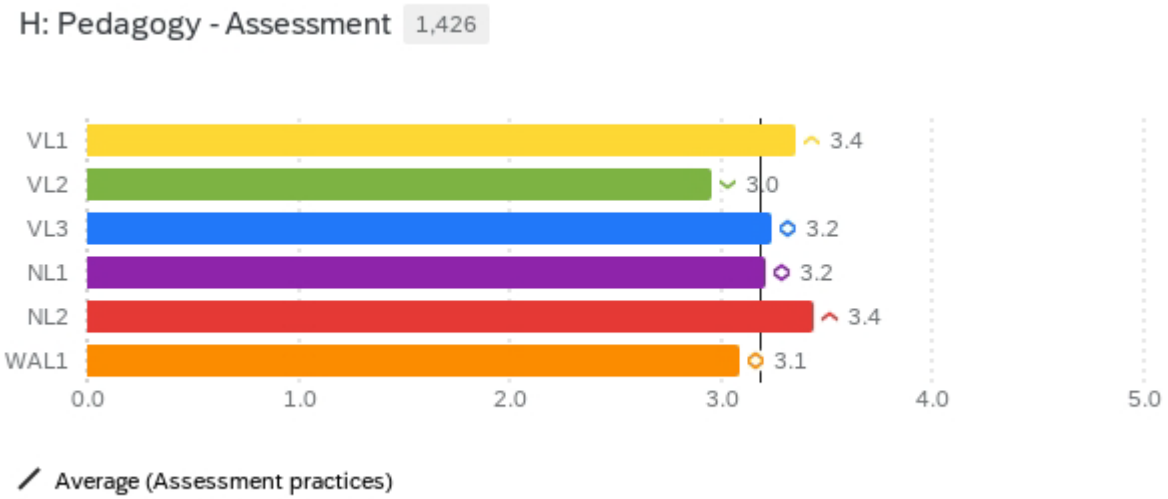


Compared to area F, the overall results went down with a few points, but the balance between the schools remained the same. So, while intentions were promising, implementing it in the classroom is a bit less promising. Again, we can compare the results of teachers and students to see whether students agree with the views of the teachers. Here school NL2 stands out where the teachers clearly gave a more positive response than their students. The groups cannot be reliably matched with each other; however, it is indicative that teachers and students have a different idea about how digital technology can or should be used in their school.

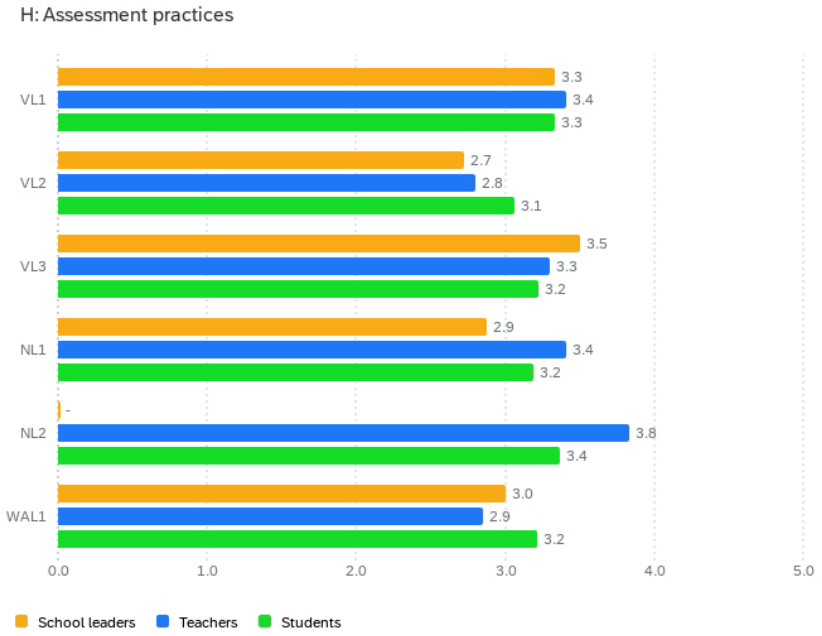


Area H: Assessment

The third way of using technology in the teaching and learning process, is by applying it to assessment. Technology can be used to evaluate the student, provide feedback, document the learning process, or to stimulate self-reflection.

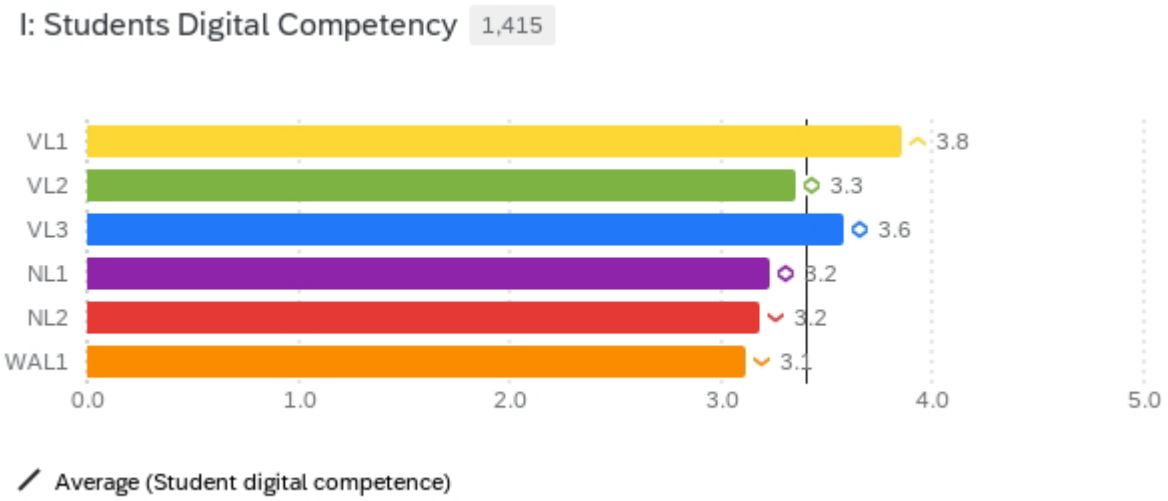


Again, compared to areas F and G, a decline is visible for all schools. Out of the three ways to use technology in the teaching and learning process, assessment seems to score the lowest overall. The average being around the neutral value 3, thus in the middle between not being used and being used. In the comparison between teachers and students, most schools have balanced results between both parties.

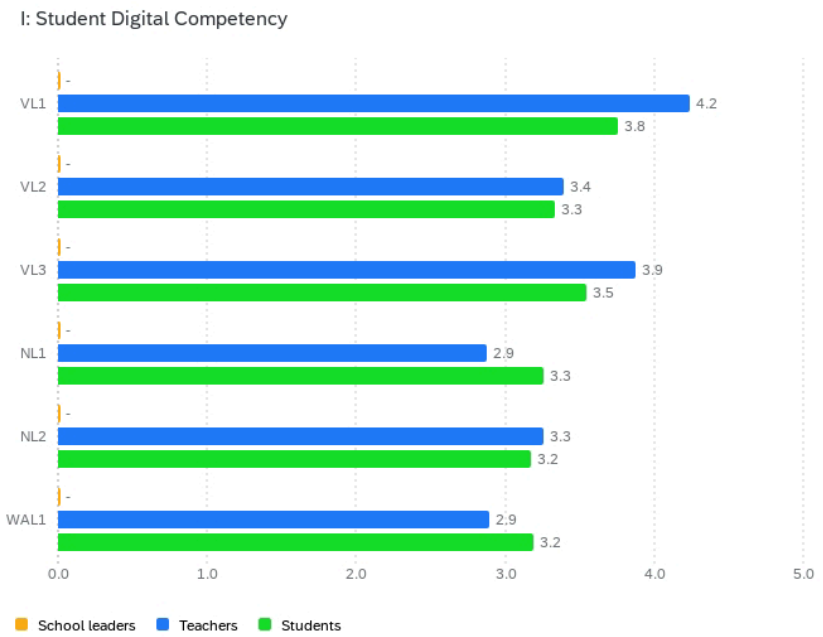


Area I: Students digital competence

The final area reflects the students' digital competence. A total of 9 items constitute this area that represents students' behavior with digital technology in school, assessed by teachers and students. Among these items are safe and responsible behavior online, checking online sources, communicating online, coding and programming, and solving technical issues. The latter two scored under the neutral value 3 for all schools.



When interpreting the results for students and teachers, an important nuance to be made is that a teacher would give a generalized evaluation of the competency of the students they know, while students would evaluate their own competency. Thus, teachers have multiple students in mind, while students only have themselves in mind. However, as there are two to three times as many student responses as there are teacher responses, the comparability of the two groups increases. The results show how teachers evaluate the students in their school, and how a sample of that schools' students evaluate themselves; making up an estimation of the student digital competency of each school.

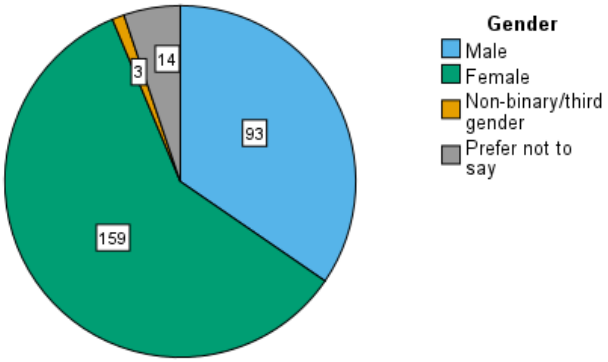


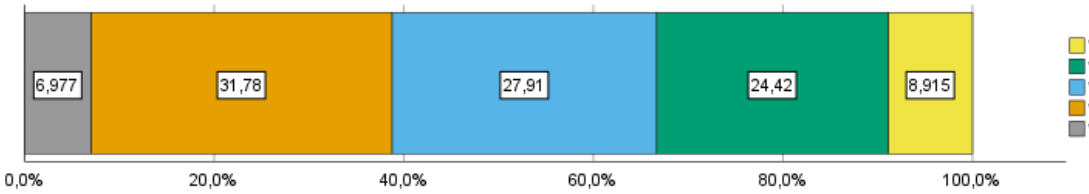
3.2. Part 2: Teachers

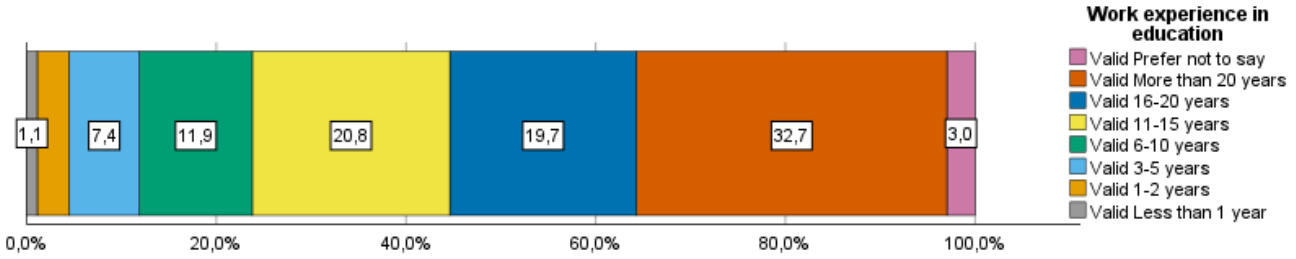
In this second part the results coming from teachers will be further explored. Who are the teachers that participated in this study? What can we learn from them? What do they like to learn and how do they prefer to be trained?

Demographics

The dataset contains 269 teachers of which most are female. All age groups are represented equally. There's a slight overweight of teachers with more than 20 years of teaching experience.



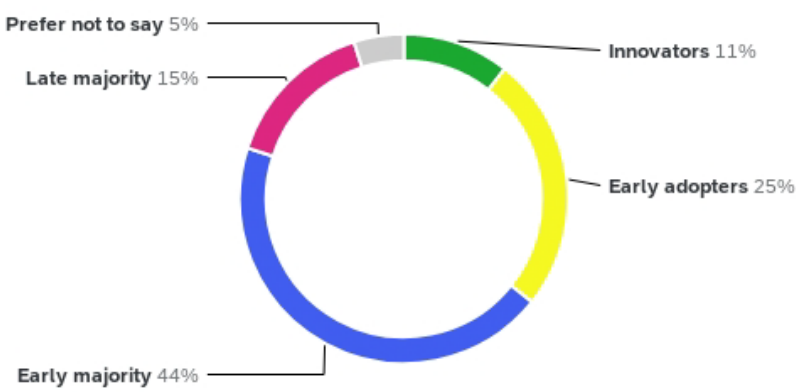




3.2.1. Innovation profiles

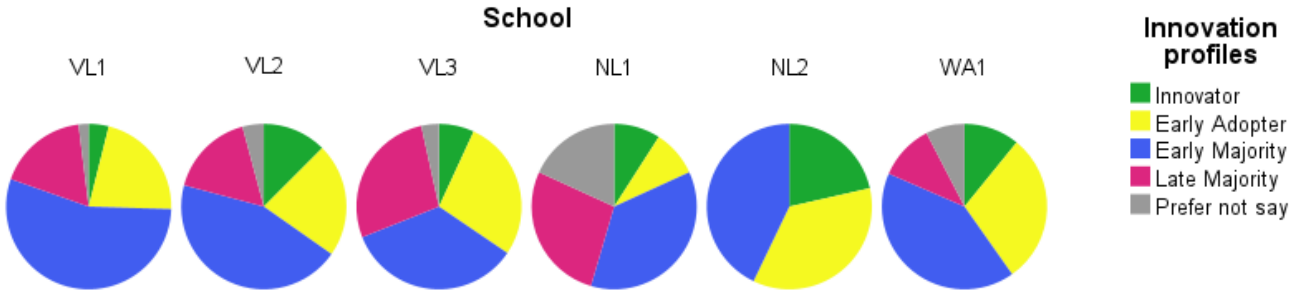
Teachers were asked when they tend to start using technology for teaching. Four profiles can be distinguished:

1. **Innovators** are among the first to try out new technology
2. **Early adopters** tend to follow when they see clear benefits
3. **Early majority** are at the pace of most of their colleagues
4. **Late majority** wait until after the majority of their colleagues



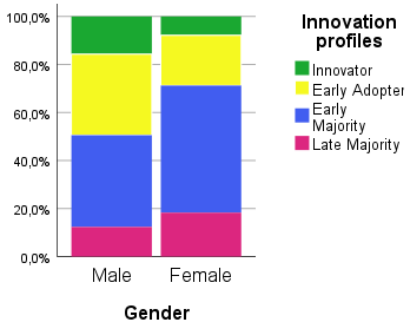
The data shows more than half of the teachers are either early or late majority, meaning they will not seek to make changes in their teaching practice unless they see enough colleagues around them are already using. The innovators and early adopters are the driving force in trying out new ways of teaching driven by digital technology.

How are these groups distributed over the different schools?

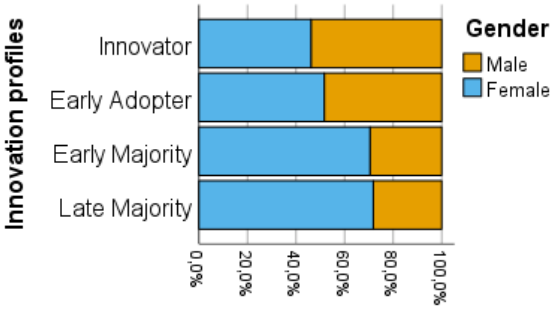


When looking at these innovation profiles, it shows all profiles can be found in all schools, with early majority each time being the dominant group. Every school has innovators and early adopters. Moreover, schools VL2 and WAL1 have more innovators and early adopters than school VL1, while the latter scored higher in all domains of the S4Y-SELFIE compared to VL2 and WAL1. School NL2 also stands out, especially compared to NL1. The only area where NL1 scored higher than NL2, was in Area C: infrastructure. This suggests the human capital is a stronger driving force behind educational change rather than investments in infrastructure.

Are men more innovative than women?

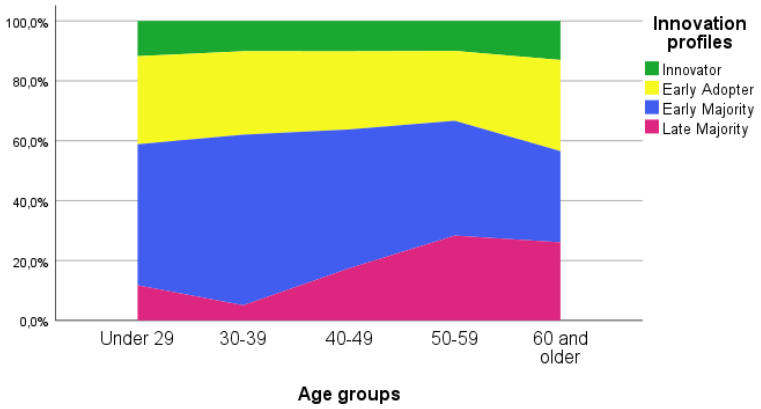


The first graph shows that male teachers are more likely to be innovators or early adopters than female teachers. A significant difference was found between male and female for the innovator and early adopters. However, the second graph shows that within the group of early adopters and innovators, male and female are distributed equally. What is clear from both graphs, is that female teachers identify more as early and late majority compared to male teachers.

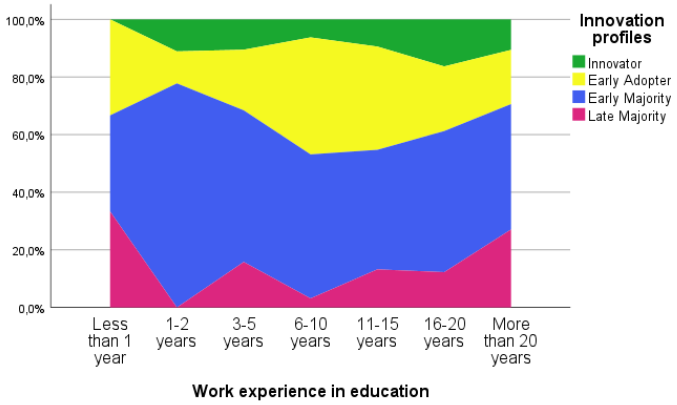


Does age predict the innovation profile?

A common assumption is that young people are more eager to use technology than their older colleagues. While we do see the share of late majority increase as age goes up, it is remarkable that the innovators and early adopters remain quite equally distributed over the different age groups. It is not possible to reliably predict the innovation profile by age.



Are more experienced teachers more innovative?



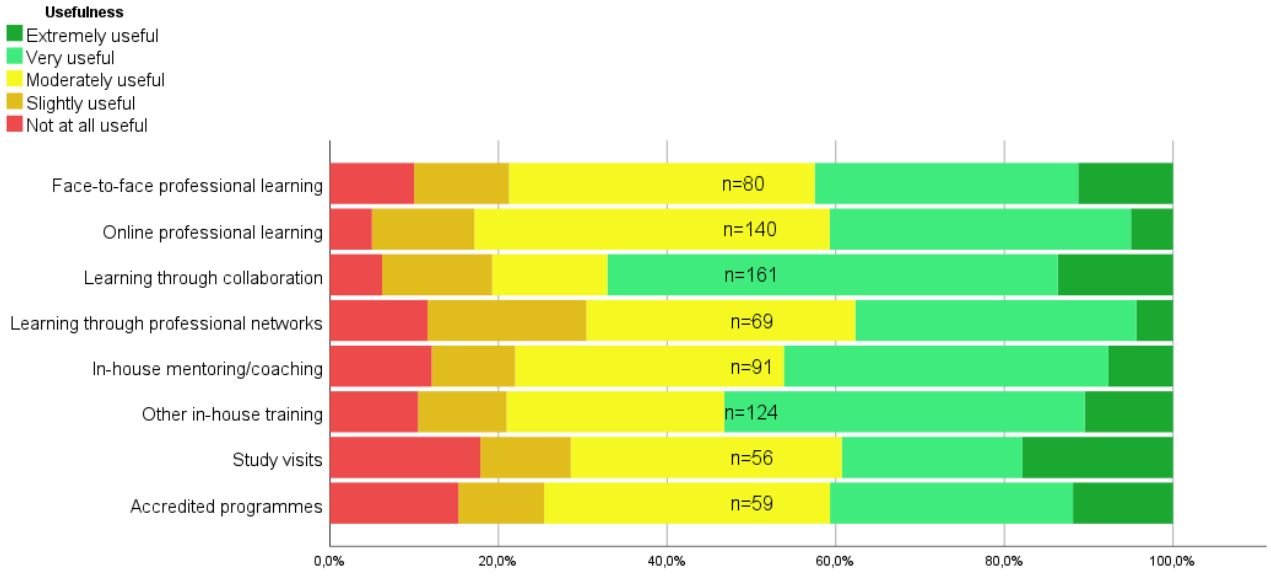
Perhaps teachers that are working longer in education build on their experiences to adapt their learning style to the new digital learning environments. Or perhaps new teachers with less experience are more likely to innovate. However, looking at the data the same pattern emerges as with age. The different innovation profiles appear at any level of experience. Even young starting teachers are not necessarily eager to try out new technologies.

To conclude, innovative teachers are present in all schools, are of all ages, and all experience levels. Men tend to be a bit more innovative than women, though there are certainly enough women that are innovative. While certain schools scored higher on the S4Y-SELFIE, the reason for these differences cannot be found in the innovativeness of the teachers. This also contains a positive message. Every school has the same potential to innovate from the perspective of human capital in their organization. The question is, how do we activate it?

3.2.2. Training teachers

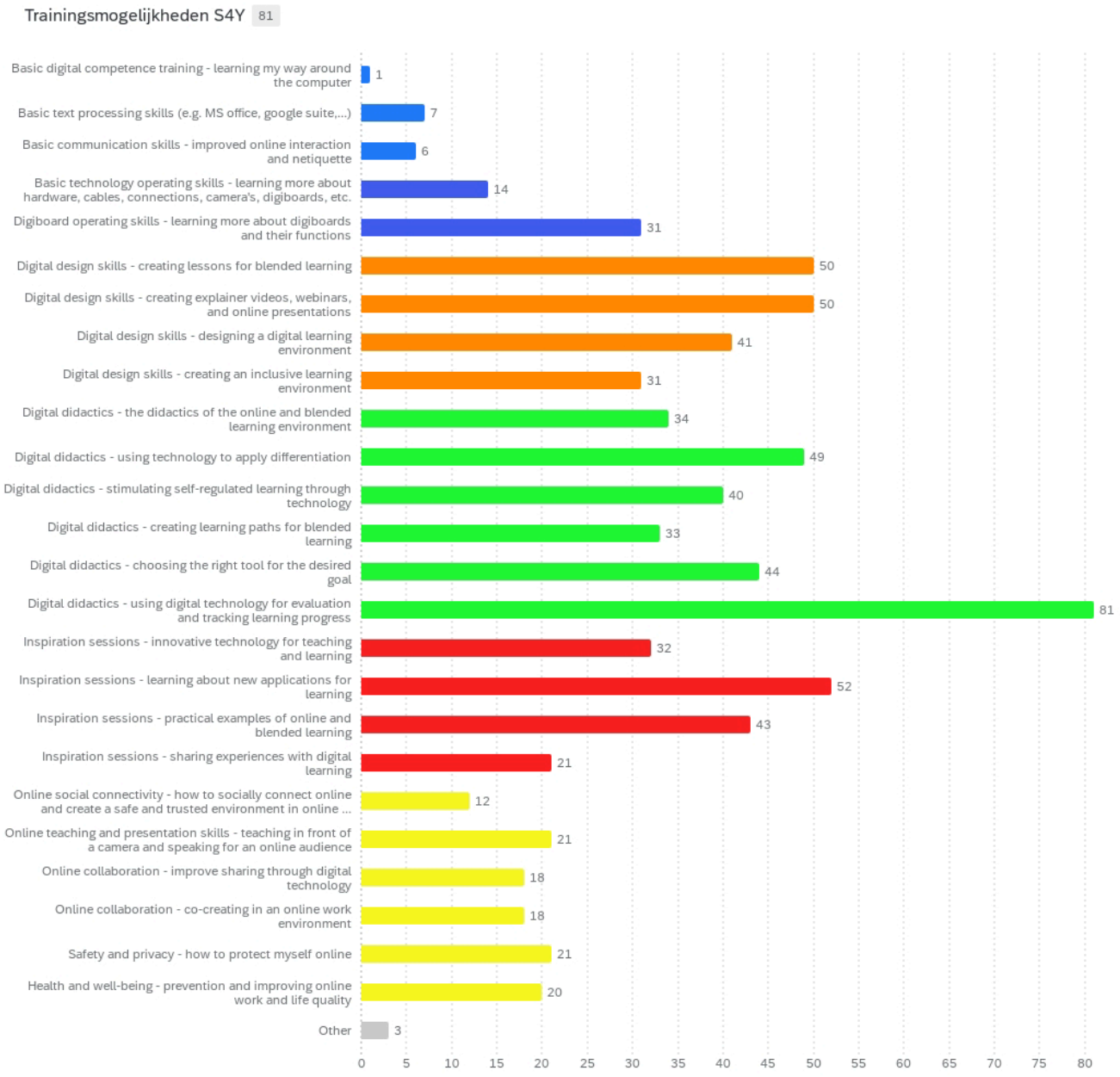
Offering training to teachers is essential to keep education moving forward and to keep up with constant changes in society that have an impact on education. Technological advancements are certainly some of these constant changes that educators need to keep up with. By offering relevant professional development in a useful way, teachers can continue to improve themselves and learn about these new technologies that find their way into society. However, what is relevant, and what is a useful way of learning? Let's first have a look at CPD (Continuous Professional Development) usefulness.

The following graph shows several ways of professional learning and their responses from not all useful (in red) to extremely useful (in dark green). The graph needs to be read in two ways. First a number is shown in the middle of the graph. This is the amount of people that experienced this type of learning prior to the questionnaire. Then, the more green the graph shows, the more useful these teachers find this way of learning.



What becomes instantly clear is that the most useful way of learning is through collaboration and from in-house training. Thus, the most useful way of learning is by working together with colleagues and learning on the work floor in their own school environment.

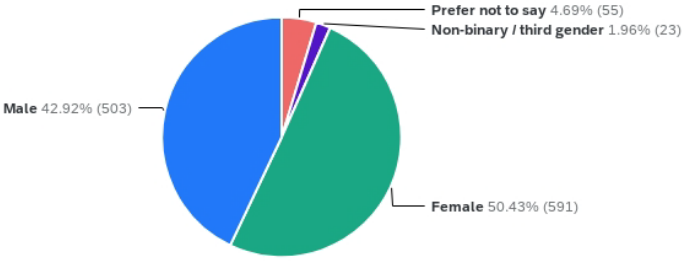
A list of 25 training possibilities was presented to the teachers to inquire them on their interests for further development. Respondents could select multiple options.



Most interest for teachers goes to digital didactics, or in other words, how to use technology for teaching. From this category "using digital technology for evaluation and tracking the learning process" received the most interest, which coincides with the results for area H: assessment. Other interest goes to the digital design skills, such as designing online and blended learning environments. Teachers also like to be more inspired on ways to use technology in education.

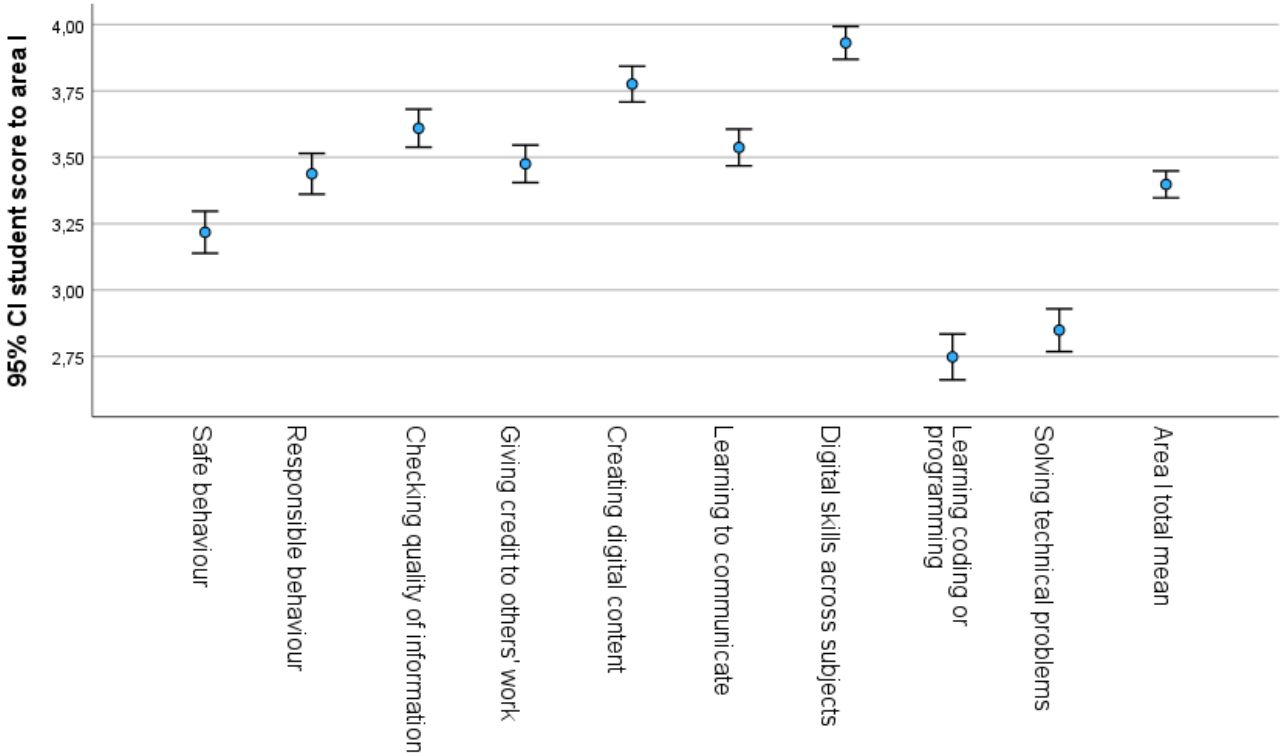
3.3. Students

The S4Y-SELFIE was replied by 1172 students from all 6 schools around the EMR respectively. About half of them are female (n = 591). How do these students evaluate their own digital skills? Where are the learning gaps? Do they have full access to technology and what do they use it for? These are the questions we'll answer in this chapter.

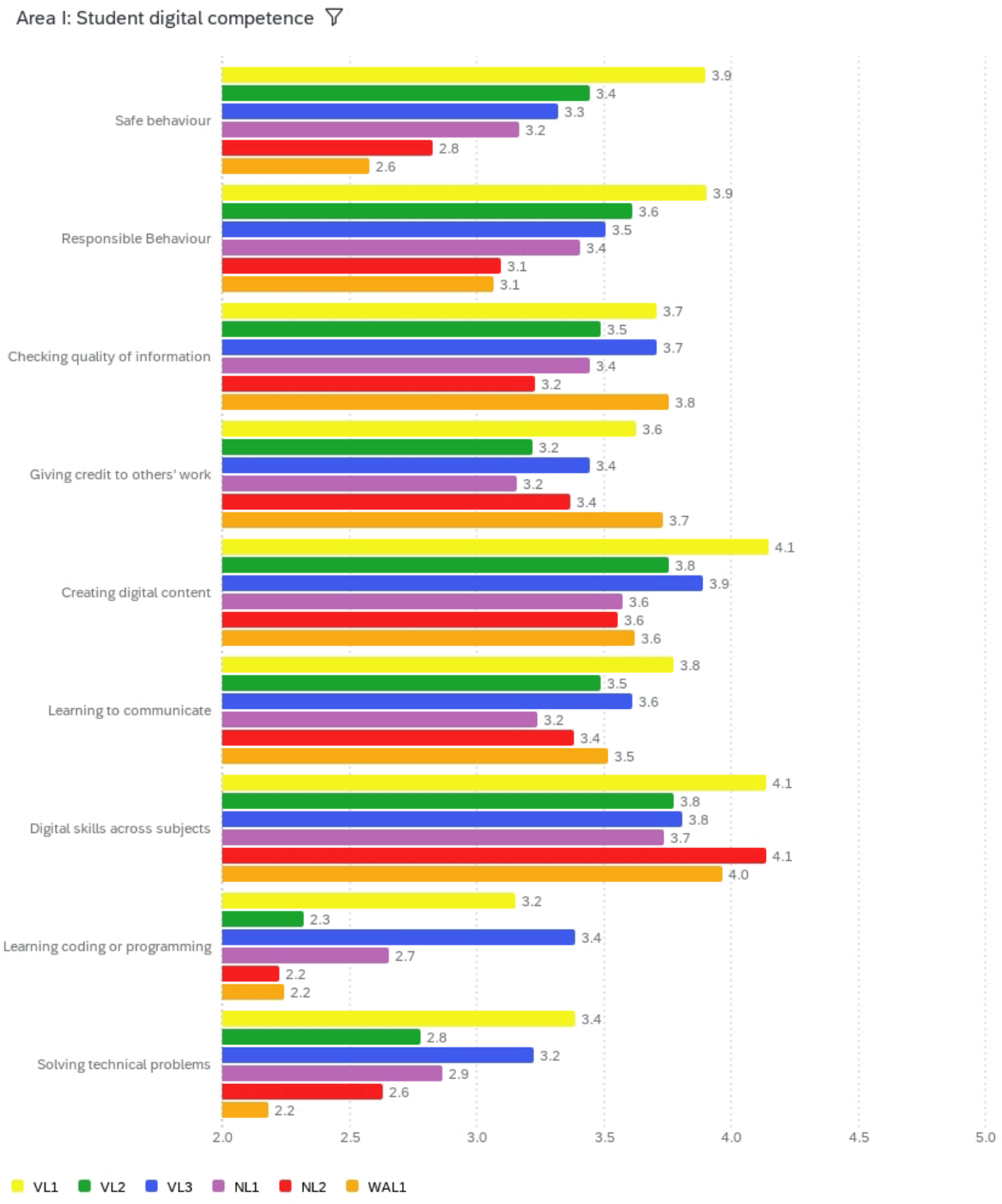


3.3.1. Digital skills

The students' digital skills were measured using 9 different items that were answered by teachers and students. In this section we'll only report the student responses. The items can be found below and show the average result for each item and a 95% confidence interval, meaning 95% of all responses are within that range.

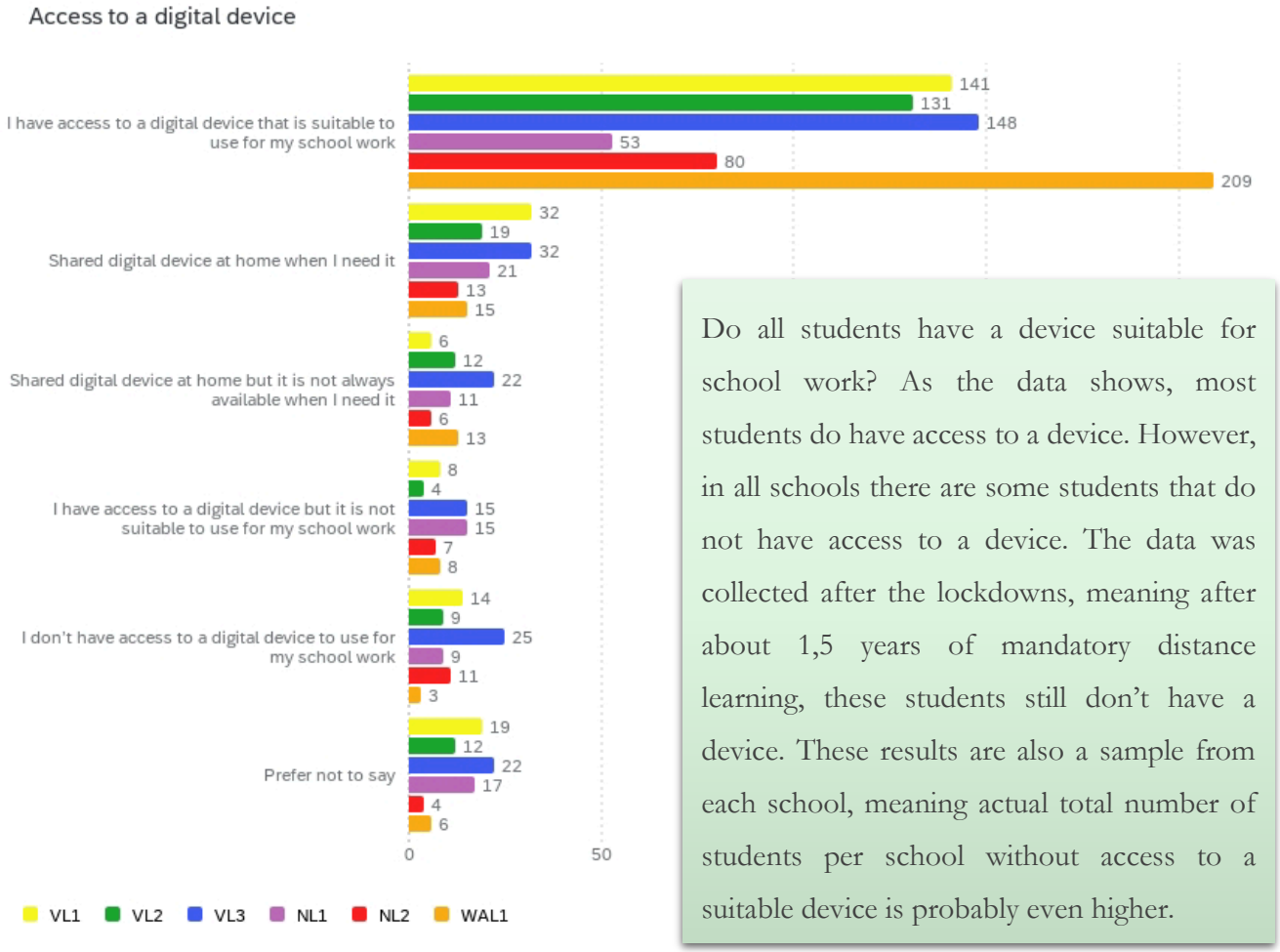


The skills that seem to need the most attention, are learning to code or program, and solving technical problems. These are the results for all schools. The next graph will show the results for each school individually.



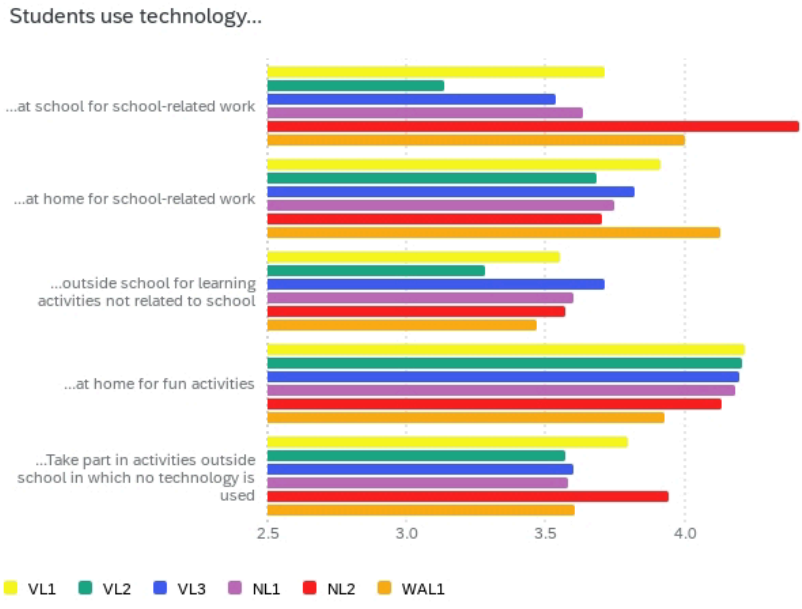
A few skills seem to score within the same range for all schools (e.g. Create digital content, and digital skills across subjects), while other skills seem to be doing better in some schools compared to other schools (e.g. Safe behavior, solving technical problems).

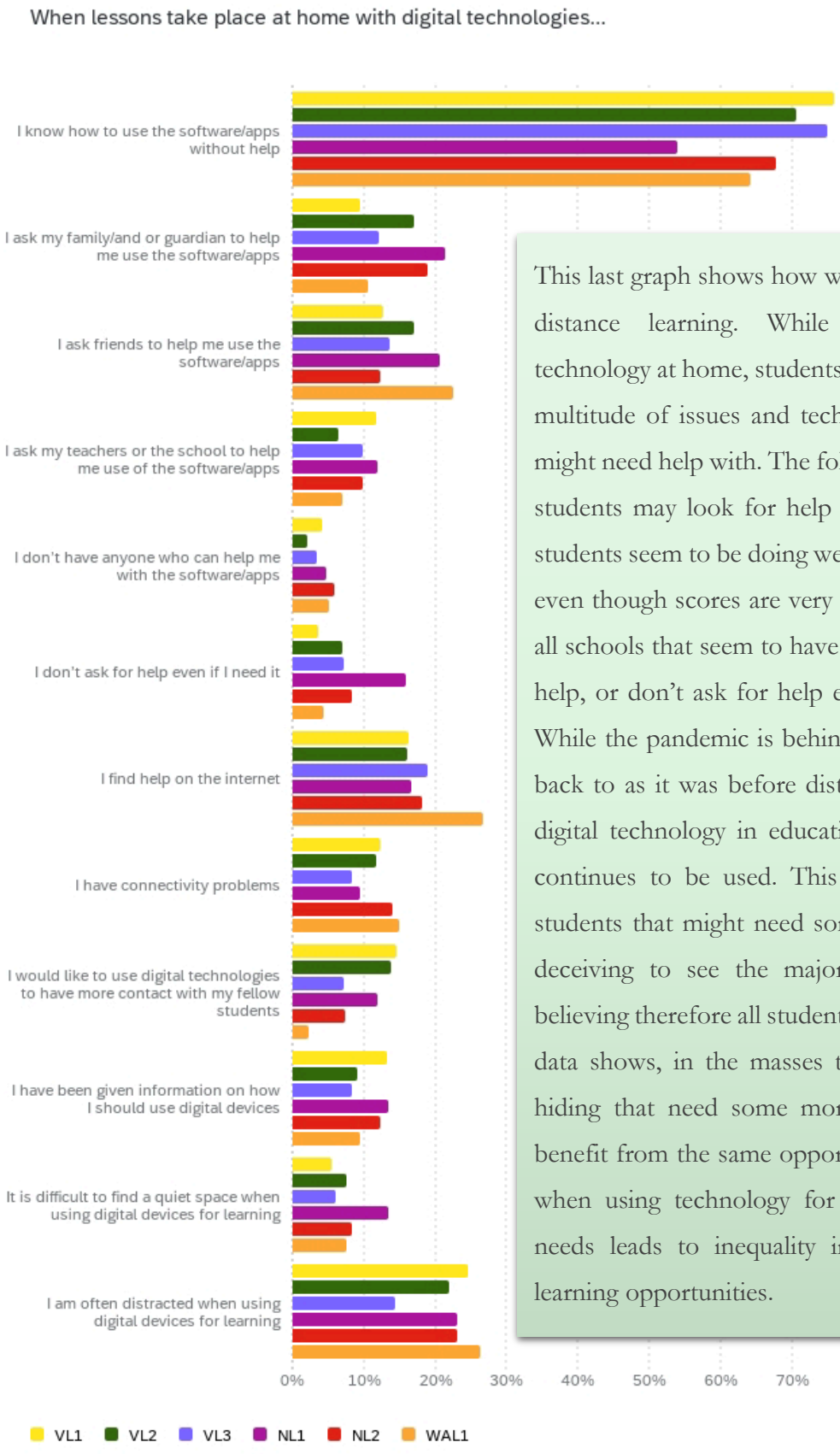
3.3.2. Students, devices, and technology use



Do all students have a device suitable for school work? As the data shows, most students do have access to a device. However, in all schools there are some students that do not have access to a device. The data was collected after the lockdowns, meaning after about 1,5 years of mandatory distance learning, these students still don't have a device. These results are also a sample from each school, meaning actual total number of students per school without access to a suitable device is probably even higher.

The next graph shows what students use technology for. Scores range from "never or hardly ever" (1) to "more than one hour per day" (5). School NL2 seems to be using technology for school-related work at school the most. In general, students use technology the most for fun activities, between 1 and more than 1 hour per day.





This last graph shows how well students got by during distance learning. While working with digital technology at home, students can be confronted with a multitude of issues and technical problems that they might need help with. The following items show where students may look for help when they need it. Most students seem to be doing well without help. However, even though scores are very low, there are students in all schools that seem to have troubles finding the right help, or don't ask for help even though they need it. While the pandemic is behind us, and education went back to as it was before distance learning, the use of digital technology in education remains relevant and continues to be used. This means there are always students that might need some more help. It may be deceiving to see the majority getting by well and believing therefore all students are fine. Though, as this data shows, in the masses there are always students hiding that need some more assistance in order to benefit from the same opportunities as other students when using technology for learning. Ignoring these needs leads to inequality in education and missed learning opportunities.

4. Conclusions

In this study, 6 schools from the EMR were compared in their results on the S4Y-SELFIE. One school scored significantly higher than all other schools, and two scored significantly lower. Looking at the results per area, no school was consistently on top or on the bottom, meaning every school has strengths and room for improvement. Area C: Infrastructure is an area that scores higher for all schools, though for school VL1 it's both infrastructure and leadership that peaks, inflating their total score. This compared to NL1, which scores also above average for infrastructure, leadership dips far under average. This suggests investing only in infrastructure is not enough to build digital capacity, more is needed to make the use of digital technology for education a success.

Looking at the use of technology in the teaching and learning process, the use of digital resources and preparing lessons with technology scores the highest for all schools. However, implementing these technologies in the classroom scores lower, and using it for assessment even lower. This coincides with the interest for training in digital didactics, especially for evaluation, and designing blended learning environments.

Exploring the teachers in the dataset, not many differences can be found between schools. The potential in human capital seems to be equal between schools, as each school has teachers that want to innovate and try new technologies. While men seem to be slightly more innovative than women, the real innovators can be of all ages and all experiences. Collaborative environments are essential to promote the use digital technology in education, which in turn requires strong leadership to bring people together and allow innovative teachers to become frontrunners in their organization in trying new technologies and didactic applications.

The student data shows that every school has some students that do not have access to devices and find it difficult to ask or find help when they need it. A digitalized education also means the technology becomes a prerequisite to learning, meaning a failure of equipment or infrastructure will turn into a loss of learning opportunities. This emphasizes the importance of inclusive policies around the use digital technology in education to ensure equal opportunities for all students to not only develop their digital skills but learning in general.

References

Bingimlas, K. A. (2009). *Barriers to the Successful Integration of ICT in Teaching and Learning Environments: A Review of the Literature.*

Läänemets, U., & Rostovtseva, M. (2015). Developing Supportive Learning Environments. *Journal of Psychology Research*, *5*. https://doi.org/10.17265/2159-5542/2015.01.004

Korthagen, F. A. J. (2004). In search of the essence of a good teacher: Towards a more holistic approach in teacher education. *Teaching and Teacher Education*, *20*(1), 77–97. https://doi.org/10.1016/j.tate.2003.10.002

Kampylis, P., Punie, Y., & Devine, J. (2015). *Promoting effective digital-age learning: A European framework for digitally competent educational organisations.* Publications Office. https://data.europa.eu/doi/10.2791/54070

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development*, *65*(3), 555–575. https://doi.org/10.1007/s11423-016-9481-2

Teacher profiles in the organization of digital education – a clustering study

1. Background

When digital technology finds its way to education, several aspects have an influence on its successful implementation within the learning environment. Take for example the laptop, as it is massively being deployed in education since the COVID-19 health crisis. For a laptop to be useful within the classroom, the infrastructure needs to be provided, being the laptop itself, a power socket to charge it, a WIFI network to connect to, the desk space to put it down, and perhaps even a safe storage space. Next, there is the software that needs to be bought and installed, and a learning monitoring system (LMS) has to be set up. A technical department would be responsible for developing and supporting this infrastructure. However, that's not where it ends. Simply having the laptop still wouldn't create purpose for it to be there. A teacher needs to develop a learning strategy to make use of the laptop, develop learning goals, instructions, and assignments using the technology. Here a direct influence can be observed. The didactical choices a teacher is able to make, is dependent on the available technology and infrastructure. By using technology, a digital learning environment is created. There are ideological choices to be made in defining that digital learning environment. These choices are defined in the vision and strategically implemented as formulated by the school leadership, preferably in collaboration with teachers. To carry out the vision and strategy, school leaders and teachers need to work together, learn together, exchange experiences, and continuously plan and execute steps in the change process defined in the strategy. This requires continuous professional development (CPD) as well. The school leadership hires external trainers to bring training programs to their school and educate teachers on the use of these novel technologies. Several direct and indirect influences on the use of digital technology can be observed, being the quality of leadership, the quality of collaboration, the quality of infrastructure, and the quality of CPD programs. These domains are part of the organizational aspect of digital education and define the context in which teachers operate.

The laptop has found its way to the school, the infrastructure is in place, the leadership has stated the vision, teachers are working together to implement it, and they have access to knowledge and training to learn and develop how to do it well. Are we done? Not quite yet. Even when everything in the organizational domain is in place, another crucial element needs to be considered. The people that have to do it.

Let's imagine two teachers. D. is a middle-aged male teacher in economics. He's been teaching for several years, uses a handbook in print that all students need to buy, and has founds his ideal way of teaching that suits him very well. He doesn't really understand the fuzz around the introduction of the laptop in his school. For his course, students already had to make exercises at home in excel, while in class he would explain the theory and show examples using a PowerPoint presentation. So why did he now have to use the laptop in class as well?

Teacher P. is a soon to retire female economics teacher. Her teaching style is very different than D., as she always liked to develop her own learning materials and look for ways to apply the theory in class by letting students make assignments. Half her classes would take place in the ICT classroom so the students could work on the school computers. The introduction of the laptop saves her time as she does not have to move to the ICT classroom anymore. It also allows her now to mix theory with exercises in the same lesson time. The finished assignments are uploaded by the students to the LMS.

Both teachers display different attitudes towards the use of digital technology in the classroom. The result, being the use of digital technology for learning, will be very different for both teachers. These attitudes are driven by beliefs and influenced by their immediate environment and encountered barriers (Abel et al., 2022; Tondeur et al., 2017). Asking a person about their beliefs for something will inform us on the probability of their behaviour. When the goal is to have meaningful applications of digital technology in the learning environment, the attitudes of the teachers need to be considered in respect to the organizational quality of the digital learning environment.

The organizational quality of digital education on the one hand, and technology beliefs on the other, are known to influence the use of digital technology in education. However, the interdependence and combined influence has not been studied yet. For this study, the following questions are asked:

- **Can different teacher profiles be identified based on their context, beliefs, and technology use in respect to digital education?**
- **Can predictions be made based on demographic data how a teacher can be classified?**

2. Methods

For this study, the teacher data from the S4Y-SELFIE was used (n = 269; female = 59%), representing teachers from 6 schools in the EMR. The data was first prepared by cleaning and imputing the dataset. Next, by applying exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), dimension were determined. The core dimensions from the SELFIE were kept and tested for construct validity using CFA (Costa et al., 2021). The remaining unused items were explored for new dimensions using EFA and tested for construct validity using CFA. Next, a Hierarchical Clustering method (HCA) was applied to identify communalities in responses within the dataset, leading to profiles. Once the profiles were identified, a multinomial regression analysis was applied to examine predictors in the demographic data for the different cluster profiles.

SELFIE construct

The original SELFIE consists of 34 core items and 17 optional items (Costa et al., 2021). The core items form the basis of the SELFIE, while the optional items can be added or left out by school leaders before taking the SELFIE in their organization. Therefore, the optional items are not part of the SELFIE construct and left out of the tool quality study. Costa et al. proposed a model of 8 dimensions which was tested for construct validity. The dimensions from the original SELFIE are:

- Di1: Leadership (3 items)
- Di2: Collaboration and networking (3 items)
- Di3: Infrastructure (6 items)
- Di4: CPD (3 items)
- Di5: Pedagogy: support and resources (4 items)
- Di6: Pedagogy: implementation in the classroom (5 items)
- Di7: Assessment (4 items)
- Di8: Student digital competence (6 items)

As explained in "study 2: measuring the digital capacity of schools", adaptations were made to the SELFIE to include technology beliefs in the SELFIE. In total 16 new items were added to create the S4Y-SELFIE. The optional and new items were explored using EFA to examine potential new dimensions that could allow for more information to be explored for the purpose of this study. CFA was then used to test the

construct validity of the newly found dimensions, which were then placed next to the dimensions from the original SELFIE.

Demographics

There are seven demographic parameters used in the S4Y-SELFIE, being age, gender, work experience, school, innovation profile, confidence, and time use. These parameters were used to assess if and how well it is possible to predict whether a teacher is part of a specific cluster group based on these demographics.

3. Findings

3.1. S4Y-SELFIE model

Core dimensions

The internal validation and reliability assessment found a good fit for the model and good scale reliability for the core dimensions. A full technical report can be requested for detailed reporting.

New dimensions

The exploratory factor analysis on the 33 optional and new items revealed six new dimensions:

- Di9: Beliefs (7 items)
- Di10: Conditions for digital learning (4 items)
- Di11: Student digital competence 2 (3 items)
- Di12: Teacher digital competence (2 items)
- Di13: Facilitation of knowledge exchange (3 items)
- Di14: Digital assessment (2 items)

The CFA revealed a good fit for the model and high scale reliability.

Items that were not loading in the model were removed from further analysis.

Labeling dimensions

The core dimensions and newly found dimensions can be labeled as being part of either the context in which digital technology is employed, the use of digital technology by the teacher, the teacher's attitudes towards use of digital technology, and the digital competency of the students.

Figure 3-1 shows an overview of these dimensions and their labels.

Figure 3-1: overview dimensions in S4Y-SELFIE

3.2. Teacher profiles

The hierarchical clustering revealed three meaningful clusters. Figure 3-2 shows all the cases in the dataset and how they group together based on the distance measures used in the clustering methods. Dots that are close to each other have given a comparable response to the S4Y-SELFIE. The closer the dots are, the more similar their responses are. These similarities are grouped together and form the three clusters that are visible in the cluster plot.

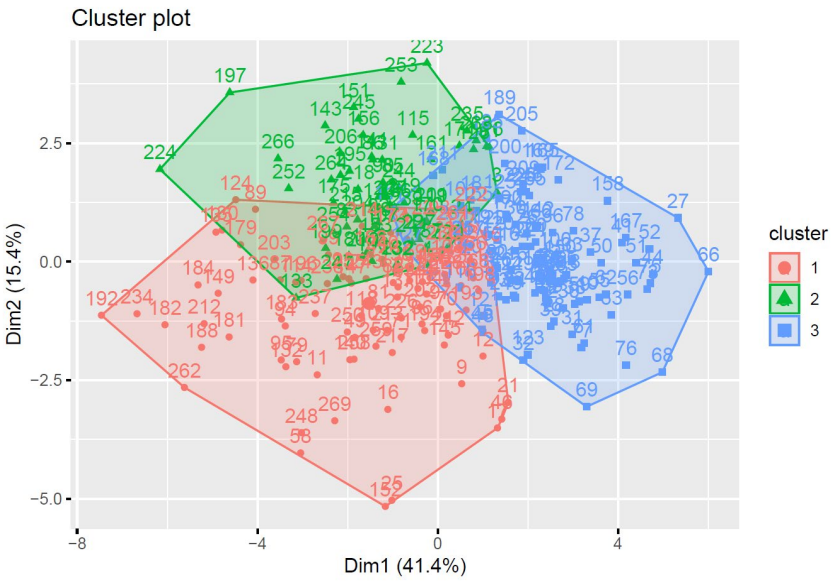


Figure 3-2: Cluster plot showing results from hierarchical clustering

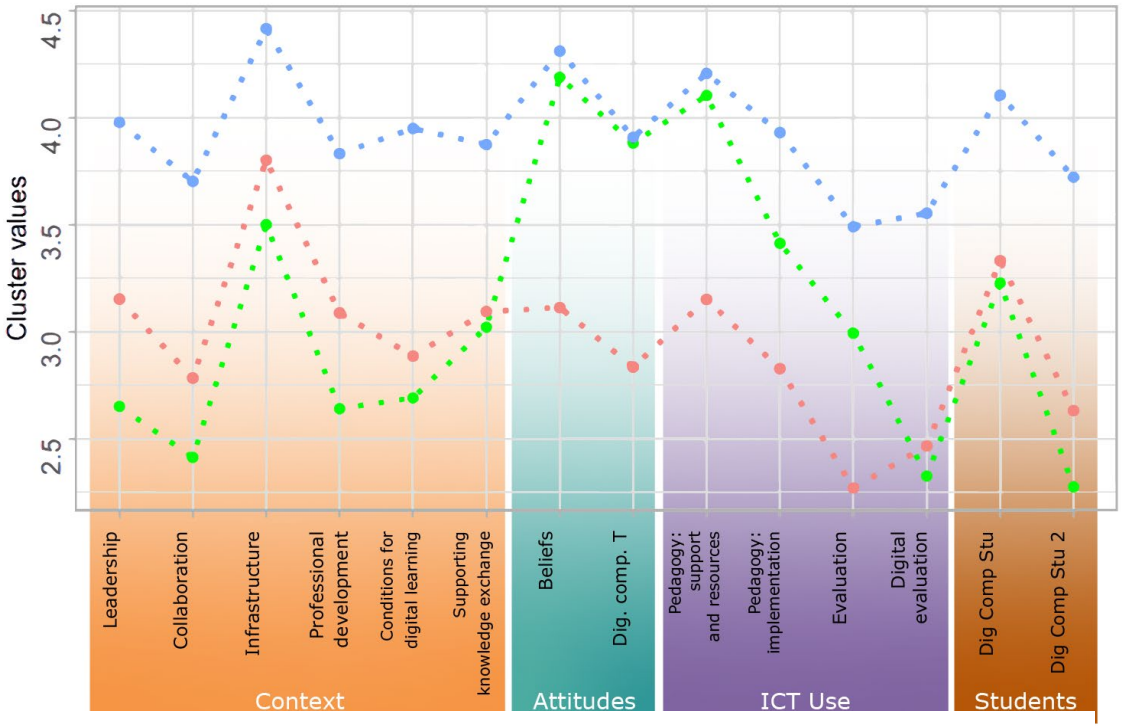


Figure 3-3: Mean results per domain for each cluster

Figure 3-3 shows the mean result per domain for each cluster. This graph visualizes differences in results for each cluster group. Three groups can be distinguished. The first group (red, n = 103), scores on the lower end for each domain. This group can be called the *unsatisfied disengaged users*, as they display low satisfaction in regard to the context in which they work, and they seem disengaged as they are neutral or lower towards both attitudes as well as the use of digital technology. The second cluster (green, n = 63) also scores low on context, even lower than the first group. However, their attitudes towards using digital technology are positive, resulting in a higher use of digital technology. This group can therefore be called the *unsatisfied engaged users*. The third cluster (blue, n = 103), displays high scores for all domains, making them the *satisfied engaged users*.

3.3. Cluster predictors

Now the cluster groups are known, the next step is to explore who the people are in each cluster. Seven demographic parameters were explored and visualized. The following demographics were explored:

- **Gender:** Only male and female have been considered for this part of the study.
- **Age:** Category of teacher's age at the time of data collection.
- **Work experience:** Category of teacher's years of experience at the time of data collection.
- **School:** The school a teacher was employed at the time of data collection.
- **Time use:** Percentage of teaching time teachers have used digital technologies in class in the 3 months prior to data collection.
- **Innovation profile:** Self-identification of when a teacher tends to adopt new technology in education. See study 2 for details.
- **Confidence:** Mean of 4 confidence items estimating how confident a teacher is in using technology for education.

Figure 3-4 summarizes all results per cluster group. Each group is marked for their overall score over context (C), attitudes (A), and technology use for teaching and learning (U). The pie charts show the configuration for each demographic parameter as a total count for each option. For example, the pie charts for gender show the share of male and female teachers for each group. Comparing groups visually can already reveal some differences between groups, however, it is important to test whether the differences between groups are significant, and not based on chance. The results from the multinomial regression analysis are shared in table 3-1.

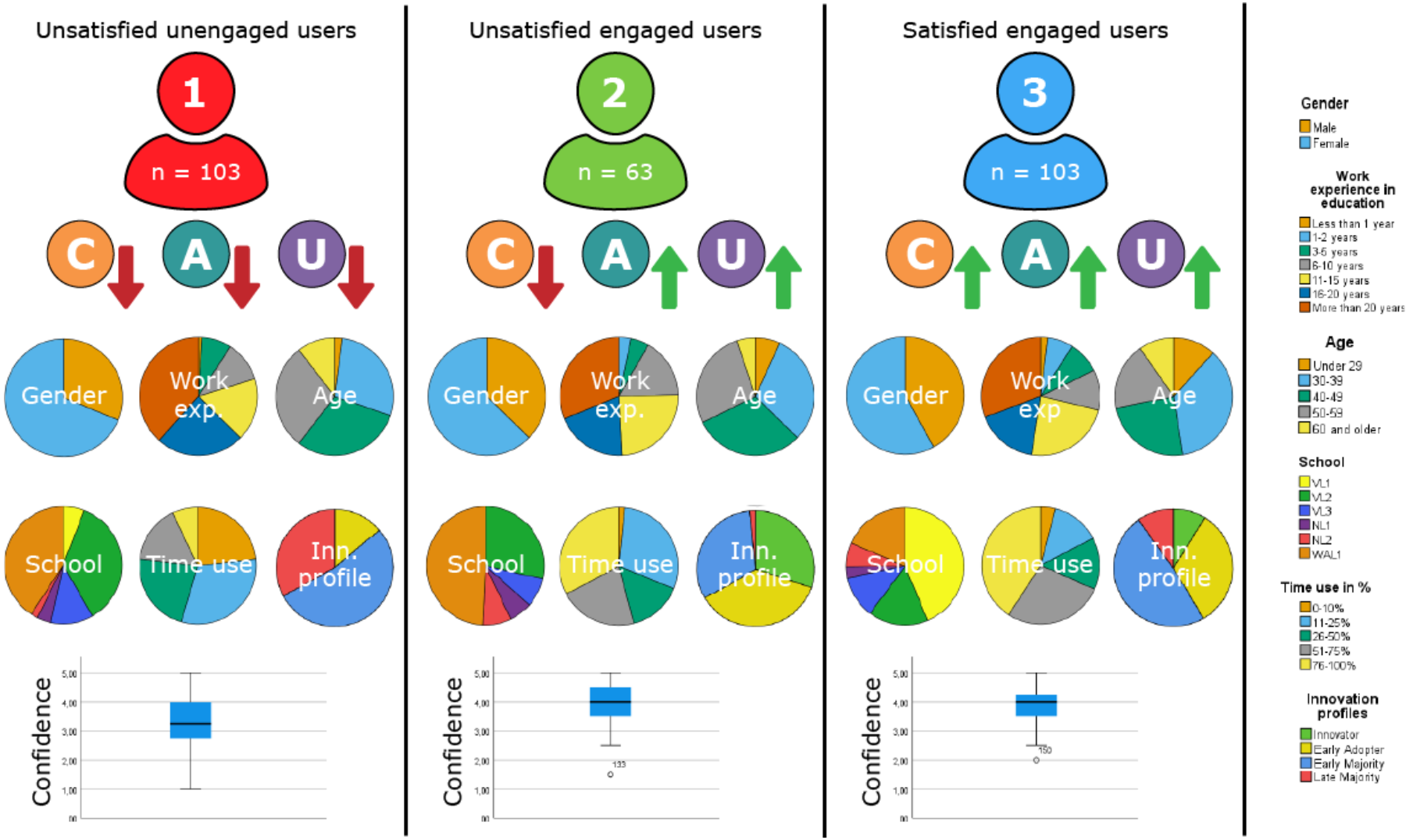


Figure 3-4: Summary of demographic predictors

Table 3-1: Results multinomial regression analysis

Likelihood Ratio Tests

Effect	Model Fitting Criteria -2 Log Likelihood of Reduced Model	Likelihood Ratio Tests Chi-Square	df	Sig.
Intercept	293,601[a]	,000	0	.
Age	294,366	,764	2	,682
Work experience in education	293,664	,063	2	,969
Confidence using technology for education	302,461	8,860	2	,012
Percentage of teaching time digital technologies was used in class in the past 3 months	301,014	7,413	2	,025
School	357,799	64,198	10	<,001
Gender	296,838	3,237	2	,198
Innovation profiles	338,321	44,719	6	<,001

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.
a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Four demographic parameters have been found significantly different between groups, being school, innovation profile, time use, and confidence. Age, gender, and work experience are not significant. This means, given a teacher's age, gender, or experience in education, it is not possible to predict whether this person would be an engaged or unengaged teacher when it comes to using digital technology in their learning environment. The significance of time use means engaged teachers indeed use more technology in their lessons. Comparing the pie graphs for time use, it is visible for both types of engaged users (clusters 2 and 3), that the share for 76% - 100% of lesson time spend using technology is about 1/3 of the graph. The same graph for unengaged users (cluster 1) shows more than half of these teachers use technology less than 25% of lesson time. Cluster 1 consists of about 85% early or late majority, who are teachers that start adopting technology at the pace or after the majority of their colleagues. Cluster 2 mostly consists of innovators and early adopters. Both engaged users are more confident in using digital technology in their lessons than the unengaged users. As confidence in using technology increases, beliefs (Di9) also increase, which is visualized in figure 3-5. The most apparent difference between the three clusters, however, is the school the teachers come from. Most teachers from VL1 are in cluster 3, the satisfied engaged users. This school came out as the strongest school in study 2. However, as these graphs are showing absolute numbers, a comparison is not justified without looking at the clusters per school, which is visible in figure 3-6.

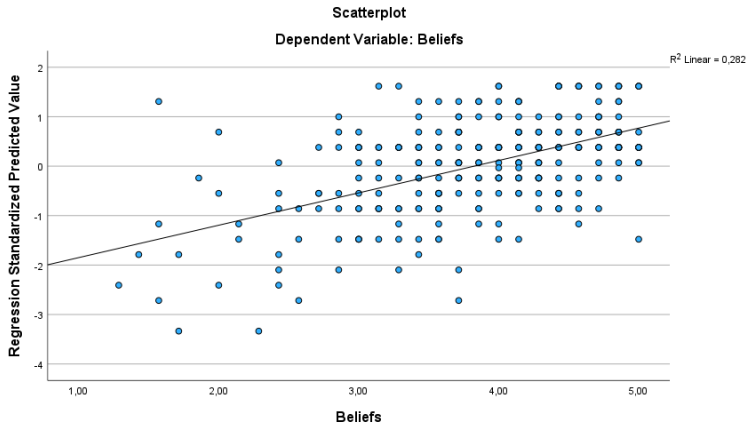


Figure 3-5: Scatterplot showing relation between beliefs (Di9) and confidence

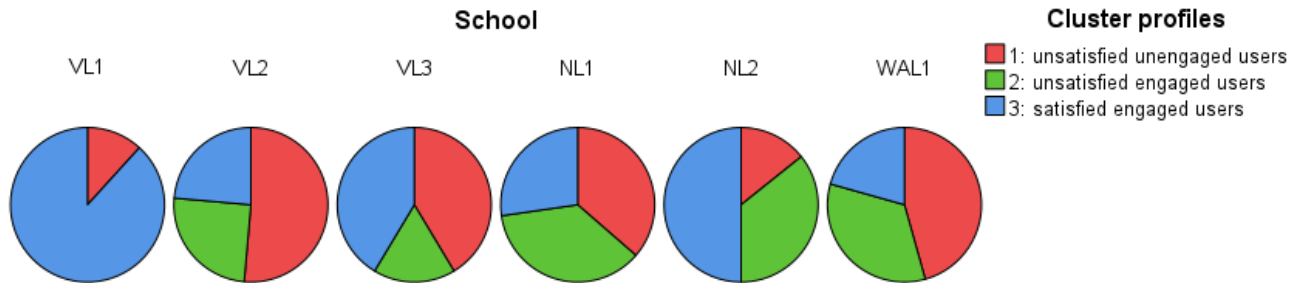


Figure 3-6: Cluster profiles per school

From these graphs, it is visible school VL1 has nearly only satisfied engaged users in their school, with a small exception of a few unsatisfied unengaged users. All other schools have all three cluster types in their teacher corps, with varying distributions. Schools VL2 and WAL1, two schools that both scored the lowest on the S4Y-SELFIE, consists of more than 3/4th of unsatisfied users. However, all schools have engaged users, at least half or more want to use or already use technology in their lessons. This means, given a certain school, it is possible to predict the chance of teachers being engaged to use technology or not, and whether they are satisfied with the context of that particular school.

4. Conclusions

The unsatisfied engaged teachers (cluster 2) demonstrate the importance of technology beliefs. Strengthened by their positive beliefs, they want to use technology in their lessons despite the context they are working in. This is reflected in their confidence and the time technology is used for teaching, as their scores for these two metrics are very close to the satisfied engaged users.

The unsatisfied engaged teachers also seem to be the innovators and early adopters in schools. In a context in which the use of technology is not the norm, it is likely that those who are convinced of the usefulness of technology enhanced learning, will need to be among the first to start the process. This could explain a self-identification as innovator and early adopter.

Looking at the context, infrastructure is only a part of the entire context in which technology is adopted. For all three groups the average score for infrastructure peaks, while the main difference between the unsatisfied and satisfied users lies in the quality of leadership, collaboration, and professional development.

Investing in technology alone is not enough to make a sustainable change towards more technology use in education. Investing in people is just as crucial in creating meaningful engagement with digital technology

in the learning environment. The unsatisfied engaged teacher can play a key role in the change process, as they are the ones that not only display the ambition to use technology, but also show a critical perspective towards their context. They can help identify barriers and formulate solutions for further improvement. Teachers who identify as early majority wait for the road to be levelled before they engage in the change themselves. Therefore, it is up to the innovators and early adopters to initiate action, level the road, and explore technology enhanced teaching and learning possibilities before these are introduced to the entire team. School leaders have the position and power to emancipate these critical and innovative teachers and support them in creating collaborative dynamics through which barriers can be overcome, and to contribute to a positive dynamic for change in their institution.

References

Abel, V. R., Tondeur, J., & Sang, G. (2022). Teacher Perceptions about ICT Integration into Classroom Instruction. *Education Sciences*, *12*(9), 609. https://doi.org/10.3390/educsci12090609

Costa, P., Castaño-Muñoz, J., & Kampylis, P. (2021). Capturing schools' digital capacity: Psychometric analyses of the SELFIE self-reflection tool. *Computers & Education*, *162*, 104080. https://doi.org/10.1016/j.compedu.2020.104080

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development*, *65*(3), 555–575. https://doi.org/10.1007/s11423-016-9481-2

State of the Art - Differentiated Instruction

An Investigation in the Meuse-Rhine Euregion

This chapter is based on:

Compen, B., Verstegen, D., Maussen, I., Hulsman., C & Dolmans, D. (2023). Good practices for differentiated instruction in vocational education. The combined perspectives of educational researchers and teachers. (submitted)

Whereas the previous chapters in this report discussed the state of the art of digital infrastructures and teachers' and students' digital skills in secondary and higher education, the present chapter focuses on the state of the art of teachers' differentiated instruction practices in these contexts. The chapter starts with an outline of the topic's background and an overview of the objectives of the study. This is followed by a description of the approach used to reach the objectives and the findings that were eventually obtained. Finally, it is discussed how the insights of the study were used in the subsequent steps of the Skills4You project.

This part of the study was conducted by Maastricht University with support of UHasselt during the data collection process.

1. Background

Distance learning during the COVID-19 pandemic has highlighted and enlarged the differences that exist between students (e.g. Haelermans et al., 2021). Teachers are increasingly expected to handle these differences adequately in their teaching by using the pedagogical-didactical approach of differentiated instruction (DI) in both offline, online and blended settings. An abundance of definitions and operationalisations of the concept of DI exist (e.g. Graham et al., 2021), but in essence, it refers to the tailoring of teaching activities to meet the various needs that may exist within a group of learners. This implies a shift from the more traditional whole-class approach to an approach in which teachers ought to value and adequately address differences among students. DI is considered a complex task (van Geel et al., 2019) that comes with many challenges and that requires a certain set of competencies of teachers. Therefore, Keuning et al., (2021) identified five principles that resemble effective DI practices by teachers:

Strong goal orientation

Teachers should be well aware of the goal of the lesson and the goals of the lesson period, and during the lessons, they are supposed to make choices in such a way that they contribute to reaching the goals. Also, teachers should inform students about what they will learn, why they learn this and what the success criteria are for reaching the goal. This helps teachers and students make targeted decisions to reaching the goal.

Monitor continuously

During all phases, teachers ought to collect information on the understanding and progress of their students. In the preparation, they could combine daily work with test results, for example. During the lesson, they explicitly make use of monitoring strategies to assess where students are at, what they are struggling with and what they are good at. Also after the lesson, they monitor the progress.

Challenge

Teachers should have high expectations and be ambitious for all students, both in their goals and approach as well as their attitude and language use. They need to ensure offering each student instruction and exercises in the zone of proximal development so that students learn and develop themselves. Challenging students also requires that teachers express their realistic, but high, expectations.

Adapt instruction and exercises

Teachers are required to adapt the level of abstraction, pace and difficulty and/or the amount of instruction and/or exercises based on observed differences between their students and their various needs. To be able to do so, extensive knowledge on the subject matter and a broad pedagogical and didactical skill set are essential.

Stimulate self-regulation

Good DI also implies that students are taught how to think for themselves about what they need to reach their goals. Teachers make students the owners of their learning process, which also implies daring to let them go and to let them learn from mistakes. It is of great relevance, however, that teachers monitor the choices students make and help them adjust their choices when necessary.

The principles outlined above were initially identified in primary education (Keuning et al., 2021) and have recently been confirmed in the context of general secondary education (Meutstege, 2023). Insight into the DI practices of teachers in different educational settings, such as vocational education, is very limited.

However, the specific characteristics of vocational education – such as its focus on competency development and its strongly heterogeneous student population with a large share of vulnerable students – may limit the transferability of findings regarding teachers' DI practices obtained in other settings. The need for increased insight into DI in vocational education is further enhanced as a result of an investigation by the Dutch Inspectorate of Education revealing that although teachers in this context see the importance of DI in vocational education, they tend to lack the competencies to apply this approach in an effective manner (Inspectie van het Onderwijs, 2021).

1.1. Objectives

For the reasons outlined above, the aim of this part of the state of the art study is to identify within the contexts of secondary and higher vocational education in the Euregio Meuse-Rhine:

- Which practices are considered important for effective DI
  - How these practices may relate to earlier identified DI principles
- Which conditions need to be met for effective DI
- Which challenges are faced by teachers when DI is concerned
- The extent to which these practices, conditions and challenges are similar in offline, online and blended settings

2. Approach

In each region and for both secondary and higher vocational education, focus group interviews were conducted with teachers and educational researchers with expertise on DI. By inviting both teachers and researchers, we aimed to gain insight into effective DI from a practical as well as theoretical perspective.

2.1. Participants

	The Netherlands	Flanders	Wallonia
Secondary vocational education	**8**	**7**	**3**
Higher vocational education	**6**	**1**	**1**

2.2. Focus group interviews

The focus groups were conducted online – due to COVID-measurements – in the beginning of 2022. The interviews lasted between 1.5 and 2 hours and were audio recorded to ease the data analysis. The focus groups were largely structured around vignettes (or cases) that reflected the five DI principles identified by Keuning and van Geel (2021). These vignettes were designed in collaboration with a few teachers from the target groups to ensure that the situations sketched would be recognisable for the focus group participants. This implies that different series of vignettes were designed for each educational setting and region. An example vignette is shown in Figure 1.

The interview procedure was similar for each of the five vignettes. Teachers were asked to discuss the extent to which they recognised the scenario and what they would do in this situation, whereas researchers were asked to indicate whether and why they believed the scenario was representative and what advice they would give the teacher in this situation. Participants were stimulated to elaborate on their answers, to come up with examples of their own practices and to discuss other aspects they considered important in relation to DI.

> Susan teaches some of the practical subjects of the programme she is involved with. She keeps track of her students' progress by taking weekly tests. Although this method works fine for her, it is time-consuming, and she wonders how colleagues with a large number of classes monitor their students. She hears that in general subjects such as Dutch and mathematics, digital programmes are being used that provide insight into student progress. She is curious whether this kind of programme could also be suitable for the more practical subjects where skills development is central. How could Susan monitor differences among her students better and more efficiently?

Figure 1. Example of a vignette

3. Findings

This section is structured according to the study objectives. Section 3.1 provides an overview of the categories of DI practices that were considered effective by participants of the focus groups and Section 3.1.1. links these practices to the earlier identified DI principles. Section 3.2 discusses the conditions the participants have identified to be able to effectively apply DI. This is followed by Section 3.3, in which the challenges that teachers face in applying DI are presented. Finally, Section 3.4 discusses the extent to which DI practices, conditions and challenges are similar in offline, online and blended settings.

3.1. Effective DI practices

Valuing and encouraging students

Participants in all settings mentioned that the educational systems tend to result in teachers focusing primarily on students' cognitive abilities and grades in their daily teaching practice. For effective DI in vocational education settings, however, it is believed that teachers should increasingly recognise, value and encourage the different types of talents that students may have. This also implies that teachers need to empower their students by conveying their trust in students' capabilities and by rewarding them on a regular basis.

Varying in instruction, assignments and assessment

Throughout the focus groups, participants reported that offering variation is key to effective DI. In particular, variation in instruction, assignments and assessments were discussed. Having access to a range of materials could support teachers in choosing those that fit the learning needs of individual students best. Simultaneously, giving students the opportunity to make choices between the materials available may enhance their motivation. One dilemma raised related to this practice concerned the extent to which teachers can differentiate in assessment; to what extent can this be considered 'fair' and justified?

Organising group work

Participants indicated that the formation of pairs or groups of students may support DI. In heterogeneous groups, for example, students who already understand a certain concept or master a skill could help others, whereas homogenous groups allow teachers to address groups of students with similar learning needs in a similar manner. In addition, project work in which students are expected to take on different roles could be

a means for teachers to let students focus on a role in which they feel confident or challenged. Participants emphasised that flexible grouping of students is essential.

Connecting school and practice

Across settings, participants emphasised that especially in the vocational education setting, teachers' DI practices would strongly benefit from connecting school with practice as much as possible. The job perspective tends to appeal to students most, and hence, ensuring that students understand why and how what they learn in school is relevant for their future, helps to motivate and encourage students to be active learners. Teachers could think of organising projects for real companies, for example. But also enhanced alignment between theoretical and practical courses within schools may be helpful. Finally, teachers ideally stay in contact with internship supervisors to gain insight into how students perform in practice. Having a more complete image of how a student performs helps teachers to provide the support needed.

3.1.1. Relations DI practices and earlier identified DI principles

The paragraphs above described four categories of practices that – according to the vocational education teachers and educational experts that participated in focus groups - contribute to effective DI: valuing and encouraging students, varying in instruction, assignments and assessment, organising group work and connecting school and practice. It could be argued that each of these practices could be related to at least one of the DI principles identified by Keuning et al., (2021).

The importance of **valuing and encouraging students** by recognising students' talents and conveying trust in their capacities could be connected to the DI principle of *continuous monitoring* and *challenging students*. Providing **variation in instruction, assignments and assessment** to address students' various learning needs is clearly related to the principle of *adapting instruction and exercises*. Similarly, the **organisation of group work** with flexible grouping and projects in which students can take on different roles seems to most strongly relate to *adapting instruction and exercises*. Finally, **connecting school and practice** – which is particularly relevant to the vocational education context – to create awareness of how school activities are important for students' future jobs, links to the DI principles of *strong goal orientation* and *challenging students*. Students are likely to be more motivated and challenged when they understand why provided tasks and study materials are relevant for their goal of becoming a professional.

3.2. Conditions for effective DI

Teachers' mindsets

The focus group interviews indicated that participants feel that adequate mindsets of teachers are essential to apply DI effectively. In particular, teachers ought to act as facilitators or coaches of students, rather than having knowledge transfer or competency development as their main objective. This implies that for DI, it is important that teachers closely observe their students and interact frequently. This also requires an open atmosphere that is less hierarchical in nature than traditional classroom teaching tends to be.

Shared team vision

Throughout the focus groups, participants emphasised the importance of a shared team vision on DI within a school or programme. Alignment between teachers is needed to ensure a coherent approach towards DI. If only one or a handful of teachers applies DI, this is believed to limit its potential impact on student learning. Relatedly, collaboration with career counsellors and care teams within schools is perceived beneficial to meet students' various needs as well as possible.

3.3. Challenges in DI

DI is a complex and time-consuming task

The analysis indicated that although both teachers and educational experts were able to share good DI practices, many still consider it a complex task that requires a significant time investment. It was discussed that DI may be challenging to both novice and experienced teachers. Whereas novice teachers, for example, may find it difficult to assess and address students' needs in addition to managing their classrooms, teachers who have obtained their degrees many years ago may have learned less about applying DI. In the focus groups with participants from higher vocational education, it was reported that DI is particularly complex because teachers tend to be confronted with large cohorts of students and few contact hours. This limits the opportunities to map student characteristics and hence, to adequately address differences among students.

Governmental regulations

In the focus groups on secondary vocational education in particular, several regulations at the governmental level were discussed that were believed to enhance the complexity of applying DI. Teachers in the Dutch focus groups reported the challenges that the national requirements for the AVO-courses bring. These are the more theoretical courses such as Dutch and mathematics that all students need to pass. Teachers feel that the relatively strict requirements for passing these courses, limit their opportunities to apply DI in contrast to the flexibility that exists for the more practical courses.

The focus groups with Flemish participants revealed a challenge resulting from the introduction of the M-decreet. The M-decreet implied that the share of students with special needs in classrooms grew and participants indicated severe difficulties to ensure that each student within their classrooms received the attention they needed to learn and progress.

3.4. DI in offline, online and blended settings

Despite that some of the vignettes that were presented during the focus groups purposely contained cues with regards to DI in online settings and the use of digital tools to support DI, participants rarely elaborated on these aspects. Although we have to interpret this observation cautiously, it may imply that the DI practices, conditions and challenges described in the sections above are believed to hold in any setting, independent of whether it is offline, online and blended.

4. Next steps

The insights obtained in this state-of-the-art study informed subsequent steps of the Skills4You project:

- The input from the focus groups interviews supported the writing of scripts for informative videos on DI in the context of vocational education. These videos were placed on the Verudise platform and used throughout the training sessions with teachers.

- Knowledge about which DI practices are considered effective in vocational education, as well awareness regarding the challenges and dilemmas faced by teachers in this particular setting, helped the research team to design and prepare for the training.

References

Graham, L. J., de Bruin, K., Lassig, C., & Spandagou, I. (2021). A scoping review of 20 years of research on differentiation: investigating conceptualisation, characteristics, and methods used. *Review of Education, 9*(1), 161–198. https://doi.org/10.1002/rev3.3238

Haelermans, C., Aarts, B., Abbink, H., Jacobs, M., Vugt, L. v., Wetten, S. v., & Velden, R. v. d. (2021). *A full year COVID-19-crisis with interrupted learning and two school closures: The effects on learning gains and inequality in primary education* [Working paper].

Inspectie van het Onderwijs. (2021). *Themaonderzoek differentiëren in MBO*. Ministerie van Onderwijs, Cultuur en Wetenschap.

Keuning, T., & van Geel, M. (2021). Differentiated teaching with adaptive learning systems and teacher dashboards: The teacher still matters most. *IEEE Transactions on Learning Technologies, 14*(2), 201-210. https://doi.org/10.1109/TLT.2021.3072143

van Geel, M., Keuning, T., Frèrejean, J., Dolmans, D., van Merriënboer, J. J. G., & Visscher, A. J. (2019). Capturing the complexity of differentiated instruction. *School Effectiveness and School Improvement, 30*(1), 51-67.