Introducing Digital Education as a Mandatory Subject: The Struggle of the Implementation of a New Curriculum in Austria

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Keywords: Digital Education, 21st Century Skills, Computational Thinking, STEM.

Abstract: In response to the requirement that every European citizen acquires the skills necessary for enhancing and utilizing digital technology in a critical, inventive, and creative way, the European Digital Competence Framework for the Digital Competence of Educators (DigCompEdu) was developed. In Austria, grade 9 students began taking "Computer Science" in 1985. For a very long time, there was only this single year of IT education that was compulsory during the educational career. 21st century skills were finally formally integrated into higher grades when Austria introduced the mandatory curriculum "Digital Education" (Digitale Grundbildung) in September 2018 for all students in lower secondary education. The administration of the school could decide whether to provide "Digital Education" as a standalone course or whether to integrate it into other subjects. Finally, the new curriculum was added to the regular timetable as a compulsory subject in the 2022/2023 academic year. But because of a staffing shortage and a lack of teaching material, schools continue to struggle with the issue of who is teaching what and how. This paper discusses the introduction of the new curriculum and examines early results of a poll that 673 teachers participated in between September and December 2022.

1 INTRODUCTION

Digital technology is usually applied in education for data collection, administrative efficiency enhancement, and testing rather than teaching. Buckingham (2020) states that many teachers teach *with* or *through* technology, rather *about* it. Moreover, educational technology often fails to bridge everyday students' lives with what they learn in school (Buckingham, 2020). However, as new professions are emerging, future adults will need new abilities and qualifications. In order to adequately prepare today's children for the demanding challenges of the next digital era, the educational community must move quickly.

The development of pupils' digital abilities is extremely important, particularly in the years of the COVID-19 pandemic and the subsequent emergency remote teaching. Dealing with the pandemic has posed new issues for the educational sector because remote learning is sometimes stigmatized as being less beneficial to academic progress. It is hardly surprising that throughout the COVID crisis, there has been an increase in young people's media use (Langmeyer et al., 2020). However, the loss of rigid frameworks from daily school life as a result of the pandemic has not only had negative effects but has also significantly increased creativity and digitization, proving the value of digital education. Nevertheless, in 2018 the "Teaching and Learning International Survey" (TALIS) revealed that Austrian teachers show less professional IT education than educators in other European countries. Additionally, compared to other states, Austrian teachers tend to attend fewer digital education training programs, and information and communications technologies (ICT) are used less frequently for project work or customized education programs. Austrian educators' lack of motivation to use new technologies is another flaw in international comparisons (Sturm, 2020).

The introduction of "Digital Education" as a stand-alone topic or integrated into other lower secondary school subjects was the next significant development in Austria to address these challenges after Computer Science was introduced in the 9th grade in 1985. The subject "Digital Education" became a mandatory subject for students in grades five to seven in 2022, and teachers should get extensive additional

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Hörmann, C., Schmidthaler, E. and Sabitzer, B.
Introducing Digital Education as a Mandatory Subject: The Struggle of the Implementation of a New Curriculum in Austria.
DOI: 10.5220/0011837000003470
In *Proceedings of the 15th International Conference on Computer Supported Education (CSEDU 2023) - Volume 2*, pages 213-220
ISBN: 978-989-758-641-5; ISSN: 2184-5026

training. Year eight will follow the consecutive year. However, schools continue to struggle with the problem of who is teaching what, and how due to a staffing shortfall and a lack of instructional materials.

This paper describes the theoretical background of "Digital Education" in Europe with a focus on Austria. It also addresses the implementation of the new curriculum and looks at preliminary findings from a survey that 673 Austrian secondary teachers took between September and December 2022.

2 THEORETICAL BACKGROUND

2.1 Digital Education in Europe

The Joint Research Center of the European Union defines "Digital Competence" as the following (Ferrari, 2013):

> Digital Competence is the set of knowledge, skills, attitudes (thus including abilities, strategies, values and awareness) that are required when using ICT and digital media to perform tasks; solve problems; communicate; manage information; collaborate; create and share content; and build knowledge effectively, efficiently, appropriately, critically, creatively, autonomously, flexibly, ethically, reflectively for work, leisure, participation, learning, socialising, consuming, and empowerment.

Every European citizen must acquire these skills in order to use digital technology critically and creatively, and the European Digital Competence Framework (DigCompEdu) addresses this need. It offers a framework for comprehending what it means to be digitally competent and provides a solid base that can inform policies in many nations (Redecker and Punie, 2017).

Due to the COVID-19 pandemic the European Commission released a "Digital Education Action Plan (DEAP)" in September 2020 to influence the path that European education should take. Two relevant strategies were proposed: Strategy (1) defines the technical part of the plan and concentrates on digital infrastructure and the provision of equipment. Additionally, it nurtures teachers' required digital abilities. Area (2) provides digital education, including the understanding of new technologies. The main objective of the program is to update educational systems and adapt them to recent significant digital advancements. Reports show that there are serious structural biases across the EU member states. Only 35% of primary schools show a reliable infrastructure, whereas 52% and 72% of lower and higher secondary schools are considered well equipped (Kask and Feller, 2021).

In Austria's bordering country Switzerland a project called "Lehrplan 21" has been developed to implement the topic "Media and Computer Science" throughout the school career. The project concentrates on "Understanding Media & Responsible Usage", "Basic Computer Science Concepts and Problem Solving", as well as "Applied Computer Science" (Grandl and Ebner, 2017).

According to a 2010 research by the Dresden University, twelve of Germany's 16 states have media literacy or fundamental computer science ideas included in their curricula. But otherwise there is no nationwide directive for teaching computer science or digital education (Grandl and Ebner, 2017).

After giving every student in Great Britain a BBC micro:bit when they turned eleven or twelve in 2014, the country added "Information and Communication Technology" as a required subject. Educational and teaching objectives concentrate on "Computer Science", "Digital Literacy", and "Information Technology" (Grandl and Ebner, 2017).

Moreover, Slovakia installed the subject "Informatika" for all students from grade two to eleven by focusing on computational thinking (Grandl and Ebner, 2017).

Poland's curriculum now includes lessons on "Understanding and Analysis of Problems" and "Programming and Problem Solving by Using Computers and other Digital Devices" (Grandl and Ebner, 2017).

Of course, the EU may only give suggestions and has limited capacities as each member is responsible for its own system. The European Union can still offer guidelines for member state coordination, though.

2.2 Digital Education in Austria

Three sub-projects were presented in the Austrian government's "Masterplan for Digitalization", which was published in 2018. The first sub-project, titled "Teaching and Learning Content", focuses on updating current curricula – however, digital content must be included. Additionally, it establishes the subject of "Digital Education" and regulates the creation and acquisition of digital teaching and learning resources for classrooms. The second sub-project defines the concept of "Teacher Training and Teacher Education". The third section of the master plan, "Infrastructure and Modern School Administration", helps in increasing technological infrastructure, installing digital devices (both technical and administrative), and optimizing school administration through the use of

practice-oriented tools and programs.

The master-plan also presented an 8-point-concept to foster digital education that is outlined as the following (Bundesministerium für Bildung, Wissenschaft und Forschung, 2018):

1. "Portal Digital School": should be a single point of entry and should unify all necessary pedagogical and administrative applications
2. Standardization of learning platforms
3. Teacher training concerning distance- and blended learning
4. Expansion of the platform "Eduthek": this learning platform provides additional exercises and has been further developed since the COVID-19 pandemic
5. Development of verified learning-apps
6. Upgrading IT infrastructure
7. Supplying students with digital devices
8. Supplying teachers with digital devices

2.2.1 Implementation of "Digital Education" in 2018

In lower secondary education (grades five to eight), the new topic "Digital Education" was introduced in September 2018 and has been taught in two to four hours per week. Schools had to use money from the school budget to implement more than those four hours. Futhermore, school administration could decide if they offer stand-alone subjects or if they implement the curriculum in an integrative way in several other subjects (Bundesministerium, BMBWF, 2018).

The 2018 curriculum's eight subject-specific topics were described as follows (BGBLA, 2018):

1. Social aspects of digitalization: reflecting the usage of digital devices in everyday life as well as benefits and ethical boundaries
2. Information, data, & media: queries, evaluating sources, sharing information
3. Operating systems & standard software: basic knowledge of operating systems, text processing, presentation software, calculations
4. Media design: adopting, producing, and adapting media
5. Communication & social media: different communication platforms, creating digital identities, cloud-sharing
6. Data security & privacy: securing devices as well as private data
7. Technical problem solving: solving basic IT problems
8. Computational thinking: working with algorithms, creative usage of programming languages

2.2.2 Implementation of "Digital Education" in 2022

Heinz Faßmann, the Austrian minister of education, announced in November 2021 that "Digital Education" would become a mandatory subject in the 2022/2023 academic year. Besides, the major difference is that from 2018 to 2021 students were solely graded with "successfully completed" or "not successfully completed", whereas now they will receive traditional grades in five stages from "very good" to "inadequate" when completing the subject "Digital Education". Starting with the academic year 2022/2023, the new model for the subject "Digital Education" proposes to implement one annual stand-alone hour peer week for students in grades five to seven. Grade eight will follow the consecutive year. Beginning with the school year 2023/2024, the new competence-oriented curriculum will be implemented at both primary level and secondary level I, and as a result "Digital Education" will be made mandatory for all students. In addition, the new curriculum introduces the overarching topics "IT education" and "media education" starting with the first grade and their mandatory implementation in other lessons (Polaschek, 2022).

A draft of the new curriculum for "Digital Education" was created by a group of experts from universities as well as teacher training programs, applying both national and international competency models (Polaschek, 2022). In March 2022 the concepts of the new curriculum were presented by the Austrian Ministry of Education by implementing the 4C's of the 21st century: Critical Thinking, Creativity, Collaboration, and Communication (BMBWF, 2022).

A two dimensional competence model forms the basis of the presented curriculum (see Figure 1) (BMBWF, 2022):

		orientation	information	communication	production	interaction
(T)	structures and functions of digital, IT, and media systems					
(G)	social interactions through the use of digital technologies					
(I)	interaction in the form of usage, action, and subjectification					

Figure 1: Competence Model of Austrian Curriculum "Digital Education" (adapted by the authors) (BMBWF, 2022).

The vertical classification lists the topics represented in the "Frankfurt Dreieck" (see Figure 2) by their respective subject headings: (T) technical-media

– structures and features of digital, IT, and media systems, (G) social-cultural – social interactions through the use of digital technologies, and (I) interaction-related – interaction in the form of usage, action, and subjectification (Brinda et al., 2019). The horizontal line is formed by the following competencies: (1) orientation – analyzing and reflecting about social aspects of media change and digitization, (2) information – responsible handling of data, information, and information systems, (3) communication – communicating and cooperating using media systems, (4) production – creating and publishing digital content, designing algorithms, and creating software programs, (5) interaction – responsible use of offers and options of a digital world (BMBWF, 2022).

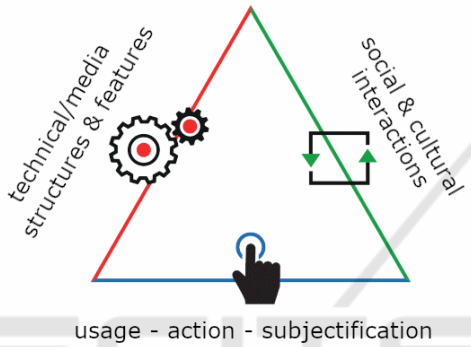

Figure 2: Frankfurt Dreieck (adapted by the authors) (BMBWF, 2022).

The curriculum's content itself is subdivided into the four grades (Informatikportal AHS Österreich, 2022):

5th grade:

(T) input–process–output (IPO) model; search engines; protection and usage of personal data; algorithms; hardware components

(G) digital vs. analog; personalized search routines; online cooperation & collaboration; different forms of presentation of content; forms of media use in media change

(I) analyzing and questioning personal usage behaviour; conduct internet research; assess quality of sources; store, copy, search, retrieve, change, and delete data; perform simple calculations with data; collect and represent data; text processing; presentations; use help-systems to solve problems

6th grade:

(T) accessibility and usability of technology; collect, filter, sort, interpret, and represent data; how the internet works; create simple code; hardware vs. software; basics of networks

(G) interests and conditions of media production; selecting and operating suitable software programs; different communication media; opinion formation and manipulation; intellectual property rights & copyrights; digital communication to participate in social discourse

(I) digital vs. analog life; license models; social media; create, adapt, and analyze visual/audiovisual/auditory content; balance of digital offers and own needs; health and ecological aspects

7th grade:

(T) interdisciplinary examples of applications of technology in environment and society; artificial intelligence; cloud-based systems; use Computational Thinking to solve problems; computer systems in everyday objects

(G) changes of media usage behaviour; personalized search routines; compromise between publication of information and confidentiality and security; popular media culture; ecological problem constellation in connection with digitization

(I) reflect on digital technologies of everyday life; searching for information and data using appropriate strategies; identification of patterns in data representations to make predictions; use data to show cause and effect relationships; crowd-sourcing; designing digital identities in a reflective way; accessibility of digital content; adapting software applications to personal needs; viruses or malicious software/malware

8th grade:

(T) reflecting on the limits and possibilities of artificial intelligence; data backup; network protocols; software development; differences of application software, system software, and hardware layers; encryption software

(G) euphoric and culturally pessimistic attitudes towards digitalization; collection, evaluation, and linking of user data in terms of negligence, misuse, and surveillance; data manipulation; different ways of displaying content; digital communication to civil society participation and commitment

(I) normativity of digital technologies and media content; updating and improving information and content; communicating responsibly; right to your own picture; creating simple programs or web applications; reflecting limits of technical configurations; precautions for independence and informational self-determination

In order to prepare students for successful jobs when they enter the profession, educators should assist them in acquiring these skills (Connections Academy, 2013). Therefore, various teacher training courses started in autumn 2022, to help teachers tackle the unfamiliar new curriculum. Most of those courses take up four semesters and are divided into five modules, which contain, connect, and link media design processes, IT basics, and media design actions.

It is meant for educators who actually teach the subject "Digital Education" as part of their teaching duties or who teach this topic in an integrative manner (PH Oberösterreich, 2022).

3 STUDY

3.1 Methodology

The study focused on the implementation of the mandatory curriculum "Digital Education", which was installed in Austria in September 2022. The survey's foundation is laid forth in the following research questions: (RQ1) Which type of implementation of the curriculum "Digital Education" preferred teachers: integrated or stand-alone? (RQ2) Are there any topics of the curriculum teachers struggle with? If so, which?

The survey was distributed to all Austrian secondary public schools to teachers who actually teach "Digital Education" in the current school year 2022/23. A total of 795 teachers agreed to begin the questionnaire, whereas 673 managed to finish it.

First, it was verified that the participants actually teach "Digital Education" in the current school year, to sort out all other teachers. The second part of the survey concerned gender, age group, years in service, school type, and subjects taught.

The next section focused on the teacher training course "Digital Education" and consisted of the following questions:

1. Are you currently attending the teacher training course for "Digital Education"? (yes/no)
2. If no at (1): Are you planning to attend such a course in the future? (yes/maybe/no)
3. If no at (2): Why is such a course out of the question for you? (no time/I already know everything about it/no interest/too much work/not supported by the school/other)

The last section was dedicated to personal encounters of the teachers. The following questions were implemented by using a scale-rating applying a five-point Likert scale with the options "strongly agree, agree, neither agree nor disagree, disagree, strongly disagree" (Joshi et al., 2015).

Please rate the following statements:

1. I think the content of the curriculum for the subject "Digital Education" makes sense.
2. I think the introduction of the subject "Digital Education" as an independent subject makes sense.
3. I think it was better when "Digital Education" could still be integrated into other subjects.
4. I am having troubles preparing for "Digital Education" class.
5. I have sufficient resources to prepare for lessons in "Digital Education".
6. I feel confident in terms of content in "Digital Education" class.
7. I think that "Digital Education" should be taught by teachers who studied computer science.

Succeeding questions also used a five-point Likert scale with the options "very good, good, intermediate, poor, very poor" (Joshi et al., 2015).

Please rate your knowledge in the individual competence areas of the "Digital Education" curriculum based on school grades:

1. analyzing and reflecting on social aspects of media change and digitization
2. handle data, information, and information systems responsibly
3. communicating and cooperating using IT systems
4. creating and publishing content digitally, designing algorithms, and programming
5. assess offers and options for a world shaped by digitization and use them responsibly

The next questions concerned possible support:

1. Would you like to have more support in implementing the "Digital Education" curriculum?
2. If yes at (1): Which offers would you use? (teacher training at universities/teacher training at school/online teacher training/online resources/books/other)

Moreover, an opportunity was provided to add personal opinion by asking "I would also like to say the following". Still, this paper concentrates on evaluating the quantitative survey data, while the qualitative survey data are reviewed in other articles.

3.2 Results

In total there were 795 participants, whereas 673 successfully completed the questionnaire. Four-hundred-fifty-four (67.5%) of those who finished the survey claimed that they actually teach "Digital Education".

3.2.1 General Information Results

Of the 454 teachers, 309 (68.1%) stated that they are "female", 138 (30.4%) "male", and seven (1.5%) described themselves as "diverse". When taking a look

at the age groups, 95 (20.9%) teachers were “under 30 years old”, 141 (31.1%) “30 to 39 years old”, 105 (23.1%) “40 to 49 years old”, 90 (19.8%) “50 to 59 years old”, and 23 (5.1%) “60 years or older”. Concerning years in service the participants stated that 127 (28%) have been working at school “five or less years”, 108 (23.8%) “five to ten years”, 82 (18.1%) “eleven to 20 years”, 70 (15.4%) “21 to 30 years”, and 67 (14.8%) “30 or more years”.

3.2.2 Teacher Training Course Results

This section wanted to know more about the teacher training courses. One-hundred-thirty-two (29.1%) teachers affirmed that they currently visit a teacher training course in digital education, whereas 322 (70.9%) don’t. Concerning the question, if they plan to attend in the future, 31 (9.6%) chose “yes”, 131 (40.7%) “maybe”, and 160 (49.7%) “no”.

3.2.3 Personal Experience Results

When looking at the results of the section concerning personal experiences, the following emerged:

The question “I think the content of the curriculum for the subject “Digital Education” makes sense” was answered by 42 (9.3%) with “strongly agree”, by 211 (46.5%) with “agree”, by 122 (26.9%) with “neither agree nor disagree”, by 67 (14.8%) with “disagree”, and by twelve (2.6%) with “strongly disagree”. The median lies with “agree”, whereas the arithmetic mean can be found at 2.55 (when numbering the Likert scale from one to five downwards).

“I think the introduction of the subject “Digital Education” as an independent subject makes sense” was rated by the teachers like the following (see Figure 3): two-hundred-eighty-five (62.8%) participants “strongly agree”, 124 (27.3%) “agree”, 33 (7.3%) “neither agree nor disagree”, ten (2.2%) “disagree”, and two (0.4%) “strongly disagree (median = “strongly agree”, arithmetic mean = 1.50).

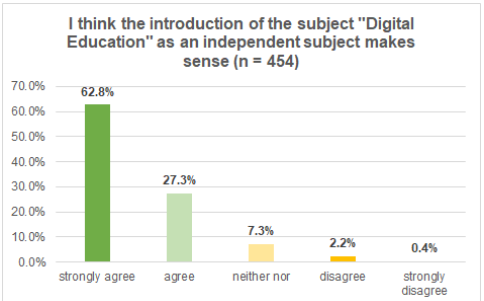

Figure 3: I think the introduction of the subject “Digital Education” as an independent subject makes sense (n = 454).

Ten (2.2%) of the attendants “strongly agreed” to the statement “I think it was better when “Digital Education” could still be integrated into other subjects”, 33 (7.3%) “agreed”, 103 (22.7%) “neither agreed nor disagreed”, 171 (37.7%) “disagreed”, and 137 (30.2%) “strongly disagreed (median = “disagree”, arithmetic mean = 3.86).

Questions (2) “I think the introduction of the subject “Digital Education” as an independent subject makes sense” and (3) “I think it was better when “Digital Education” could still be integrated into other subjects” together answered the first research question that was stated like the following (RQ1) Which type of implementation of the curriculum “Digital Education” preferred teachers: integrated or stand-alone? In total 90.1% “strongly agreed” or “agreed” that they prefer the stand-alone version of the curriculum. As a control sequence the question “I think it was better when “Digital Education”could still be integrated into other subjects” verified this hypothesis, when 67.9% “disagreed” or “strongly disagreed”.

The next part consisted of a self-assessment of teachers in the various topics of the curriculum. One-hundred-twenty-two (26.9%) rated their knowledge in the field of “analyzing and reflecting on social aspects of media change and digitization” with “very good”, 218 (48%) “good”, 89 (19.6%) “intermediate”, 21 (4.6%) “poor”, and four (0.9%) “very poor”. When numbering the Likert scale from one to five downwards, the median is “good”, whereas the arithmetic mean is 2.05.

Concerning the topic “handle data, information, and information systems responsibly”, 197 (43.3%) classified themselves as “very good”, 195 (43%) “good”, 49 (10.8%) “intermediate”, eleven (2.4%) “poor”, and two (0.4%) “very poor” (median = “good”, arithmetic mean = 1.74).

The section “communicating and cooperating using IT systems” was rated by 177 (39%) teachers with “very good”, 197 (43.4%) “good”, 64 (14.1%) “intermediate”, 14 (3.3%) “poor”, and one (0.2%) “very poor” (median = “good”, arithmetic mean = 1.82).

On the contrary, as shown in Figure 4, 99 (21.8%) participants claimed their knowledge on “creating and publishing content digitally, designing algorithms, and programming” is “very good”, 102 (22.5%) “good”, 119 (26.2%) “intermediate”, 82 (18.1%) “poor”, and 52 (11.5%) “very poor” (median = “intermediate”, arithmetic mean = 2.75). This answers the second research question, that was stated like the following: (RQ2) Are there any topics of the curriculum teachers struggle with? If so, which?

Regarding the topic “assess offers and options for a world shaped by digitization and use them respon-

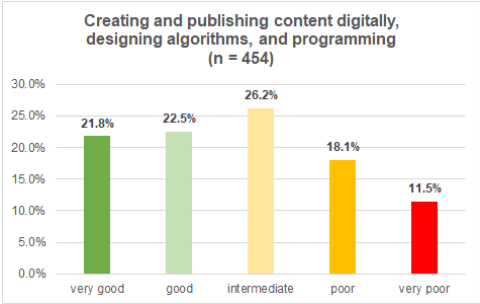

Figure 4: Creating and publishing content digitally, designing algorithms, and programming (n = 454).

sibly", 143 (31.5%) teachers rated themselves "very good", 208 (45.8%) "good", 81 (17.8%) "intermediate", 20 (4.4%) "poor", and two (0.4%) "very poor" (median = "good", arithmetic mean = 1.96).

The last questions from this survey contained teacher support. Three-hundred-and-fifteen (69.4%) teachers stated that they "would like to have more support in implementing the "Digital Education" curriculum", whereas 113 (24.9%) claimed that they do not need any support. Twenty-six (5.7%) declared "other".

3.3 Discussion

The gender distribution, with 68.1% female, 30.4%, and 1.5% diverse, is representative for Austria. Furthermore, it is not surprising, that the upper two age groups (50 or older) do not want to teach a brand new subject and is therefore under-represented with 24.9%.

In Austria every teacher usually studies two subjects and therefore covers at least two at a time at school. Because of a lack of teachers, administration also deploys their staff in other, field related, subjects. This is most often seen in Middle School. As nearly half of the participants state that they are employed at a Middle School, it is not uncommon that in this survey each teacher covers 3.6 subject on average. The two most stated second subjects covered by the teachers who implement "Digital Education" are Mathematics (185) and Computer Science (153). No wonder that teachers who already have STEM subjects, tend to teach the new curriculum as well. Remarkably, the next subject in line is German (100) closely followed by Physical Education (99), which both have no connection at all to the curriculum of "Digital Education".

Only 132 (29.1%) claimed that they currently visit a teacher training course. This could be due to the lack of vacant spots, as there was a run of applicants for a place at those classes. The organizing teacher training colleges even limited the spots to active teachers with recommendations of respective headmasters, only. Even though there was a keen demand. Half of those who do not attend a course at the moment, do not want to in the future. This could be due to the fact that lots of the participants of this survey teach Computer Science, which is very similar to the new curriculum. Also, in the second most subject Mathematics, educators already tend to use digital devices for many years. Some state that they find themselves "too old" or "in the last years" of their job, but still this does not seem to justify no further professional education at all. Of course the geographical location of the teacher training colleges plays an important role, as most of the time they can be found in central regions. To guarantee accessibility for all teachers, colleges already think about a course that is fully online. Still, such a teacher training is time-consuming and a lot of extra work, most often at weekends. Considering that, teachers also brought forth that they cannot attend because they have "little children to care for".

Interestingly, only 22.9% of the participants claimed that they have troubles when preparing for "Digital Education" class and 23.5% stated that they do not have sufficient teaching material. Compared to one of the last questions, 69.4% "would like to have more support in implementing the "Digital Education" curriculum" (see Figure 7), this seems odd. In conclusion, it can be said that there is already lots of available teaching material but still teachers need help in dealing with the unfamiliar curriculum.

When looking at the topics of the curriculum, there is only one that stands out. Fifty-five percent of the participants rated their knowledge in the field of "creating and publishing content digitally, designing algorithms, and programming" with "intermediate" to "very poor", which is alarming, considering the fact that those teachers already implement the curriculum (see Figure 5).

4 CONCLUSION AND OUTLOOK

This paper evaluated a study carried out from September to December 2022 with a focus on the adoption of the compulsory curriculum "Digital Education" in Austria in 2022. In conclusion, both research questions could be answered:

1. Which type of implementation of the curriculum "Digital Education" preferred teachers: integrated or stand-alone? Overall, 90.1% of respondents indicated that they "strongly agreed" or "agreed" that they prefer the curriculum as a stand-alone.

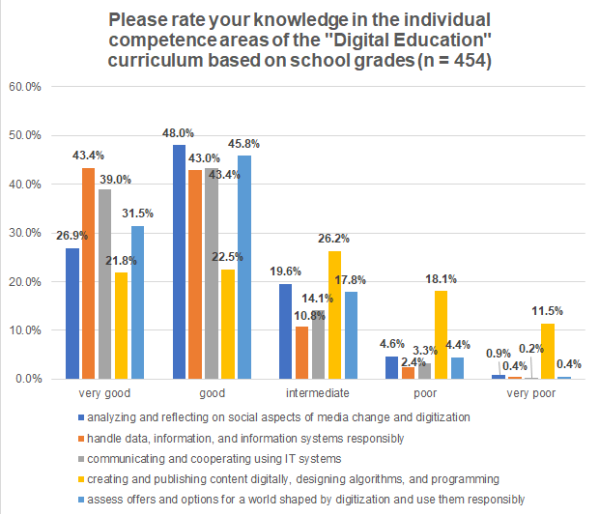

Figure 5: Rating of knowledge of the topics of the curriculum (n = 454).

This hypothesis was supported by the control question, "I think it was better when "Digital Education" could still be integrated into other subjects", with 67.9% "disagreeing" or "strongly disagreeing".

2. Are there any topics of the curriculum teachers struggle with? If so, which? The participants' understanding of "creating and publishing content digitally, designing algorithms, and programming" was assessed by 55% of them as "intermediate" to "very poor".

With the introduction of the compulsory subject another problem appeared, as currently no entire "Digital Education" studies in Austrian teacher education exist, as there is for other traditional subjects. In autumn 2022 postgraduate training for teachers started to tackle the lack of fully trained staff in "Digital Education". Still, there seems to be an urgent need for establishing and expanding the subject-specific expertise of teachers especially in the field of "creating and publishing content digitally, designing algorithms, and programming".

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