Navigating the Implementation of the Curriculum Digital Education in Austrian Secondary Schools: Challenges and Teacher Perspectives

Corinna Hörmann, Eva Schmidthaler(✉), and Barbara Sabitzer

Johannes Kepler University Linz, Altenbergerstraße 69, 4040 Linz, Austria
{corinna.hoermann,eva.schmidthaler,barbara.sabitzer}@jku.at

Abstract. For a considerable period, there was only a single year of compulsory Computer Science (CS) education in Austria that was required as part of a student's academic career. The mandatory curriculum "Digital Education" (Digitale Grundbildung) was launched in September 2018 for all students in lower secondary education, formally integrating 21st-century skills into upper grades. The school's management could choose to offer "Digital Education" as a stand-alone course or to include it in other classes. The 2022/2023 academic year saw the addition of an altered curriculum, where the subject was added to the normal timetable. Nonetheless, schools continue to deal with the problem of who is teaching what and how due to a staffing shortfall and a lack of instructional materials. This paper reports on experiences with the 2022 curriculum by evaluating a survey that examines the implementation of the mandatory curriculum "Digital Education" in Austrian secondary schools and the challenges that teachers face in navigating this new landscape. Aiming to do so, the qualitative data were interpreted, summarized, and discussed, whereas the quantitative data were analyzed in former papers. Despite the obstacles that emerged, teachers recognized the importance of digital literacy skills for their students and expressed a desire for more support in implementing the curriculum. The findings of this study have implications for policymakers, school administrators, and teacher training programs as they work to ensure the successful integration of "Digital Education" in secondary schools.

Keywords: Digital Education · 21st Century Skills · Curriculum · STEM

1 Introduction

Around 90% of today's employment require the most basic IT skills, according to relevant studies conducted by the EU Commission for the EU Digital Agenda [14]. A child who understands how to code will also have more work opportunities in the technology, finance, retail, and health industry, as well as

J.-P. Pellet and G. Parriaux (Eds.): ISSEP 2023, LNCS 14296, pp. 167–179, 2023.
https://doi.org/10.1007/978-3-031-44900-0_13

various other areas [24]. Therefore, the European Digital Competence Framework (DigCompEdu) responds to the need that every European citizen should gain necessary competencies to use digital technologies critically and creatively. It provides a structure to understand what it means to be digitally competent and gives a sound background that can guide policies in different countries [23].

Researching a new curriculum, like "Digital Education" in Austria, allows for an assessment of its effectiveness in enhancing educational outcomes. By identifying strengths and weaknesses, adjustments can be made to improve the curriculum and the educational experience for students and teachers. Furthermore, data and findings can guide educators and policymakers in making informed decisions about curriculum design, implementation, and modifications. However, researching a new curriculum promotes a culture of continuous improvement in education. It also motivates educators to evaluate their methods, spot opportunities for development, and implement evidence-based adjustments to boost both curriculum and instruction. Continuous development is essential for ensuring that education remains dynamic, responsive, and effective in preparing students for the changing demands of the modern world.

This paper reflects on experiences from teachers by analyzing the qualitative data from a study that focuses on the implementation of the mandatory curriculum "Digital Education" in Austrian secondary schools. Chapter two describes the theoretical background by concentrating on the history of the subject in Austria. The study with its methodology, results, and discussion is described in section three, whereas chapter four provides a conclusion and an outlook on upcoming work.

2 Theoretical Background

In 1985, Austria made Computer Science (CS) a mandatory standalone subject in schools, with two hours a week in the 9th grade [13,16]. In 2018, the mandatory subject "Digital Education" was introduced in lower secondary education (grades five to eight) in Austria [2], covering digital competences, media competences, and civic education [15]. Furthermore, the Austrian government published a masterplan for digitalization, including three sub-projects: revising existing curricula, teacher training (TT), and expanding technical infrastructure [1,19].

Moreover, an 8-point-concept was presented to foster digital education, which included a platform called Portal Digital School (PoDS) [9], Massive Open Online Courses (MOOCs) [8], and the Eduthek [5]. Additionally, the installation of standardized qualification marks in the evaluation and certification of learning applications was planned and has been launched already [7]. Furthermore, basic IT infrastructure is being improved in federal schools [6]. Funding for digital devices for students was planned for the 5th and 6th grades in 2021/22, but shipping problems caused delays [3,4,18]. However, since the school year 2023/24, every child has access to their own learning and teaching device.

In March 2022, the concepts of a new curriculum were presented by the Ministry of Education by implementing the 4C's of the 21st century: *Critical*

Thinking, *Creativity*, *Collaboration*, and *Communication* [10]. A two-dimensional competence model forms the basis of the presented curriculum of "Digital Education". The different areas of competencies form the horizontal line: (1) *orientation* – analyzing and reflecting on 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 [10]. The vertical classification describes the subject-specific topics that are represented in the "Frankfurt Dreieck" [11]. This theory can be seen as an extension of the famous "Dagstuhl-Dreieck" but concentrates on the aspects of digital education. The three central concepts are based on the following perspectives: (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 [11].

One annual hour each week is implemented in the curriculum's redesigned model from grades 5 to 7 starting in the school year 2022/23, with year 8 following in the consecutive school year [18,22]. The new competence-oriented curriculum will be installed at the beginning of the next school year 2023/24 in both primary level and secondary level and therefore, "Digital Education" will be compulsory for all Austrian primary and secondary school students [18].

Another issue arose with the introduction of the new subject because there are presently no study programs for "Digital Education" in Austrian teacher preparation programs like there are for other traditional subjects. Postgraduate teacher training began in the fall of 2022 to address the field's need of fully qualified staff. Still, there is a lack of vacant spots at these programs, as a lot of teachers want to join. Nevertheless, Gabriel et al. state that adequate teacher training is crucial to ensure digital policies are adopted and therefore implemented in the classroom. The PISA winners Estonia, Finland, Germany and New Zealand all set a strong focus on teacher training with improvement of teachers' digital skills [17].

3 Study

3.1 Methodology

The underlying study concentrated on the implementation of Austria's mandatory "Digital Education" curriculum, which went into implementation in September 2022. Teachers who actually teach "Digital Education" in the current school year 2022/23 received the survey, which was delivered to all secondary public schools in Austria. In total, 795 teachers agreed to start the survey – only 673 were able to finish it. The complete questionnaire is listed in the appendix.

To distinguish the participants from other teachers, it was first confirmed that they truly teach "Digital Education" throughout the current school year.

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", whereas the final segment focused on the teachers' individual experiences.

Additionally, the question "I would also like to say the following" gave participants the chance to add their own opinions. Ninety-eight people completed this section. The focus of this work lies on analyzing the qualitative survey data, whereas previous articles have looked at the quantitative survey data [19].

By performing a qualitative content analysis, the gathered qualitative data was evaluated with regard to the seven steps of the spiral model (see Fig. 1) of Kuckartz and Rädiker [20]. Overall, the image provides an overview of the key steps involved in conducting a structured qualitative content analysis: In the first of the seven phases, the text has to be analyzed, structured and summarized. In the next step the main categories need to be identified and the first coding process takes place, regarding those categories. If need be, sub-categories can be developed and the second coding process is conducted. After that various analysis may be performed, whereas the last step is defined by documenting the process and the results. Of course, it is possible, and often necessary, to restart the spiral-process again [20].

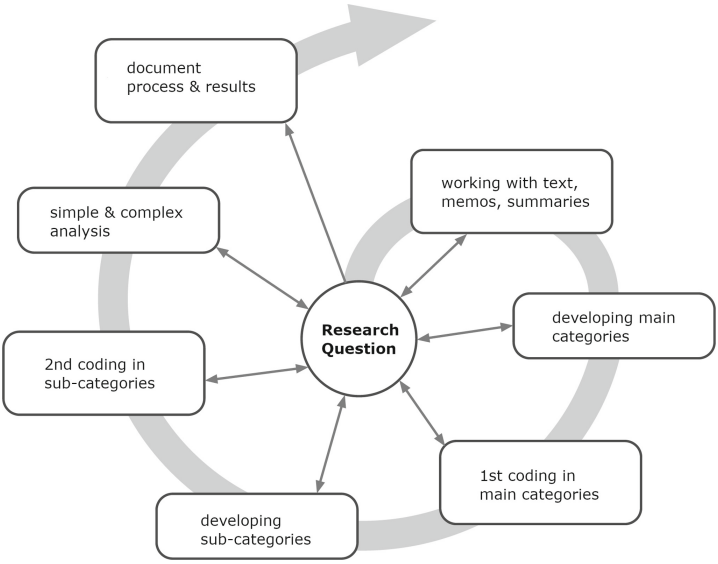

Fig. 1. Sequence of a qualitative content analysis in seven phases [20] (edited by the authors)

Transcribing the text was the first stage of the evaluation process. Existing dialects have been altered and rewritten to improve compatibility. Step two involved paraphrasing the words and identifying important information. The

statements were subsequently arranged in accordance with several categories, although one statement might possibly be related to multiple topics. We defined five key codes to identify the major problems teachers described. Problems dealt with "large groups of students", "lack of skills of teachers", "resources", "teacher training", and "curriculum". Furthermore, the statements were categorized in three codes, whether or not teachers support the new curriculum: "positive", "neutral", and "negative".

The computer-supported evaluation was done using the software "MAXQDA" and a code book, though more codes might be added if necessary. The fourth and final part of the review involved finding potential arguments by fusing qualitative and quantitative analyses.

The online tool "LimeSurvey" was utilized to gather data. This application was provided by the university for free and is GDPR (General Data Protection Regulation) compliant. Moreover, it ensures total data export, as well as in-built data evaluation [21].

Ethics were taken into account during the entire study. Introducing a new curriculum may appear innocent to a researcher at first glance but can be highly sensitive to the participating teacher or other involved parties. As the introduction of "Digital Education" was strongly politically influenced, it was vital that respondents remain anonymous to reduce undesirable consequences at all costs. The inability to track participants was also crucial, particularly when identifying people through data backtracking was minimized as effectively as possible [12].

3.2 Quantitative Results

The quantitative results have been published before but are worth summarizing (see Fig. 2 and 3), as the combination of both, quantitative and qualitative, parts are discussed later. To conclude, 90.1% of the respondents stated that they "strongly agreed" or "agreed" that they prefer the curriculum as a stand-alone subject. 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". There is only one area in the curriculum that sticks out when compared to others. 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 [19].

3.3 Qualitative Results

Ninety-eight out of 673 participants (14.6%) completed the voluntary comment section. The text field had an average character count of approximately 316, with the shortest comment having only four words and the longest text consisting of 216 words.

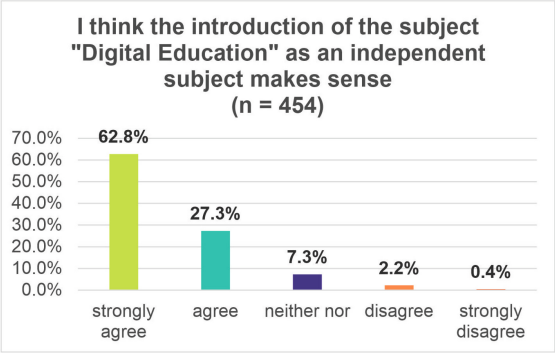

Fig. 2. Quantitative result "I think the introduction of the subject "Digital Education" as an independent subject makes sense" [19]

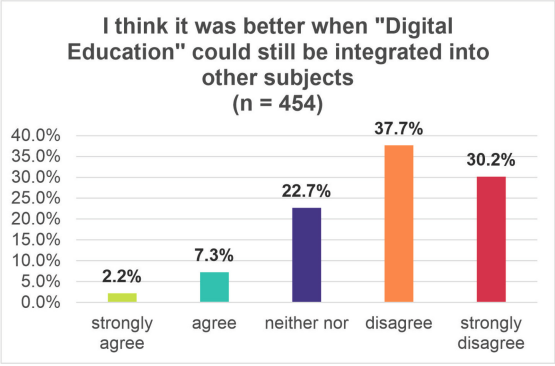

Fig. 3. Quantitative result "I think it was better when "Digital Education" could still be integrated into other subjects" [19]

Figure 4 lists the open comments' most frequent words, whereas "digital" was stated seven, and "education" four times.

When looking at the attitude of teachers towards the curriculum of "Digital Education", 30 statements could be identified as "positive", 39 as "negative", and 42 as "neutral", which is displayed in Fig. 5. Of course, it was also possible that one comment was assigned more than one code, as the descriptions of the teachers often consisted of more than one argument.

Performing a category-based quantitative analysis one can look at the key codes related to problems to determine the type of difficulty teachers face with the subject (see Fig. 6).

In total, 67 problems were listed. Five (7.5%) teachers stated that they had major problems because of a "large group" of students. They described that "they urgently need class divisions" and that "it is not possible to teach "Digital Education" with over 25 students seriously". Nine (13.4%) participants

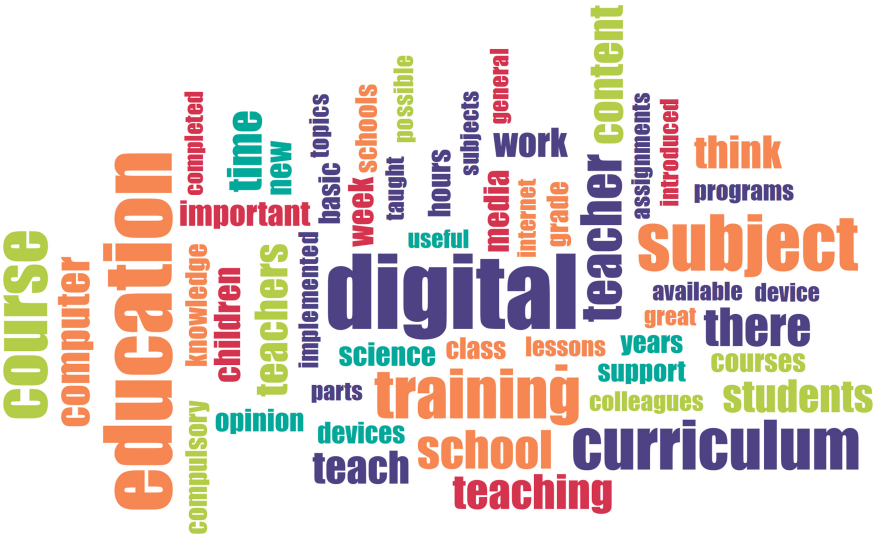

Fig. 4. Wordcloud of most common words

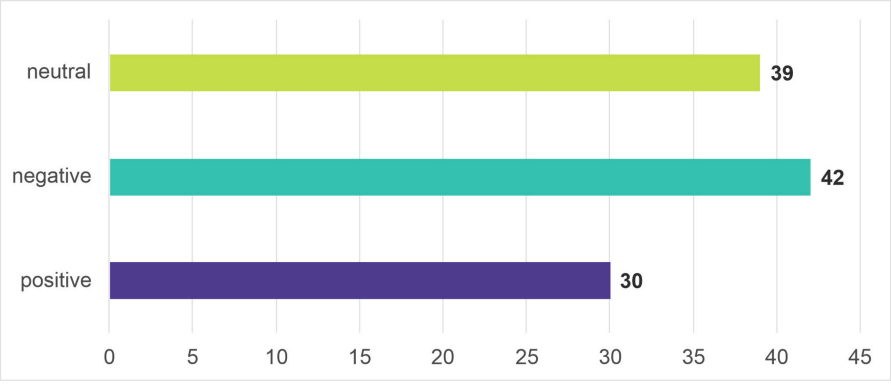

Fig. 5. Attitude towards the subject "Digital Education" (n = 98)

stated there are few or non-suitable "resources" for teaching "Digital Education". Among the comments were statements like "recently received the textbook and I find it linguistically far too complicated", "a good suitable book(s) would be good", "existing textbooks are too theory-heavy and complicated", "the content for teaching has to be gathered from countless pages on the Internet", or "an official platform with sample lessons and networking opportunities would help a lot". Another eleven (16.4%) saw the difficulty within the lack of digital skills of teachers, stating "I do not know anything about it – how should I, without training", "teachers do not have the necessary background knowledge for this subject", "there was no training for it yet", "computer scientists should teach",

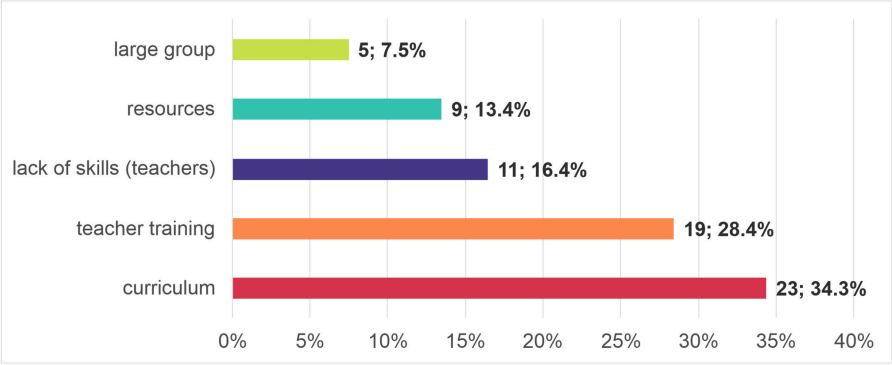

Fig. 6. Stated problems of teachers concerning the subject (n = 98)

"I always have to acquire certain knowledge by myself before I can teach it", "I do not understand what is expected of me, what I am supposed to do", and "little or no technical understanding". Nineteen (28.4%) saw a problem in the official "teacher training", saying "you can't take a teacher training course for everything", "I lack the basics of IT to support the students in understanding this. This was not an issue in the course.", "It would need more places in the teacher training course", "I didn't get a fixed place", "training for teaching staff should have started much earlier", "there is far too much theory involved", "they should provide more study places. 50 seats for 700 schools is an imposition!", "some parts are unfortunately not ideally planned", "teacher training course is not doing anything for me at the moment", or "teacher training course urgently needs to be designed more professionally". When looking at the curriculum itself, 23 (34.3%) described obstacles, stating "a lot of material in little time", "not implementable", "curriculum is too general and not helpful", "level of the students is not compatible with the curriculum", "curriculum is far from any reality", "curriculum as it is needs urgent revision", "it consists of word shells and management blah", and "clearly created by theorists".

We discovered that some codes are frequently used together while others stand alone entirely when looking at a code-relation-model (see Fig. 7), which depicts how close the key codes are to each other in different statements.

Problems with "resources" seam to have a connection to "curriculum', showing a frequency of three, as well as to "teacher training" with two connections, and "lack of skills of teachers" with one connection. The issue of "lack of skills of teachers" connect to "curriculum" problems with a frequency of three. Furthermore, "teacher training" and "curriculum" have one connected argument. Interestingly, problems with "large groups" of students do not interact with other occurring issues.

Negative classified comments show a high number of 18 connections with the problem "curriculum", eight with "teacher training", five with "lack of skills of teachers", four concerning "resources", and four "large groups". On the con-

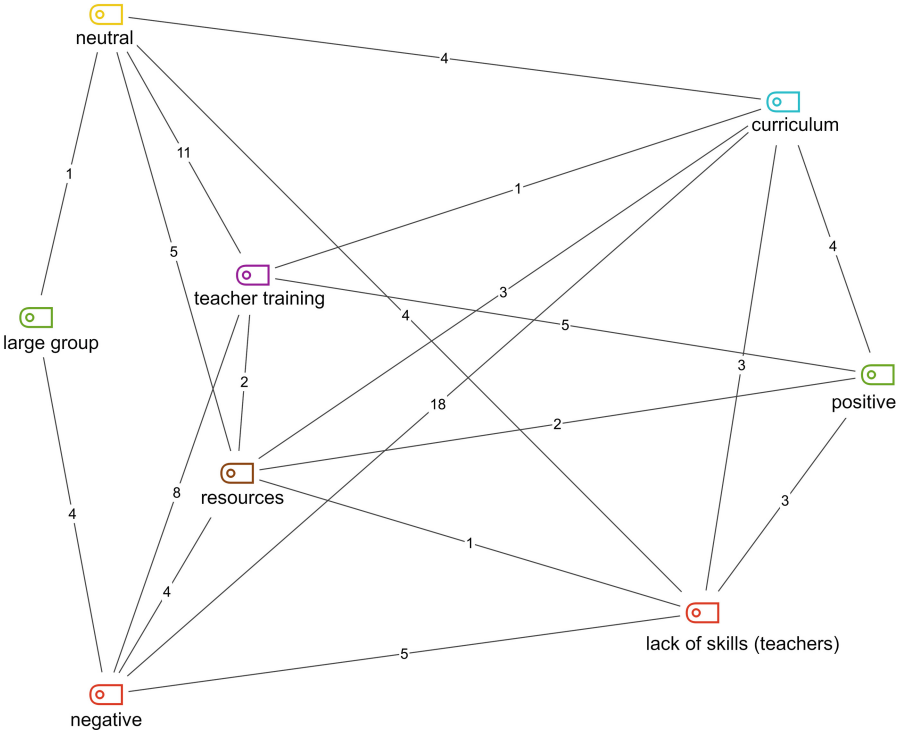

Fig. 7. Code-Relations-Model (n = 98)

trary, positive arguments connect to the problems of "teacher training" with a frequency of five, "curriculum" with four, "lack of skills of teachers" with three, and "resources" with two relations. When taking a look at neutral comments, eleven could be connected with "teacher training", five with "resources", four with "lack of skills", another four with "curriculum", and one with "large group of students".

3.4 Discussion

The underlying survey depended on volunteer samples because visiting educators at school or conducting experiments in class was impossible due to the COVID pandemic. Of course, this sampling carries the possibility that some potential participants may opt-out. Nevertheless, this strategy was met since it was the only method of contacting Austrian teachers. When looking at the rating of the subject "Digital Education" in the comment section, negative and neutral clearly dominate. This could also be due to the fact that most people fill out the comment section when they have something negative to add. Furthermore, a study (n = 117) from the authors from 2020 found out that 61% of the participating teachers rated the subject "very useful", 26% "rather useful", 9% "partly

useful", 2% "rather not useful", and 2% "not useful at all". The rating was in the upper section with an arithmetic mean of approximately 1.57.

A total of 39% stated problems with the curriculum itself, even if the analysis of the quantitative data showed that 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) [19].

Furthermore, similarities can be found in qualitative and quantitative data when the "lack of skills of teachers" were described. In the comment section, 18.6% of the participants observe problems with some parts of the curriculum, mostly technical issues.

Interestingly, teachers also mentioned that they have to teach large groups of students, as currently students are not divided into two groups with two instructors in "Digital Education" class, as it is the case in Computer Science.

4 Conclusion and Outlook

A new curriculum's introduction is a continual process that calls for ongoing improvement. Knowing how teachers felt about the initial implementation will identify areas that require enhancement and guide modifications to subsequent roll-outs. The underlying research can be used to determine areas where teachers might want additional training or support by understanding how they responded to the new curriculum. This could result in better opportunities for teachers to advance their careers, which would ultimately improve curriculum delivery.

To summarize, most teachers stated problems with "large groups", "lack of skills", "resources", "teacher straining", and "curriculum", when talking about "Digital Education" in Austria. Still, when combining both quantitative and qualitative data it stands out that most teachers approve of the new subject and its stand-alone version over the old one, but a major knowledge gap of teachers can be observed in the field of "creating and publishing content digitally, designing algorithms, and programming".

With the introduction of the compulsory subject another problem appeared, as currently no entire "Digital Education" study courses in Austrian teacher education exist, as there is for other traditional subjects. In autumn of 2022, postgraduate training for teachers started to tackle the lack of fully trained staff in "Digital Education". Henceforth, there is still much effort that has to be put into implementing the curriculum to gain further teachers' motivation. To help educators dealing with the unfamiliar curriculum of "Digital Education", it is necessary to create an extensive collection of material for the specific topics, especially for the technically oriented ones, for example, in the field of "creating and publishing content digitally, designing algorithms, and programming".

Moreover, a new study started to find out the best possible options for teacher training.

A Appendix

A.1 Questionnaire

1. I am teaching the subject "Digital Education" in the current school year 2022/23: yes/no
2. Gender: male/femal/diverse
3. Age: under 30/30–39/40–49/50–59/60+
4. Years in service: under 5 years/5–20 years/11–20 years/21–30 years/30+ years
5. I teach in the following school type(s): secondary school/lower level AHS/higher level AHS/other
6. subjects: Vocational Orientation/Physical Activity and Sports/Fine Arts Education/Biology/Chemistry/(Descriptive) Geometry or Geometric Drawing/German/Digital Education/English/Nutrition and Household/French/ Geography/History/Computer Science/Italian/Latin/Mathematics/Music Education/Physics/Political Education/Psychology & Philosophy/Religion/ Spanish/Technical Work/Textile Work/other
7. Are you currently attending the teacher training course for "Digital Education"? yes/no
8. If no at (7): Are you planning to attend such a course in the future? yes/maybe/no
9. If no at (8): 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
10. Please rate the following statements (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree):
    - I think the content of the curriculum for the subject "Digital Education" makes sense.
    - I think the introduction of the subject "Digital Education" as an independent subject makes sense.
    - I think it was better when "Digital Education" could still be integrated into other subjects.
    - I am having troubles preparing for "Digital Education" class.
    - I have sufficient resources to prepare for lessons in "Digital Education".
    - I feel confident in terms of content in "Digital Education" class.
    - I think that "Digital Education" should be taught by teachers who studied computer science.
11. Please rate your knowledge in the individual competence areas of the "Digital Education" curriculum based on school grades:
    - analyzing and reflecting on social aspects of media change and digitization
    - handle data, information, and information systems responsibly

  - communicating and cooperating using IT systems
  - creating and publishing content digitally, designing algorithms, and programming
  - assess offers and options for a world shaped by digitization and use them responsibly
12. Would you like to have more support in implementing the "Digital Education" curriculum?
13. If yes at (12): Which offers would you use? teacher training at universities/teacher training at school/online teacher training/online resources/books/
other
14. I would also like to say the following: ...

References

1. BMBWF: Masterplan für die Digitalisierung im Bildungswesen (2018). https://www.bmbwf.gv.at/Themen/schule/zrp/dibi/mp.html
2. BMBWF: Verbindliche Übung Digitale Grundbildung - Umsetzung am Schulstandort (2018). https://www.bmbwf.gv.at/Themen/schule/zrp/dibi/dgb.html
3. BMBWF: Digital devices for students - Digitale Schule - Bundesministerium für Bildung, Wissenschaft und Forschung (2020). https://digitaleschule.gv.at/digitale-endgerate-fur-schulerinnen-und-schuler/
4. BMBWF: Digital devices for teachers - Digitale Schule - Bundesministerium für Bildung, Wissenschaft und Forschung (2020). https://digitaleschule.gv.at/digitale-endgerate-fur-lehrerinnen-und-lehrer/
5. BMBWF: Eduthek - Digitale Schule - Bundesministerium für Bildung, Wissenschaft und Forschung (2020). https://digitaleschule.gv.at/ausrichtung-der-eduthek-nach-lehrplanen/
6. BMBWF: Expansion of the school's basic IT infrastructure - Digitale Schule - Bundesministerium für Bildung, Wissenschaft und Forschung (2020). https://digitaleschule.gv.at/ausbau-der-schulischen-basis-it-infrastruktur/
7. BMBWF: Learning Apps - Digitale Schule - Bundesministerium für Bildung, Wissenschaft und Forschung (2020). https://digitaleschule.gv.at/gutesiegel-lernapps/
8. BMBWF: MOOC - Digitale Schule - Bundesministerium für Bildung, Wissenschaft und Forschung (2020). https://digitaleschule.gv.at/lehrenden-fortbildung/
9. BMBWF: PODS - Digitale Schule - Bundesministerium für Bildung, Wissenschaft und Forschung (2020). https://digitaleschule.gv.at/portal-digitale-schule/
10. BMBWF: Projekt Lehrpläne NEU - Fachlehrplan Digitale Grundbildung (2022). https://www.ahs-informatik.com/app/download/10356599585/22-03-14_Fachlehrplan_Digitale+Grundbildung_sek+I.pdf?t=1651008169
11. Brinda, et al.: Frankfurt-Dreieck zur Bildung in der digital vernetzten Welt - Ein interdisziplinäres Modell (2019)
12. Cohen, L., Manion, L., Morrison, K.: Research Methods in Education. Routledge, London (2018)
13. Döbeli, B.: ICT im Hosensack - Informatik im Kopf? In: Brandhofer, G., Futschek, G., Micheuz, P., Reiter, A., Schoder, K. (eds.) 25 Jahre Schulinformatik in Österreich. Zukunft mit Herkunft, pp. 35–44 (2010)
14. European Commission: Digital Agenda for Europe. https://eige.europa.eu/resources/digital_agenda_en.pdf

15. Ferrari, A.: Digital competence in practice: an analysis of frameworks. In: Joint Research Centre of the European Commission, p. 91 (2013). https://doi.org/10.2791/82116
16. Friedrich, S., Hartmann, W.: Informatikunterricht im Spannungsfeld zwischen Tastendruck und UML. In: Brandhofer, G., Futschek, G., Micheuz, P., Reiter, A., Schoder, K. (eds.) 25 Jahre Schulinformatik in Österreich. Zukunft mit Herkunft, pp. 27–28 (01 2010)
17. Gabriel, F., Marrone, R., Sebille, Y.V., Kovanovic, V., de Laat, M.: Digital education strategies around the world: practices and policies. Irish Educ. Stud. **41**, 85–106 (2022). https://doi.org/10.1080/03323315.2021.2022513
18. Hörmann, C., Schmidthaler, E., Kuka, L., Rottenhofer, M., Sabitzer, B.: From nonexistent to mandatory in five years - the journey of digital education in Austrian schools. In: International Conference on Informatics in Schools (ISSEP) (2022)
19. Hörmann, C., Schmidthaler, E., Sabitzer, B.: Introducing digital education as a mandatory subject - the struggle of the implementation of a new curriculum in Austria. In: Proceedings of the 15th International Conference on Computer Supported Education - Volume 2: CSEDU, pp. 213–220. INSTICC, SciTePress (2023). https://doi.org/10.5220/0011837000003470
20. Kuckartz, U., Rädiker, S.: Qualitative Inhaltsanalyse. Methoden, Praxis, Computerunterstützung. Beltz Juventa, 5 edn. (2022)
21. Limesurvey: Free university surveys & questionnaires. https://www.limesurvey.org/solutions/universities
22. Polaschek, M.: Erledigung BMBWF - Österreichisches Parlament - 9338 (2022). https://www.parlament.gv.at
23. Redecker, C., Punie, Y.: European framework for the digital competence of educators: DigCompEdu. Publications Office of the European Union (2017). https://doi.org/10.2760/159770, https://moodle.ktu.edu/pluginfile.php/428841/mod_resource/content/1/pdf_digcomedu_a4_final.pdf
24. Videnovik, M., Vlahu-Gjorgievska, E., Trajkovik, V.: To code or not to code: introducing coding in primary schools. Comput. Appl. Eng. Educ. **29**, 1132–1145 (2020)