Summary analysis

„ Virtual Reality for Education Network" (VReduNet) is a project of the INTERREG VA Austria-Czech Republic program (Interreg ATCZ256).

Content

1. Characteristics of the project

project name:	Virtual Reality for Education Network
project abbreviation:	VReduNet
project number:	ATCZ256
project request:	ATCZ256 VReduNet
within the program:	INTERREG VA Austria – Czech Republic
start of the project:	1 January 2021
end of the project:	31 December 2022
leading partner:	South Bohemian Science and Technology Park, as (JVTP)
project partner 2:	Business Upper Austria – OÖ Wirtschaftsagentur GmbH
project partner 3:	University of South Bohemia in České Budějovice, Faculty of Education
project partner 4:	Education Group GmbH
www Interreg :	https://www.at-cz.eu/cz
www VReduNet :	https://vredunet.eu/?lang=cs
Specific goal of the project:	Nachhaltige Netzwerke und institutionelle Kooperation/ Sustainable networks and institutional cooperation

Specific objective of the program priority: 4a Unterstützung der grenzüberschreitenden Zusammenarbeit des Gemeinwesens and Institutionen in der Grenzregion
4a Support for cross-border cooperation of communities and institutions in the common region

1.1. Project objectives

The main goal of the project was to create a functional network of cross-border cooperating entities in the programming area, dealing with the current trend of using virtual and augmented reality in corporate practice and the readiness of the educational system to absorb these new technologies into its educational programs, thereby developing the necessary competencies of future and current employees. Within the framework of the created cross-border network, there was continuous linking of cooperation on the common topic of AR/VR, sharing and exchange of experience, joint education in a shared infrastructure, search for synergies between projects, identification of potentials for the development of further cooperation, implementation of ongoing projects.

Three specific objectives were defined:

1) Creation of a cross-border network about AR/VR
2) Processing of analyzes related to the topic of AR/VR
3) Pilot testing of the educational program in VR

The main goal of the project was to establish, if possible permanent, cross-border cooperation of members of the established network, the possibility of exchanging experiences, introducing new AR / VR trends into corporate practice and quality training of future specialists. To this end, the project contributed and will contribute to strengthening the competitiveness of enterprises in the program area and thus to stability in the entire region.

1.2. Analysis processing

The main output of this part of the project is detailed analysis that maps the current situation of the use and readiness of entities in the field of virtual and augmented reality. These are subjects from the field of education, as well as institutions that prepare future teaching staff for practice and small and medium-sized enterprises. The overall output of the individual analyzes is a summary analysis mapping the entire area of virtual and augmented reality use in the above-mentioned entities in both regions.

Progress:

1) 6 regional analyzes (3CZ+3AT)
2) 3 comparative analyses
3) 1comprehensive analysis

Analyzes relate to the current state of knowledge and the possibilities of using virtual and augmented reality from various aspects, development trends in this area in the area and the resulting requirements for the infrastructure of educational institutions, study plans, educational programs, training and further education of teaching staff and professional trainers AR/ VR. The summary (comprehensive) analysis describes and summarizes all regional and comparative analyses.

Regional analyzes map the current readiness of the existing, functioning or planned technical equipment of individual educational institutions. They contain evidence of didactic knowledge and methodological experience of teachers (secondary schools) who have already implemented this technology. The analyzes mapped in detail the readiness of educational plans and programs for the implementation of new technologies at all levels of the educational system, including the preparation of future teachers. The analyzes also brought an insight into the current situation in the use of AR and VR in company practice, based on surveys in more than 20 CZ and 20 AT companies, which were conducted in the form of personal interviews, or in the form of an online questionnaire, Google Forms, or Microsoft Forms, and e.g., a video call with a member of the project team was also used when filling it out.

As part of workshops, round tables and regular meetings of the PP, a precise outline of the final output was drawn up on an ongoing basis, adequate ranges of didactic content were selected for educational facilities and organizations, which according to the results of the analyzes can suit the target groups.

Subsequently, in the solution of the project, three **comparative analyzes were created,** the output of which compares the situation in the field of virtual and augmented reality on the Czech and Austrian sides. The results of all regional analyzes and comparative analyzes resulted in the formulation

of **a comprehensive analysis,** which became the basis for an overall description of the situation in the field of AR and VR for relevant entities on the Czech and Austrian sides. Based on the results of comparative analyses, the differences in the level of solution of individual topics solved in individual analyzes on the Austrian and Czech sides were defined, about which there was, is and will be a discussion within the cross-border network, which will help to find the optimal solution for the creation and implementation of the educational program and thus the cross-border institutional cooperation of subjects is fulfilled

2. State of Art in field of AR/VR in Austria-Czechia region

The following section summarizes and presents the main results of individual regional and comparative analyses, which are available on the project's website.

2.1. Enterprises

In the initial phase of the project, emphasis was placed on the development of a network of cooperating entities from education and society. This phase of the project was devoted to finding suitable partners from the private sector, where a number of telephone conversations and face-to-face meetings took place in order to obtain its participation in the project. The approached companies took part in the round tables that took place in the Czech Republic on June 1, 2021, and Austria on July 6, 2021. The lecturers were Mr. Klaus Stöttner (Pool 3), Andrej Barguca (Virtual Lab), Jeremiah Diephuise (FH OÖ Campus Hagenberg) and Florian Hofer (Ars Electronica Center). A total of 76 company representatives (41 CZ and 35 AT) participated in these round tables. Possibilities and directions for the development of company practices in the field of employee training and cooperation with educational institutions in the field of VR/AR were presented here. This was followed by a questionnaire survey, which covered general questions about digitization, as well as specific questions about the use of digital tools and virtual reality in company practice.

Filling out questionnaires among companies was accompanied by various difficulties caused by the pandemic situation – only 20 companies from 31 representatives from Upper Austria sent back the questionnaire. For the purposes of the following comparative analysis, the same number of Czech representatives were addressed with questionnaires. In total, 40 questionnaires were filled out for the Czech and Austrian sides. The questionnaire was focused on questions related to the digital strategies of individual companies and the related transformation, which is characterized using new technologies for existing business activities and a focus on the development of new digital capabilities for business. We understand digital transformation as the basis for innovation, and thus the gradual integration of new technologies into the work process. For a detailed look at the state of AR and VR in the industrial field, we focused on questions that are closely related to this technology in the questionnaire.

In the following text, the results of the questionnaire survey are summarized for the Czech and Austrian sides. These results are then compared and concluded with a synthesis of risks, trends, and recommendations for development in companies in the field of virtual and augmented reality (hereafter referred to as AR/VR).

2.1.1. Enterprises: South Bohemia region

The results of the analysis of the questionnaire survey among South Bohemian companies clearly show significant support for innovation. Most companies that actively use VR are from the automotive, furniture and wood production, IT and mechatronics fields. Over 60% of them consider innovation to be key, and more than a third of surveyed companies consider digital transformation to be the most important task. 25% of the Czech companies interviewed have not developed any digital strategy for their transformation. According to the results of our survey, the most frequently mentioned reason is a lack of funds. If the company obtains funds, they are most often invested in the digital skills of employees, because the biggest obstacle in this direction is know-how and enough qualified workers who would participate in the digital transformation. Enterprises since the transformation, or modern technologies expect an increase in the overall efficiency and productivity of work.

Within South Bohemian businesses, the use of virtual reality prevails over augmented reality. It is used by 30% of businesses. Both types of technologies are used by Czech companies in different ways, in the range of 1-10 years. The main factor influencing the acquisition of virtual reality was client needs and marketing. Therefore, the market itself to a certain extent started the transformation in companies, where enthusiasm for modern technologies such as AR/VR and general interest in innovations in the field of ICT was recorded. From the original enthusiasm for technological innovations and focus on marketing, the use of AR/VR is moving to development departments and virtualization. Businesses that plan to implement this technology want to use it primarily for virtual meetings, training and as services for their customers. It should be noted that 35% of the companies we contacted do not plan to use virtual reality at all, because they do not see any added value. For two of the companies surveyed in the questionnaire, investing in AR/VR means too much financial investment and too complex implementation into work processes.

2.1.2. Enterprises: Upper Austria

The situation is different in Upper Austria. Digital transformation and digitization in general is a very important topic for businesses. The difference is mainly in the management, which brings the necessary skills to the companies, and the employees of most companies already have the necessary digital skills and knowledge and can thus work effectively in the new digital environment. Austrian companies are therefore actively implementing digital strategies, but the answers to the questionnaire survey show that, similarly to the South Bohemian Region, there is also a shortage of qualified employees.

Most of the companies addressed in our survey have been dealing with virtual reality for several years. Technological driving forces are mainly found in the development and IT departments, where virtual reality is used the most. Most companies are still in the early stages of using it, in a sort of first experimental phase. The main directions of using virtual reality are marketing purposes. It is also interesting for companies to use VR/AR for business

or development purposes (visualization, virtual meetings, training, simulation, testing). Additionally, some companies would like to implement VR/AR for HR (soft skills training) or other purposes. The reasons why companies do not want to implement VR/AR technologies are mainly the obstacle of financial investments, the complexity of implementation and the lack of human resources. Additionally, some companies see no additional benefit in implementing VR/AR.

2.1.3. Enterprises: A Comparison

The common feature of the Czech and Austrian sides are the technologies themselves, which are identical in most cases. Considering the implementation time of around 10 years, VR systems with outdoor monitoring are the most represented - over 50%. Special tracking tracking stations are needed for the headset itself. Representatives of this technology are mainly HTC Vive and Oculus Rift. HTC Cosmos – that is, a headset that does not use a tracking station, but still requires a cable connection to a PC – and the Oculus Quest series are represented in the same proportion. These glasses already work independently - there is no need to connect to a PC via a cable.

A very significant agreement, registered on both sides of the program area, is the requirements for acquiring more know-how, training employees and greater connection between companies and schools, where, according to the management, more work should be done with VR. You can find a detailed comparison of individual answers in the comparative analysis for businesses.

	Czechia				Austria			
Question	Definitely yes	Rather yes	Rather not	Definitely not	Definitely yes	Rather yes	Rather not	Definitely not
AR/VR opens up many new possibilities for the economy.	58.8	29.4	11.8	0.0	40.0	60.0	0.0	0.0
AR/VR opens up many new possibilities for education.	70.6	23.5	5.9	0.0	55.0	45.0	0.0	0.0
The use of VR/AR should be taught in schools.	41.2	41.2	23.5	0.0	35.0	45.0	15.0	0.0
The benefits of AR/VR outweigh the cost/effort.	35.3	35.3	23.5	0.0	35.0	45.0	20.0	0.0
AR/VR is too controversial for the health of its users.	5.9	17.6	52.9	17.6	0.0	10.0	55.0	25.0
Using AR/VR is relatively easy	11.8	64.7	23.5	5.9	20.0	40.0	40.0	0.0
I have a general interest in VR/AR.	58.8	35.3	5.9	5.9	70.0	30.0	0.0	0.0
The main purpose of AR/VR is entertainment/gaming.	0.0	17.6	41.2	35.3	0.0	15.0	70.0	15.0
In the next three years, I will probably be using VR/AR in my work.	35.3	23.5	17.6	17.6	40.0	15.0	35.0	5.0

2.1.4. Enterprises: Synthesis of findings

Businesses on both sides of the border understand and feel the need for digital transformation. This fundamental change is implemented at a different pace and is significantly dependent on the number of qualified workers and the demands on the financial side of the matter - purchase of technology, training, etc. In general, the biggest demand that emerged from the answers is a significantly greater degree of cooperation between companies, but also schools. Furthermore, there are very often mentioned workshops, training in the field of virtual and augmented reality. It was therefore appropriate to strengthen this network created at the round tables and in other parts of the project and to work on it in the next program period.

There is a very strong demand for networking between individual companies, as well as schools, in the program area, which needs to be supported from all sides - an example for supporting businesses in the field of technological transformation, which will help ensure both finance and the acquisition of know - how, is the current program ' Digital Europe' focused directly on bringing technology closer to businesses, companies and people. Its aim is to invest in digital infrastructure so that strategic technologies can contribute to strengthening Europe's competitiveness, to the green transition and also to ensuring technological sovereignty.

Enterprises in the program area can be divided into three groups on the basis of AR/VR involvement.

- **Group 1**: Enterprises using technology on a long-term basis over a period of several years. They mainly use AR/VR in new product development and training. These enterprises suffer mainly from a lack of skilled workers. Most often they confirm the need for cooperation between other enterprises, but also schools and universities and active preparation for VR in school education.

- **Group 2**: Enterprises, which do not currently use VR but are planning to acquire the technology. They are mainly motivated by their enthusiasm for the technology, staff training and the implementation of meetings. The driver was the epidemic situation where face-to-face meetings could not take place. Their most common needs are adequate meaningful software and acquiring more know-how through training and collaboration.

- **Group 3**: These are enterprises that do not plan to purchase AR/VR technology at present or in the near future (1-3 years). This is mainly due to the financial and implementation complexity together with the low possibility of meaningful use in their industry.

2.2. Schools (students aged 15-18)

Along with asking companies, they were as part of our VReduNet project, surveys were also carried out in the secondary education sector. Surveyed schools were secondary grammar schools, vocational schools, and technically oriented secondary schools. In Upper Austria, there are 118 schools which are attended by students over the age of 15. These schools represented a potential target group for the survey according to the work plan. Due to the covid-19 pandemic and the phases associated with it however, due to distance learning, shift teaching, classrooms or schools in quarantine, and other unfavorable circumstances caused by the pandemic, it was very difficult to get schools to participate in the survey. Therefore, 80 schools were selected from the potentially possible schools in Upper Austria, which, due to their orientation, e.g. higher vocational schools, or due to their focus, e.g. secondary schools with a focus on informatics, should be more interested in the subject of VR/AR. These schools were asked to take part in a survey.

School principals were contacted in person, several times, and asked if they or a faculty colleague designated by them would participate in a brief telephone interview. In addition, representatives of the school inspectorate, organizations for teacher training and further teacher education, dual apprenticeships and two out-of-school education initiatives were interviewed. A total of 22 complete interviews took place between March and July 2021. Schools in the South Bohemian region were approached on a similar principle. From this area, a total of 44 secondary schools participated in the research, which had a diverse focus, from general grammar schools to specialized secondary schools. A total of 66 schools actively participated in the survey.

The questions asked in the questionnaire were focused on the respondents' general awareness of the concept of AR/VR. We were also interested in cooperation in the field of technology transfers and know-how in the field of AR/VR between schools and other institutions. Further, the questionnaire was followed by questions regarding the equipment and financing of the purchase of AR/VR technology. The two regional and comparative analysis are available on the project website.

2.2.1. Schools: South Bohemia region

Within schools in the South Bohemian Region, there is a fairly clear idea of what AR/VR is. Only one person did not encounter this term. The results show that roughly 54% had the opportunity to try VR or AR in practice. The remaining 45% percent have not yet had the opportunity to try VR or AR. Only 18% of the schools that participated in the survey cooperate with another entity, whether it is a school, a company or another type of institution. Czech schools, based on the answers, can be divided into three main groups:

- **Group 1:** This group has a rather vague experience with AR/VR and is kind of at the beginning. This group then expects more general information for teachers and

students, not necessarily focused on specific practical use, but generally showing new horizons and possibilities. Nevertheless, even this group expects examples focused more or less on their expertise.

- **Group 2:** The second group mainly includes respondents who have experience with AR/VR, know its possibilities, but are not sure how to motivate other employees for whom they are responsible, especially teachers. Therefore, these respondents would welcome more motivational and practical examples to convince their colleagues to consider purchasing AR/VR equipment and incorporating it into the curriculum.

- **Group 3:** The third group has more experience with AR/VR technology. Members of this group most need practical examples and meaningful ways to incorporate AR/VR into teaching. This group is motivated but not sure how and in what subjects to use AR/VR, be it general or specialist subjects.

2.2.2. Schools: Upper Austria

In Upper Austria, the results show that all survey participants, who represented schools as well as school inspectorate, teacher training and school-related technology initiatives, are well familiar with the concepts of AR/VR. In contrast to the South Bohemian Region, 91% of them tried this technology. Almost three-quarters of respondents (73%) already work with an institution that is equipped with VR or AR equipment. Most of the interviewed schools cooperate in the framework of practical teaching and projects with partner companies. The reason is the national digital education plan " digi.kompP " and the related initiative "Digital School", which introduces processes related to increasing the digital competence of teachers and modernizing the IT infrastructure into the functioning of schools.

Austrian schools can be divided into three main groups based on the stories (or frequent reluctance to answer at all):

- **Group 1:** The first group of schools has or had no interest in the topic, and probably no or little experience with VR/AR, and therefore did not participate in the survey.

- **Group 2:** The second group of schools has little experience with VR/AR but has no equipment in the school. Most of these schools are interested in working with institutions with VR/AR or are interested in this topic. However, these schools are not currently interested in purchasing VR or AR equipment as other priorities are currently more important.

- **Group 3:** The third group has deeper experience with AR/VR technology and is also equipped with this technology. They are also interested in further VR/AR training.

2.2.3. Schools: Comparison

In general, it should be noted that VR/AR seems to be known in both regions, but too few examples of meaningful use are known, or the benefits and value for the education system are still little widespread or not at all. VR/AR is not widely used in schools (or even unknown to schools), except in technical schools that work very closely with industrial enterprises. This is also confirmed by the fact that mainly these schools participated in the survey.

The situation in Austria seems to be different compared to the Czech Republic in terms of the number of schools equipped with VR technology. While in the Czech Republic only 13.6% of schools surveyed were equipped with virtual reality, in Austria 64% of the secondary schools taking part in the survey are equipped with virtual reality.

Equipment in both countries appears to be similar, although the number of headsets (VR glasses) in the Czech Republic is higher. Based on the answers, schools in the Czech Republic are inclined to purchase AR/VR sets to equip entire classes or at least half of them to enable interaction within the virtual classroom. Most often in schools we can meet technological solutions from Oculus (Quest, Rift) and then HTC (Vive, PRO). In the Czech Republic, thanks to the purchase of entire sets for the class, the Class VR brand is represented. At some specialized technical schools, we can meet other types of equipment such as MS Hololens and other systems for AR/VR, taking into account their expertise. The attached comparative matrix of attitudes shows similarities and differences in the view of AR/VR. While the attitudes were almost the same for companies, in the field of education there are slight differences in the opinion of the benefit to the economy or even in the general interest of VR.

	Czechia					Austria				
Question	Definitely yes	Rather yes	Rather not	Definitely not	Not applicable	Definitely yes	Rather yes	Rather not	Definitely not	Not applicable
AR/VR opens up many new possibilities for the economy.	34%	55%	7%	0%	5%	82%	14%	0%	0%	5%
AR/VR opens up many new possibilities for education.	52%	41%	7%	0%	0%	41%	50%	5%	0%	5%
The use of VR/AR should be taught in schools.	27%	61%	9%	0%	2%	32%	50%	14%	0%	5%
The benefits of AR/VR outweigh the cost/effort.	20%	23%	11%	0%	45%	32%	41%	5%	9%	14%
AR/VR is too controversial for the health of its users.	0%	7%	45%	23%	25%	0%	18%	36%	23%	23%
AR/VR is relatively easy to use.	9%	52%	18%	5%	16%	23%	55%	18%	0%	5%
I have a general interest in VR/AR.	52%	43%	5%	0%	0%	68%	27%	0%	0%	5%
The main purpose of AR/VR is entertainment/gaming.	7%	23%	43%	27%	0%	5%	27%	36%	27%	5%

In the next three years, I will probably be using VR/AR in my work.	27%	57%	14%	0%	2%	50%	14%	9%	18%	9%

2.2.4. Schools: Synthesis of findings

The finding that schools in Upper Austria and South Bohemia can be classified into similar groups regarding the use of VR can be considered the most significant one. Based on these groups mentioned in the previous chapter, it is possible to reach certain conclusions and recommendations:

1) **Motivating teachers to use VR**

   A significant number of teachers do not want to research and learn with VR/AR because they are not properly motivated to do so. The analysis shows that it is mainly a matter of awareness of this technology: Because teachers do not know how VR/AR can facilitate/improve their teaching methods, it is difficult to motivate them to take trainings and courses that explain these things to them. It follows from this information that it would be appropriate to familiarize teachers with the possibility of using VR/AR already during their studies at university, so that they come into practice already familiar with this technology and know how and what it can help them with.

2) **Meaningful and practical use of VR in teaching**

   The analysis shows that there are teachers in schools who know VR/AR technology, would like to use it, have experience with it, but are not sure how to use it meaningfully in their subjects. So, the question of purely practical use with specific teaching examples arises. From this it can be concluded that these teachers would need direct practical demonstrations of individual software and their use in teaching. So, it's not just about showing the possibilities of VR/AR, but rather about showing how to directly implement these possibilities into teaching.

3) **Regular training and updating of methods**

   The third important point is the possibility of long-term and regular teacher training. Even if the university graduate will be familiar with the current possibilities and software for VR/AR, in a few years in practice, other new possibilities will be created, with which he will not have much opportunity to become familiar. For this reason, it would be appropriate to offer teachers regular training in current trends and innovations in VR/AR educational software. In the same way, this could work through greater connection and cooperation of companies that routinely use VR/AR in their activities and can thus show teachers what they can prepare their students for.

2.3. Summary of AR/VR attitudes

At the end of the survey of schools and enterprises we asked statements about AR/VR. In the summary of the comparison, we can see the same attitude very much. All respondents see new opportunities in both the economy and education. Thus, AR/VR should be used more in schools. Related to this is the perception of greater benefits of AR/VR for educational and work purposes rather than for gaming. Overall, there is a general interest in this technology and the planned use of AR/VR in the near future.

	Definitely yes		Rather yes		Rather not		Definitely not		Not applicable	
Statement	Schools	Enterprises	Schools	Enterprises	Schools	Enterprises	Schools	Enterprises	Schools	Enterprises
AR/VR opens up many new possibilities for the economy.	58%	45%	34%	43%	3%	5%	0%	0%	5%	8%
AR/VR opens up many new possibilities for education.	47%	58%	45%	33%	6%	3%	0%	0%	2%	8%
The use of VR/AR should be taught in schools.	30%	35%	56%	40%	11%	18%	0%	0%	3%	8%
The benefits of AR/VR outweigh the cost/effort.	26%	33%	32%	38%	8%	20%	5%	0%	30%	10%
AR/VR is too controversial for the health of its users.	0%	3%	13%	13%	41%	50%	23%	20%	24%	15%
AR/VR is relatively easy to use.	16%	15%	53%	48%	18%	30%	2%	3%	10%	5%
I have a general interest in VR/AR.	60%	60%	35%	30%	2%	3%	0%	3%	2%	5%
The main purpose of AR/VR is entertainment/gaming.	6%	0%	25%	15%	40%	53%	27%	23%	2%	10%
In the next three years, I will probably be using VR/AR in my work.	39%	35%	35%	18%	11%	25%	9%	10%	6%	13%

2.4. Teacher training (Higher Education)

The following section describes the functioning system of undergraduate teacher training in the South Bohemian Region and Upper Austria. The system of lifelong education and the relationship of curricula to AR/VR are also described.

2.4.1. The functioning system of the undergraduate training of future teachers

How to become a teacher in the Czech Republic?

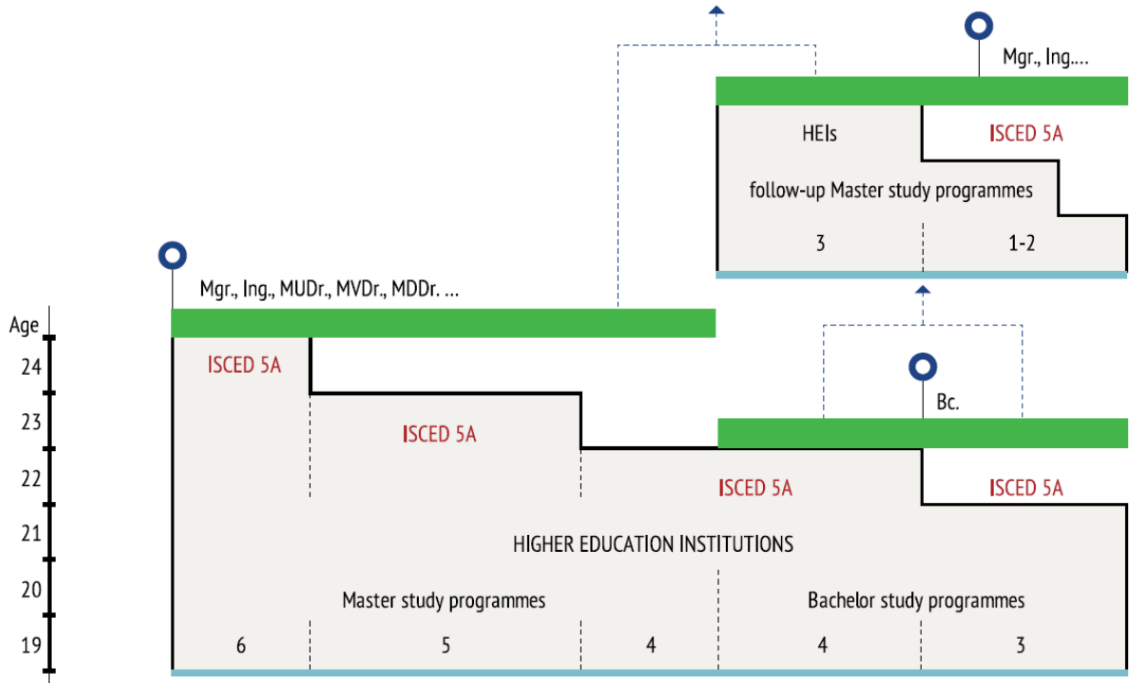
In the Czech Republic, teacher training is carried out at faculties preparing teacher students within accredited study programs in undergraduate studies and postgraduate studies (as part of continuing education for teaching staff). The length of the study, its structure and the level of education achieved are determined by the legislative requirements for the qualification of teachers at individual school levels.

In undergraduate education, the preparation of teachers for kindergartens is implemented through a bachelor's study program. Teachers for the 1st grade of elementary schools are trained in an unstructured five-year master's degree, and the qualification of teachers for the 2nd grade of elementary schools and for secondary schools is realized through a structured study, i.e., completing a bachelor's and subsequent master's degree. The standards of the study programs are determined by the framework requirements of the Ministry of Education, Youth and Sports (MŠMT), which determine the proportion of subjects of theoretical (specialist) preparation, subjects with a didactic focus, realization and reflection of practice and subjects with a pedagogical-psychological basis.

In the system of postgraduate training, already completed university training is linked with a study in the field of pedagogical sciences or an additional pedagogical study. In the case of the qualification of teachers for kindergartens and for the 1st grade of elementary school, the condition for admission to study is the completion of a previous university degree in teaching or pedagogically oriented educational programs. In this system, the qualification of a 2nd grade primary and secondary school teacher is based on the de facto recognition of any focus of previous higher education. The structure of the subsequent program then consists in the preparation of participants in a shortened model in topics focused on the field of didactics, pedagogy-psychology, and reflection on educational practice. The preparation of study programs is governed by the Standard of study in the field of pedagogical sciences for obtaining a teacher's qualification.

Long-term undergraduate training, in which the theoretical and practical components of education are connected, appears to be effective for obtaining a teacher's qualification, which is a basic prerequisite for the formation of the teacher's competence during the entire course of study as a reflective practitioner who can perceive various aspects of the educational process, processes pupils' learning as well as their own results in the education of other

individuals. The key to professional success and the beginning of lifelong growth is the achievement of a professional vision and the realization of a professional conviction, when intuition and improvisation are significantly replaced by a purposeful, reflective, and deliberate procedure. The institution providing higher education for teachers in South Bohemia is the University of South Bohemia in České Budějovice.



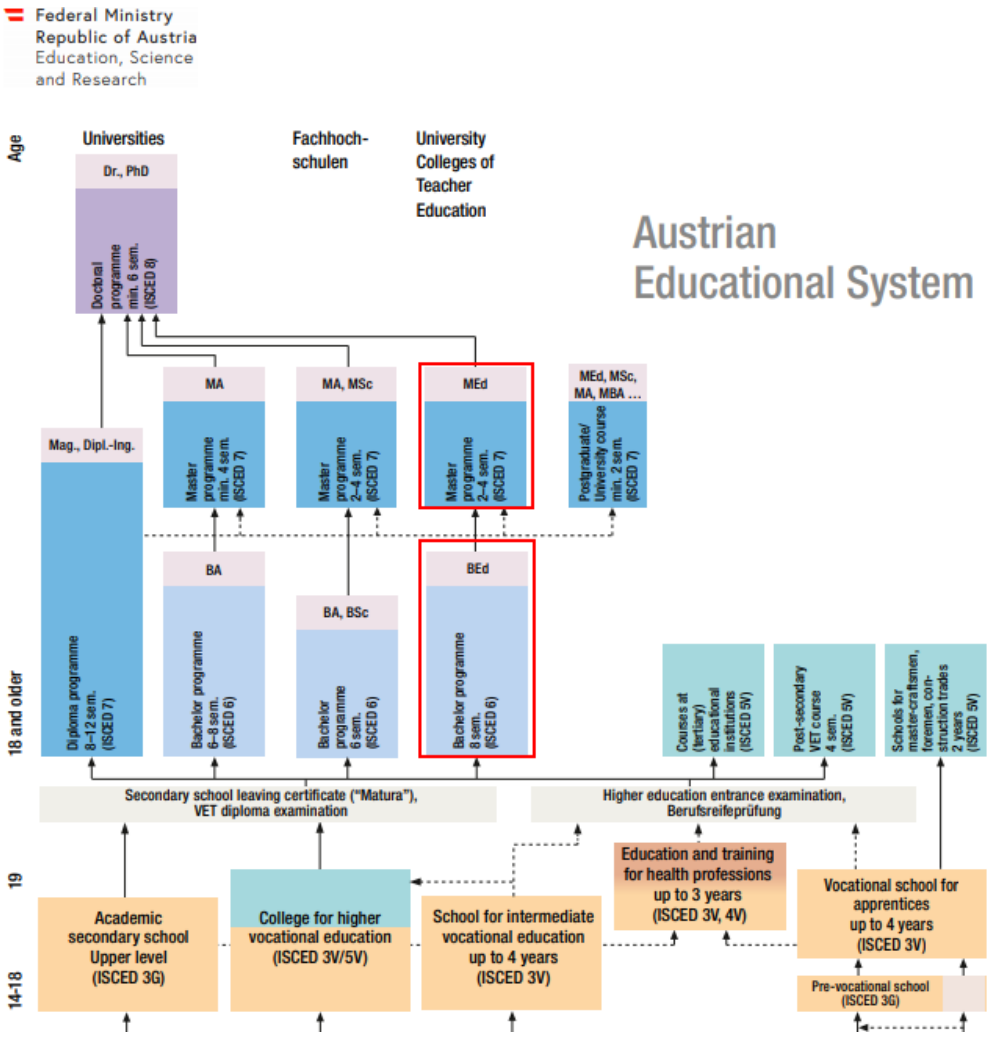
How to become a teacher in Austria?

In Austria, teacher training takes place at public universities and pedagogical colleges. Until a few years ago, these institutions were subordinated to various ministries. While pedagogical higher schools were subordinated to the Ministry of Education, universities were subordinated to the Ministry of Science. Teacher training in Austria has been fundamentally reformed and standardized since 2009 as part of the "new teacher training" process. The PädagogInnenbildung NEU initiative was created because there was a need for a higher number of teaching staff in Austria. At the same time, it was an effort to standardize and merge the education of all pedagogues based on the Bologna process, which would also ensure a high degree of transferability and ensure the possibility of combined higher education, especially the master's degree. As part of the reform, the level of cooperation between pedagogical higher schools and universities also increased, which ensured the harmonization of study plans, courses and teaching content.

There are a total of four different teacher education networks (Entwicklungsverbünde): West, Central, South-East and North-East. Within these networks, there is close mutual cooperation between higher education schools and universities in the area of offering new teacher training programs at the tertiary level.

In Upper Austria there is a Network Center for Teacher Training, consisting of the following institutions: Private Anton Bruckner University; Johannes Kepler University in Linz; Private College of Pedagogy, Diocese of Linz; Private Catholic University, Linz; Edith Stein Church Pedagogical University; University of Pedagogy in Upper Austria; Stefan Zweig College of Education , Salzburg; Paris Lodron University in Salzburg, University of Art and Industrial Design, Linz; and the University Mozarteum , Salzburg.

Teachers of general education subjects at the 2nd level of elementary schools are now being educated in teacher's courses at universities and higher education schools. Teacher courses for both primary and secondary levels of vocational schools take place exclusively at higher pedagogic schools. The structure of teacher education has changed as part of the reform and now consists of a four-year bachelor's degree, which can be followed by a one- or two-year master's degree.



2.4.2. Accreditation system and technical adjustment possibilities in relation to AR/VR

How are study plans and accreditations created?

In the Czech Republic, the right to implement a study program (admit students, teach, issue a diploma and a supplement to the diploma) arises based on institutional or program accreditation of the study program.

The Council of the National Accreditation Office for Higher Education granted institutional accreditation to the only higher education institution in the South Bohemian Region – the University of South Bohemia in České Budějovice (JU) for the field of study in Teaching. This means that JU has the right to accredit study programs in each field of education within its internal procedures and rules. In addition to Act No. 111/1998 Coll., on universities and on the amendment and addition of other laws (the Act on Universities), as amended, there are minimum requirements for the quality of educational activities, resp. provision of the study program, established by Government Regulation No. 274/2016 Coll., on standards for accreditation in higher education and Government Regulation No. 275/2016 Coll., on areas of education in higher education, evaluation conclusions, recommended procedures and methods for evaluating the activities of the National of the Accreditation Office for Higher Education (NAÚ) as the main guarantor of the external evaluation of JU and the higher education environment in the Czech Republic in general, the JU statute, the Habilitation Regulations and the Order for the Appointment of Professors at JU, the Study and Examination Regulations of JU, the Rules of the Educational, Creative Quality Assurance System and related activities and Internal evaluation of the quality of educational, creative and related activities of JU, Standards for accreditation and realization of study programs of JU and related internal standards of JU and individual faculties.

The authorization to carry out a study program for a given type (bachelor's, master's, doctorate), form (full-time, combined or distance learning), standard duration of study and language of instruction is granted to one or more faculties by the Internal Evaluation Board of the JU (RpVH JU) based on the proposal of the dean or joint at the proposal of the deans of the faculties until the end of the validity of the JU's institutional accreditation, or for a period of 10 years. The detailed procedure for the preparation and approval of study programs within the field or fields of education for which the JU was granted institutional accreditation, as well as for the preparation and approval of other study programs, is set out in the Standards for the Accreditation and Implementation of the Study Programs of the JU. In accordance with the defined rules, a study program guarantor is appointed for each study program carried out at JU and a Study Program Council is established. Their task is to take care of the quality of the study program, to submit ideas for the possible improvement of the teaching of individual subjects, or to modify the study plans.

In the case of the creation of study plans for teaching fields, the above-mentioned framework requirements of the Ministry of Education, Culture, Sports and Science are the

starting point as a standard for a regulated profession establishing the optimal proportion between the so-called field, field-didactic, pedagogical-psychological component of preparation and practice. The preparation of the study plan is organized and ideologically supported by the guarantor of the study program, who proposes the structure of the individual fields and their staffing so that it is in accordance with the stated standard, but also with the profile of the graduate of the study program. In terms of staffing, the guarantor consolidates the staffing of the fields with the opinions of the heads of departments or institutes so that, on the one hand, the capacities of specific workplaces are used, and on the other hand, the qualification, and professional requirements for the guarantors of the fields of theoretical and profiling basis are observed. The created draft of the study program (with a defined structure of individual subjects, their staffing, and a presentation of the graduate's profile) is discussed by the faculty management and subsequently forwarded to the scientific council of the faculty for expert discussion. After incorporating the comments in the faculty's internal evaluation, the document is assessed by the university - the Council for Internal Evaluation (RpVH). By approving and incorporating any comments, space is created for the preparation of a complete accreditation file and for its re-discussion both at the faculty level (Council of Study Programs, Faculty Scientific Council and Faculty Academic Senate) and at the university level. Depending on the nature of the accreditation (institutional or programmatic), the accreditation process is terminated either by the opinion of the Council for Internal Evaluation, or the material is forwarded to the National Accreditation Office for Higher Education. The entire accreditation process is therefore procedurally very complex, it includes several levels of decision-making and assessment of the quality of the study program proposal.

The Center for Further Education of Pedagogical Staff was established at the Faculty of Education of the University of South Bohemia in České Budějovice for accreditation, organization, and provision of studies in the field of lifelong learning. The center's staff prepared the accreditation of the Additional Pedagogical Study, the completion of which can be used to obtain a teacher's qualification. The study program has its guarantor, who wrote the application for accreditation. The proposal of the study program was discussed in the faculty committees, and, after the approval of the faculty management, it was sent to the Ministry of Education, Youth and Sports for the accreditation procedure.

Additional pedagogical study (B7501) is a study to meet the qualification requirements in the field of pedagogical sciences according to § 2 of Decree No. 317/2005 Coll., on the further education of pedagogical workers, the accreditation commission, and the career system of pedagogical workers, as amended. This is a study in the field of pedagogical sciences to obtain the qualification of a teacher of the 2nd grade of elementary school and secondary school of a general education or professional subject, which corresponds to the nature of the previous study. The program is accredited by the Ministry of Education, Culture and Sports in the system of further education of pedagogical staff. The target group is graduates of an accredited master's degree program with a non-teaching focus (Mgr., Ing. - including graduates of linguistic fields), which corresponds to the nature of one of the subjects taught in primary or secondary school. Thanks to this study, participants will acquire the competence to teach general education or professional subjects. Teaching takes place in three semesters with a time allowance of 254 hours in face-to-face and distance learning.

In Austria, the curricula of bachelor's and master's programs are developed, coordinated and implemented in the relevant network of universities or educational institutions. This process takes several years because the curricula of all subjects and all studies must be coordinated centrally within these institutions.
The legal basis of the curriculum is the federal laws, which determine the scope and scope, as well as the implementation and implementation of the study. Specifically, the legal basis for the bachelor's degree in teaching for secondary schools (general education) and for the master's degree in teaching in secondary schools (general education) are the following laws and study regulations of decrees based on these laws in the currently valid wording: Federal Act on the Organization of Universities and Their studies (UG 2002; *Bundesgesetz über dies Organization of Universities and hey Study*); Higher Education Act (HG 2005; *Hochschulgesetz*); Private Universities Act (PUG; *Privatuniversitätengesetz*); Higher Education Quality Assurance Act (HS-QSG; *Hochschul-Qualitätssicherungsgesetz*); and the amendment to the Service Act 2013 – Pedagogical service (*Dienstrechts-Novelle 2013 – Pädagogischer service*). The study is established and carried out jointly in the development association "Network Center for Teacher Education" with all participating institutions in accordance with § 54e UG and § 39b HG.

How can changes be made?

In the Czech Republic, certain changes can be made, but it is necessary to strictly comply with legislative requirements and predetermined procedural procedures. If there are any changes in the accredited study program during the validity of the undergraduate study accreditation, it must always be with the consent of the study program guarantor and after discussion in the study program Council. The quality coordinator at the relevant faculty must also be informed about these changes immediately. If it is a fundamental change, the JU Internal Evaluation Council must also be informed immediately. Within the measures of the rector of the JU, fundamental changes are defined that need to be discussed with the Internal Evaluation Council of the JU (e.g., it is not necessary to discuss changes in the parameters of a specific subject or changes in the offer of compulsory-elective or optional subjects, these adjustments are fully within the competence of the faculty bodies established for quality assessment. The quality coordinator of the faculty informs the vice-chairman of the Internal Evaluation Council about other changes in the study program approved in the faculty bodies established for quality evaluation, who submits an overview of the changes to the Internal Evaluation Council as information at least once a year. The Internal Evaluation Council assesses whether significant changes in the implementation of the study program, of which she is informed, will not cause the study program to cease to meet the relevant requirements. In such a case, she is entitled to reject the change and demand a return to the original state, request adjustments to these changes or make other changes that will again achieve the fulfillment of the relevant requirement in set deadline.

Minor adjustments to the study program in the area of lifelong learning are the responsibility of the study program guarantor. If these are fundamental changes, then the

given changes must be reported to the Ministry of Education and Culture as an accreditation body in the application regime for the extension of the educational program.

In Austria, changes in study plans can only be made in accordance with the applicable legal regulations and in coordination with all institutions represented in the network of teacher training institutions in the given area. At the same time, they must be approved by the relevant ministry.

Final comparison:

The preparation of future teachers in the Czech Republic is primarily carried out by faculties that have accredited programs leading to the teaching profession. The continuing education of teaching staff is often also connected with these faculties, but other entities also enter into it. Teacher training itself is undergoing a certain reform as part of the implementation of the Education Strategy 2030+ (see Ministry of Education, Culture, Sports, Science and Technology, 2022). The preparation and further education of teachers in Austria is organized through a network of special universities focused on teaching fields or universities. As in the Czech Republic, teacher training in Austria was converted to a two-level system (bachelor's and subsequent master's degree) according to the Bologna program. In the Czech Republic, study programs are processed by individual institutions, their quality is assessed first at the institutional level and then through the National Accreditation Office for Higher Education. In Austria, the study programs are drawn up again by the respective institutions, which, however, cooperate within local networks. This process of creating programs takes several years, so it takes quite a long time to make any changes.

2.4.3. Study plans for undergraduate preparation of future teachers and AR/VR involvement

South Bohemian region

As part of the study plans of all study programs focused on teacher training, for the 1st and 2nd grade of elementary schools and for secondary schools, the Faculty of Education of the University of South Bohemia in České Budějovice offers the subject Technology in Education, which is common to all students of the mentioned programs. The aim of the course is to familiarize students with the possibilities of using computer technologies in the work of teachers, and to equip them, as future teachers, with the skills and competences for creating teaching materials of a multimedia and interactive nature. In this subject, students are also regularly introduced to virtual (VR) and augmented reality (AR) resources. iPads, both school and students' own, as well as students' smartphones, are most often used to familiarize themselves with AR. A specialized 3D lab with two HTC Vive headsets is then used for the VR demonstration. Due to the small capacity of the classrooms, the number of technical devices and the time allocation of the subject, students are introduced to this technique only for informational purposes, without sufficient space for a deeper understanding of it.

Selected examples of VR/AR implementation options for specific teacher preparation specializations (i.e., endorsements)

Mathematics: In mathematics, stereometry, the geometry of three-dimensional (3D) space, is directly offered for applying the means of virtual or augmented reality. The simulation of a 3D space filled with geometric shapes is an application that comes directly from the purpose of VR and AR. At the same time, the dynamism of the VR scene makes it possible to interactively recognize and reveal the properties of three-dimensional objects and shapes. The use of VR and AR is suitable in combination with physical models. VR brings the possibility of direct interaction with the geometric properties of objects. The ability to create a virtual environment of geometric shapes with which the user can interact is beneficial for the development of pupils and students' ability to perceive three-dimensional space. A less obvious area for VR application, yet with considerable potential, is financial mathematics. Here, VR allows you to simulate situations that develop and test the financial literacy of pupils and students. In a safe environment, without the need for a live simulation of an often-unpleasant counterparty. This option is now widely used by financial institutions to train their employees.

Physics: In physics, VR and AR undoubtedly have great educational potential. It involves both the implementation of virtual experiments and learning about phenomena and places that are difficult for ordinary people to access, e.g., the universe, a particle accelerator, curved space, microscopic phenomena in matter related to the phenomena that pupils learn about, etc.

Technical Education: VR and AR already play an important role in technical practice. It is mainly about preparation and training of complex production or service operations. However, the use of VR for 3D modeling of three-dimensional objects or environments is also real, whether it is design in the field of structures, residential architecture, or the automotive industry. For the preparation of students in this field, the use of VR and AR is offered for virtual tours of any machines or equipment or entire production lines.

Geography: The possibility of including modern technologies such as GIS (geographical information system), VR, AR, etc., in the teaching of geography in the 2nd grade of primary schools is very important. This is already a specific didactic application of the given field. If we go into details, then almost every topic and educational procedure within geography can be used for these technologies. Especially when preparing materials for teaching, understanding a more complex issue or getting to know a certain region.

Language teaching: For teaching English, German or Russian, it is not easy to find any clearly graspable, language-specific situations in which VR or AR would be useful. Nevertheless, even here these technologies can be involved in teaching, especially in cooperation with geography. The language teaching curriculum includes the realities of Canada, Ireland, German-speaking countries, Russia, etc. The aim of this course is therefore to familiarize students with the basic geographical, cultural, social and political aspects of life in different countries, with an emphasis on the practical use of this knowledge. During the lectures, students gradually

become familiar with geographical areas (Great Britain and its smaller units, USA, Australia, Canada, former colonies, Germany, Austria, Switzerland, Russia, etc.) and work with texts, visual and audiovisual materials that they can also use during own teaching.

Science: In the bachelor's study program, as part of the preparation of science teachers, the use of VR or AR is offered in the following subjects: Cell and molecular biology; Biology of viruses and unicellular organisms in the context of the school curriculum; Geology I. and II. and Functional Human Anatomy. In cell and virus biology, VR and AR can be used to show students structures that are microscopic and generally difficult to imagine. In the case of geological subjects, students could familiarize themselves with the manifestations of internal or external geological factors through VR and AR. Human anatomy is generally a very suitable topic for the use of VR and AR, as it will provide an opportunity to gain insight into the structure of the human body, the relative position of individual organs, their actual shape or size, etc. In subsequent studies, it would be possible to use VR and AR in the subjects of Physiology I and II., because they represent complex physiological processes from botany and zoology. VR and AR would certainly increase the clarity of the presented processes. All of the mentioned areas of the curriculum where VR and AR could be used belong to the problematic ones even within the teaching of natural history at primary school. A teacher student who would have encountered the effective use of VR and AR in the teaching of these passages during his bachelor's training could also apply these tools in his pedagogical practice and thereby convey better knowledge to elementary school students.

Chemistry: As part of the bachelor's program for the preparation of chemistry teachers, there is the possibility of using VR and AR in the following subjects: Didactics of school experiments and Laboratory technique of chemical experiments. In the follow-up master's study, VR and AR resources can suitably supplement the teaching of the subject Basics of chemical technologies. In all these subjects, students may encounter more complex technological processes, laboratory procedures or tools that are not commonly available in laboratories at the university or are not used by any company in the area. VR and AR can help in the education of teachers (and subsequently in a very simplified form in the teaching of elementary school students) with a better illustration of chemical processes, such as substitution and elimination reactions in organic chemistry or the distribution of valence electrons in orbitals. When VR or AR is implemented in laboratory procedures, fine motor skills and work habits in conducting experiments can also be developed in this way.

Art education: As part of art education, it is very appropriate to use VR and AR, for example, in the so-called mediation of architecture, when the 3D model of the building enables a comprehensive and comprehensible interpretation of the principles of construction. It is also possible to work with the visualization of sculptural works for the possibility of their full spatial perception.

1st grade of elementary school: Areas focused on the study of nature offer the use of VR and AR in the subjects Man and his world I. - Inanimate nature and Methodology of natural science experiments, Man and his world II. – Living nature and Didactics of learning about nature, Natural science research and work with natural resources and Regional natural science. VR and AR offer the possibility to demonstrate more complex experiments (again together with

the development of fine motor skills and mastery of work procedures) or to visit different habitats where students (and therefore pupils) cannot easily get to, or to observe animals and their behavior. In Regional Natural Sciences, students (and pupils) could get to know localities in their surroundings without the need for complicated travel to the given locality, or it would be possible to present materials in direct connection with the curriculum (without the need to follow the seasonal aspect).

Teaching practice: In general, it is possible to consider the use of virtual reality as part of the continuous practice of teaching students, where students could become familiar with interesting moments in the classroom and propose their own solution to the pedagogical situation (in this case, however, long-term preparation will be necessary, including making recordings and creating an adequate virtual environment).

Upper Austria

Curricula for teacher training at universities of pedagogy (Pädagogische Hochschulen) in Upper Austria provide detailed information on all subjects, both on their contents and goals, and on the organization into more complex modules, as well as on the prerequisites for their study and the conditions for their completion.
Curricula intended for undergraduate studies [1]do not yet contain any explicit reference to virtual or augmented reality. However, in the description of the subject media design (Mediengestaltung ; see p. 380 et seq.) there is a passage in which "virtuality and immersion" are mentioned. However, it must be said that the subject Media design is only offered in the curricula of special types of schools with a focus on media. The terms virtual reality or augmented reality do not even appear in the master's curriculum [2]. Only the term "virtual spaces" (... "presentation in real and virtual spaces", p. 170) can again be found as a term in the description of the subject media design.

In general, it should be noted that terms referring to digital technologies are rarely found in the curriculum. If we take the bachelor's curriculum as an example, the words "tablet" and "notebook" do not appear in them at all, the word "computer" is mentioned 28 times and the term "new media" 24 times, the term "new technologies" then occurs twice.

Specifically, these terms are used in the curriculum descriptions of the following fields:

- History and Social Sciences/Political Education
- Design/Industrial Art
- IT and IT management
- Music
- English
- Nutrition and household
- Instrumental music education
- Mathematics
- Media design
- Inclusive education/focus on the disadvantaged

[1] https://www.lehrerin-werden.at/fileadmin/user_upload/pdf/Bachelorstudium_Lehramt_Allgemeinbildung.pdf
[2] https://www.lehrerin-werden.at/fileadmin/user_upload/pdf/Masterstudium_Lehramt_Allgemeinbildung.pdf

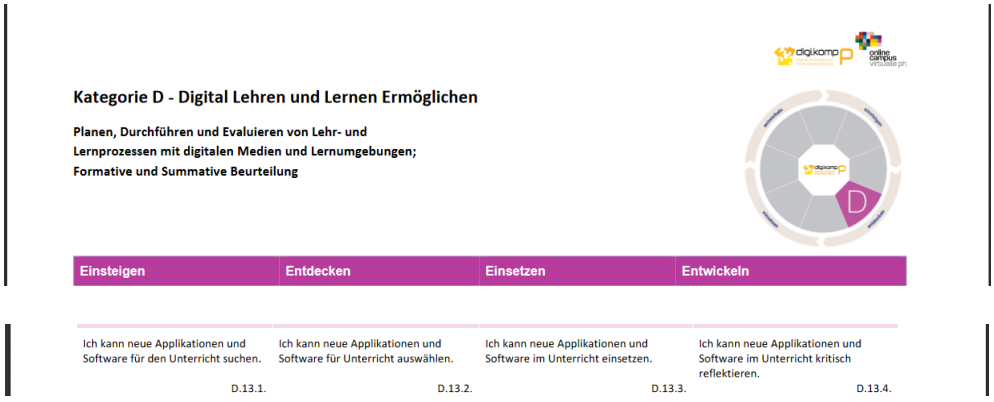
It may seem surprising why there are so few technology or technological terms in teacher education curricula. It is therefore necessary to know that in Austria there is a separate concept of digital competences for educators presented under the acronym " digi.kompP [34]". This model of digital competences was formulated in its first version in 2016, and the second version was created in 2019. It is based on analogous national and international models. It is a system for the self-evaluation of the continuous professional development of pedagogues, which also serves to categorize further education events in the field of digital competences at teacher training universities. The " digi.kompP " model is mentioned 143 times in the curriculum for undergraduate students, which means that this competency model is already applied in a wide range of professional education courses. In the master's curriculum, the " digi.kompP " competence model is mentioned 54 times. The competence model " digi.kompP " for educators consists of 8 sub-areas:

- **Category A (= digi.komp12) – Digital skills and education in the field of IT**
  This subfield is the basis for starting education at a pedagogical university, specifically the digi.komp12 competence model (see https://digikomp.at/?id= 585), which must be mastered at universities.
- **Category B – Digital life**
  Life, teaching and learning in the sign of digitality; Technical ethics issues; Media education and biography; Accessibility
- **Category C - Creation of digital materials**
  Creation, editing and publishing of teaching materials; Right of Use and Copyright
- **Category D - Enabling digital teaching and learning**
  Planning, implementation and evaluation of teaching and learning processes using digital media and learning environments; formative and summative assessment
- **Category E - Digital teaching and learning in specialist areas**
  Specific use of digital media, software and digital content
- **Category F – Digital education**
  Promoting students' digital skills
- **Category G – Digital management and formation of the school community**
  Effective and responsible digital classroom and school management; communication and cooperation in the school community
- **Category H - Further digital learning**
  Lifelong learning (LLL): Further and advanced learning with or on digital media

Even in this model of digital competences for teachers (see https://www.virtuelle-ph.at/wp-content/uploads/2021/04/Grafik-und-Deskriptoren_Langfassung_adapt-2021.pdf) the frequency of references to specific digital resources is not big; we would look for the terms virtual and augmented reality, as well as tablet and laptop in its specification in vain, the computer is then mentioned three times. Instead of these terms, neutral formulations such as digital media, digital tools, software, etc. are used to describe competences in such a way that they can be used independently of technology.
VR and AR tools have their place in several categories of this model [5]:

[3] https://www.virtuelle-ph.at/digikomp/
[4] https://www.virtuelle-ph.at/wp-content/uploads/2021/04/Grafik-und-Deskriptoren_Langfassung_adapt-2021.pdf
[5] https://www.virtuelle-ph.at/wp-content/uploads/2021/04/Grafik-und-Deskriptoren_Langfassung_adapt-2021.pdf

Specifically, in category D "Enabling digital teaching and learning", the content of point D.13 (page 14) ("I can search for or select new applications and software for teaching" or "use them in teaching" and "think critically") can clearly be related to work with virtual or augmented reality:



Kategorie D - Digital Lehren und Lernen Ermöglichen

Planen, Durchführen und Evaluieren von Lehr- und Lernprozessen mit digitalen Medien und Lernumgebungen; Formative und Summative Beurteilung

Einsteigen	Entdecken	Einsetzen	Entwickeln
Ich kann neue Applikationen und Software für den Unterricht suchen. D.13.1.	Ich kann neue Applikationen und Software für Unterricht auswählen. D.13.2.	Ich kann neue Applikationen und Software im Unterricht einsetzen. D.13.3.	Ich kann neue Applikationen und Software im Unterricht kritisch reflektieren. D.13.4.

...

Category E "Digital teaching and learning in professional areas" is also very suitable, specifically for example competences E.7 and E.9 (p. 17) with basic abilities such as "I can find/select new applications for teaching and learning", which extend to "I can try/use new teaching and learning applications" or "I can learn to use/implement new teaching and learning applications" and finally end with the competency "I can use/adapt new teaching and learning applications and evaluate their strengths and weaknesses":

Kategorie E - Digital Lehren und Lernen im Fachbereich

Fachspezifische Nutzung von digitalen Medien, Software und digitalem Content

Einsteigen	Entdecken	Einsetzen	Entwickeln
...			
...			

In addition, AR/VR fits very well with Section D.12 (page 18), where current trends are identified, described, adapted and evaluated and further developments in media-based teaching and learning for self-directed learning are indicated:

Ich kann aktuelle Trends und Entwicklungen zum mediengestützten Lehren und Lernen identifizieren. E.12.1.	Ich kann aktuelle Trends und Entwicklungen zum mediengestützten Lehren und Lernen im eigenen Unterrichtsfach beschreiben. E.12.2.	Ich kann aktuelle Trends und Entwicklungen zum mediengestützten Lehren und Lernen für meine Lehrtätigkeit anpassen. E.12.3.	Ich kann aktuelle Trends und Entwicklungen zum mediengestützten Lehren und Lernen evaluieren. E.12.4.

Formulations relevant to AR/VR can also be found in category H "Further digital education", specifically, e.g. in point H.11 "I can search for, find, evaluate, reflect upon and

(learn to) use meaningful and beneficial content of software and media for educational or didactic purposes independently and legally compliant".

Kategorie H - Digital Weiterlernen

Lebenslanges Lernen (LLL): Fort- und Weiterbildung mit bzw. zu digitalen Medien

...

Ich kann für pädagogische bzw. didaktische Zwecke sinnvollen und förderlichen Content, Software und Medien suchen, und finden.	Ich kann für pädagogische bzw. didaktische Zwecke sinnvollen und förderlichen Content, Software und Medien suchen, finden und bewerten.	Ich kann für pädagogische bzw. didaktische Zwecke sinnvollen und förderlichen Content, Software und Medien suchen, finden, bewerten und reflektieren.	Ich kann für pädagogische bzw. didaktische Zwecke sinnvollen und förderlichen Content, Software und Medien suchen, finden, bewerten, reflektieren, (rechtskonform) verwenden bzw. selbständig verwenden lernen.
H.11.1.	H.11.2.	H.11.3.	H.11.4.

2.4.4. Lifelong teacher education study plans and AR/VR involvement

Czech Republic

The means of virtual and augmented reality (VR/AR) can be used at the Faculty of Education of the University of South Bohemia in České Budějovice in the education of existing teachers as part of the Additional Pedagogical Studies and in the courses of further education of pedagogical staff (DVPP) for improving qualifications (third approval subject) in the field of general and subject didactics for a better understanding of students about the methods and forms of teaching in primary and secondary schools. VR/AR has the potential to supplement the theoretical framework of study programs with the possibility of immediate demonstration of its implementation in practice. For DVPP students, especially beginning teachers, VR/AR can also be used to simulate or practice problem situations with students that they may encounter in educational practice. In the case of offering further education courses for teaching staff, it is also possible to create a specialized short-term course accredited by the Ministry of Education, Youth and Sports in the DVPP system, which would be targeted at the use of VR/AR in a specific educational area.

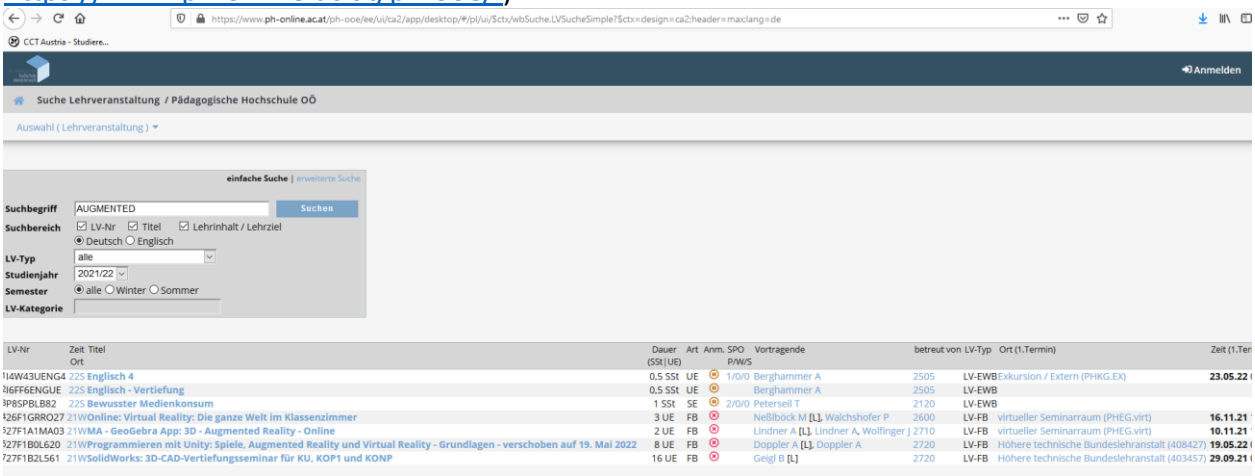
However, the development of the implementation of VR/AR in the preparation of future teachers and within the DVPP also has its weaknesses that must be taken into account. Higher involvement of VR/AR in teaching also entails higher demands on technical equipment. Currently, several VR headsets are available at the Faculty of Education of JU. For effective use, at least model class VR is required, which means about 17 glasses and at the same time the need for sufficiently large spaces. The second obstacle to a more massive deployment is the absence of teaching materials, procedures and models. There are a number of applications of a game nature, but there is a lack of quality didactic materials, both at the level of the Faculty of Education of the JU and the Czech education system. However, the creation of these materials already requires greater knowledge of technology, programming and testing. The

above-mentioned possibilities of implementation into the curriculum can be realized provided that the teachers of individual subjects/courses are able and willing to master these technologies. This places additional demands on educational institutions, as experience in the academic environment with the involvement and use of these technologies is scarce, as is the case in primary and secondary schools in the South Bohemian Region.

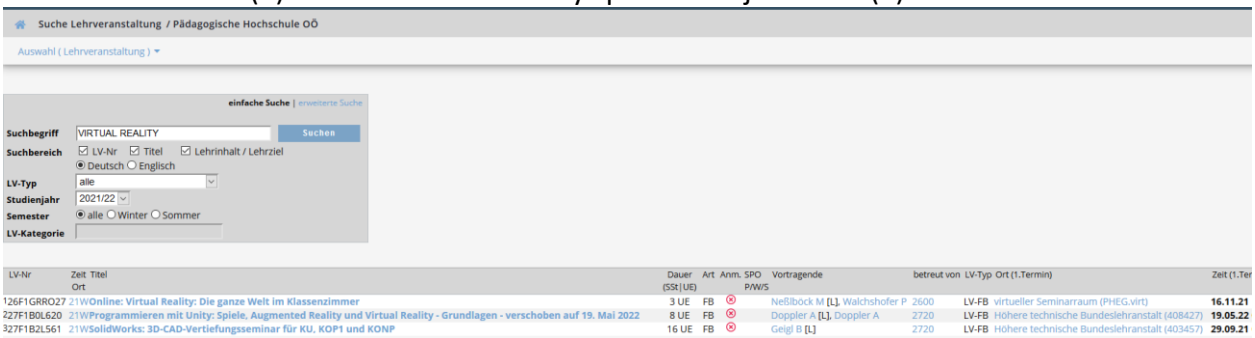
Upper Austria

Given that the current curriculum and the closely related competence model " digi.kompP " already allow the use of all kinds of technologies - including VR and AR - there is no need to make corresponding adjustments to the curriculum. The goal of our research was to answer the question of whether there are specific courses with information on the use and use of VR/AR as teaching or study content.

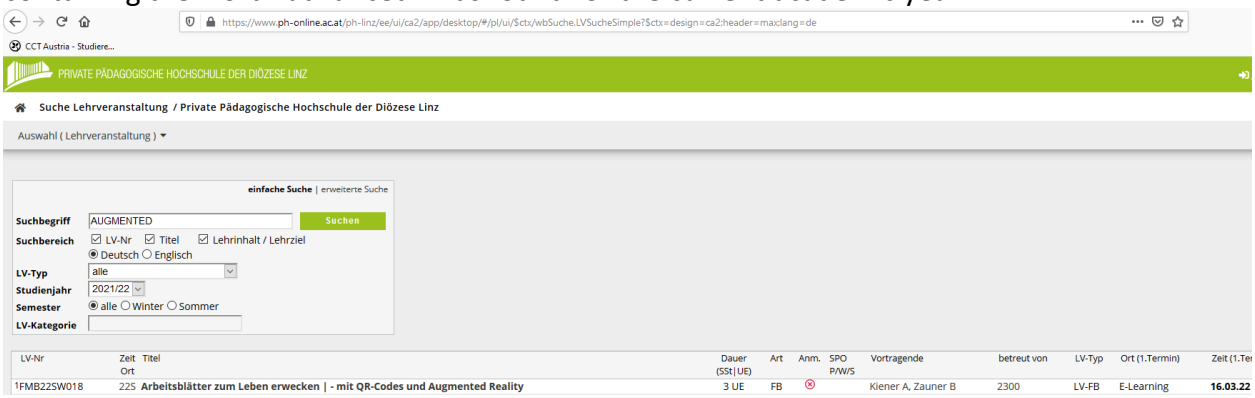
The curriculum is the framework for the courses in which future teachers are trained. The exact specifications of the courses and their content are stored in the online database "PH online" (https://www.ph-online.ac.at/), which is used by every college of education. We searched this database for the terms "virtual reality" or "augmented reality" in current courses:
In the academic year 2021/2022, three initial education events and four advanced teacher education events were detected at the University of Pedagogy in Upper Austria (https://www.ph-online.ac.at/ph-ooe/) :



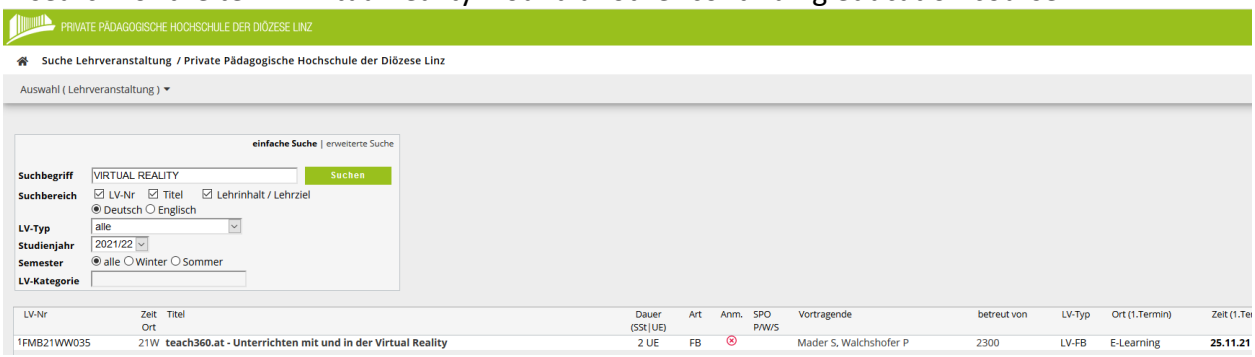
All three introductory trainings were intended for future English teachers. Four advanced teacher education courses focused on mathematics (1), were intended for teachers of higher vocational schools (2) or did not concern any specific subject at all (1).



Searching for "virtual reality" showed three advanced teacher courses that were already part of the search results mentioned above.
When searching the database of the courses of the Private University of Pedagogy, Diocese of Linz (https://www.ph-online.ac.at/ph-linz), only one advanced teacher education course containing the word "advanced" was found for the current academic year:



A search for the term "virtual reality" found another continuing education course:



It can therefore be stated that the concepts of virtual reality and augmented reality appear very sporadically in undergraduate and further education at universities for teachers in Upper Austria.

It is good to mention that in the bachelor's curriculum [6]two hours of media laboratory are planned in the introductory module (see MG B 1.5 Medienlabor p. 382), another three hours of media laboratory (see MG B 4.2 Medienlabor II p. 383) are then part of another specialized module. In addition, the New Media – Technology, Art, Culture module can be used for VR or AR (see MG B 5.3 New Media – Technik, Kunst, Kultur p. 383), which is intended as a pedagogical practical module.
The term Medienlabor (medialab) indicates that innovation laboratories for greater use of digital media are offered at universities. These labs are called educational innovation studios (see also https://eis.eeducation.at) and are learning labs that aim to encourage pupils, students and educators to use new media. In these labs, hardware and software are available to work on topics such as Robotics, Design Thinking and Programming: The overall aim is to foster competencies and skills for the 21st century.
In Upper Austria, there is a Studio for Innovation in Education (=EIS) at the University of Education in Upper Austria (see https://ph-ooe.at/eis). However , the topics addressed there do not include virtual and augmented reality (see https://ph-ooe.at/eis/themen).

[6] https://www.lehrerin-werden.at/fileadmin/user_upload/pdf/Bachelorstudium_Lehramt_Allgemeinbildung.pdf

The media workshop (https://www.phdl.at/service/medien/medienwerkstatt/) at the Private College of Pedagogical Diocese of Linz is already equipped with an Oculus Rift device that students can use (see section " Geräte bedienen " at https://www.phdl.at/service/medien/medienwerkstatt/). This media workshop and the equipment available in it, including the Oculus Rift, may be used by students outside of the course after consultation with the course instructor or in agreement with the media coaches. It can therefore be stated that at the University of Education in Upper Austria, students can already gain experience with VR equipment in the media workshop.

2.4.5. Synthesis of knowledge - common features, possibilities of cooperation, examples

The potential of VR and AR tools for education is obvious and is documented by a number of research. It is already used in many areas, especially outside of education. It thus represents a clear and meaningful challenge for teams made up of experts in field didactics and digital technologies to start systematically preparing a didactic and technical-organizational framework for the use of VR and AR resources in education and teacher training.

The analysis carried out proved that both regions, South Bohemia and Upper Austria, together have the potential for meaningful and mutually beneficial and enriching cooperation in this area. The dynamics of this cooperation is guaranteed by an optimal mix of common and unique aspects for each region. It can be stated that each of the cooperating institutions has unique experiences and resources, which will enrich each other through mutual transfer and sharing. For example, the South Bohemian region can offer a VR laboratory with the necessary technical and software equipment, as well as experience with the systematic preparation of all teacher students in the Technology in Education course. The Austrian side, on the other hand, has a detailed concept of the digital competences of teachers and experience with its implementation or can offer experience with the use of media laboratories in teacher training.

Although the teacher training systems in the given regions show some differences, their common element, important for the project's goals, is the accentuation of the concept of digital competence. Both in the curriculum documents of both regions and in their teacher training systems, this term reflects the current level of development of digital tools, the degree of their interweaving with the professional and personal life of every citizen, and the requirements for mastering all aspects of their control and use. In the case of the Czech Republic, the concept of digital competence is specified in relation to the pupil (see digital competence in RVP ZV 2021), in Upper Austria also in relation to the teacher (see digi.kompP). It can thus be concluded that in both regions the concept of digital competences is integrated into the goals of teacher training. This creates a similar conceptual framework for the implementation of virtual and augmented reality resources in both regions, an implementation that is still awaiting its systematic and purposeful implementation.

An important reason for the need for the systematic implementation of virtual and augmented reality resources into educational systems and into teacher training systems is the fact that, with increasing breadth and intensity, they find their application in a number of practical areas, from informal educational institutions such as museums or science centers, through the field of services to after manufacturing companies. It is appropriate that these centers of

practical use of VR and AR cooperate at the regional level with educational institutions. Both regions involved have a lot to offer in field of AR/VR.

3. Conclusions

The Upper Austria and South Bohemia region has a relatively high potential for the expansion of AR/VR. However, several major barriers were identified in the analysis of the region. These barriers are common to all analyzed segments. First, there is the issue of financial complexity. This is often already addressed by various subsidies from national governments as well as the EU itself. Technology transfer and cooperation between all actors (schools, enterprises and universities) can also help to overcome financial constraints.

Business analysis has shown that there is an interest to continue to integrate AR/VR into work processes and to extend this technology to new segments of the labor market, especially for employee training, meetings, and new product development. However, the biggest challenge is the lack of qualified people in AR/VR. It is therefore essential for enterprises to use AR/VR in the education of students in secondary schools.

Within the secondary education segment, there is interest in the use of AR/VR, which was reflected in the filling the questionnaires and at the final conference. Schools mainly mention the need for teacher training and transfer of know-how. Awareness of what AR/VR is considerable, but schools often lack examples of meaningful use, concrete applications for specific subjects and lessons. It is a really challenging process for schools to implement this technology in the educational process.

The training of teachers, who would pass on the experience to their pupils, who will then be able to use AR/VR in everyday practice, is very closely related to the education of future (and current) teachers. In this regard, universities play an irreplaceable role. The analysis showed that there is no specific course or seminar on this technology in teacher training. This is because the involvement of digital technologies is related to general digital competences and therefore cannot be applied to only one type of technology. Nevertheless, future teachers encounter AR/VR technology in their training, in seminars of general subjects such as "Technology in Education" or "Media Education". However, there is room for more involvement of AR/VR in vocational subjects as well, but again this will always depend on the specific teachers who have experience with AR/VR.

Based on the analysis, it appears to be the most essential and greatest need for education, information and exchange of expertise. However, this depends on educators who will be experienced users of AR/VR. It can therefore be recommended as promising and meaningful that both parties involved in the project assemble a joint team of experts from all the necessary areas, from technical support to representatives from out-of-school and in-school practice to subject didactics, who will work systematically and purposefully on the task of preparing a didactic and technical-organizational framework for the implementation of AR/VR, especially in teacher education and training.