



Scenario approach for training classroom management in virtual reality

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ABSTRACT

Modern higher education faces serious challenge of teaching future teachers to provide a psychologically safe environment in their interactions with students. This ability involves addressing developing conflict situations, accurately recognizing issue's root cause, and concentrating on emotional condition of participants. The goal of this study is to show possibility of utilizing scenario method while creating a virtual reality (VR) application for pre-service teachers to use in pedagogically complicated conflict scenarios. The proposed technology facilitates creation of scenarios based on actual teacher-student interactions. Different scenarios comprise dialogues that illustrate a variety of possible instructors' responses to a disagreement, so demonstrating range of chosen behavior tactics in pedagogical interaction settings. The research was developed utilizing ADDIE model instructional design methodology. At this level, useful classroom management scenarios have been constructed. These scenarios have been examined by experts. According to scenario analysis, three scenarios received positive ratings for their relevance, realism, learning objectives, feedback, engagement, flexibility, and effectiveness. During level of implementation, participants are master's degree candidates in "training in pedagogical conflict management." Participants also studied use of text and video material in VR. Notwithstanding their assumption that they are more effective, a survey of participants showed that they feel learning and deploying VR technology is time-consuming. As VR development tools become more accessible and user-friendly, unfavorable opinions will change, since it will take user time to comprehend technology. On the other hand, while it is a great indicator that they feel they are competent in execution, it may be troublesome for institutions to believe they are incapable of reaching these goals.

Keywords: virtual reality, scenario, scenario approach, pedagogical interaction, conflict situations

INTRODUCTION

A teacher in the modern educational environment is considered to be not just a participant in the interaction of subjects of educational relations, but also a professional who is able to organize and manage this interaction. A future teacher should learn how to create a psychologically safe and comfortable educational environment (Kanbul et al., 2020). Thus, training of a student, a future teacher, should be based on his social experience and personal qualities that allow him to find the best solutions in difficult situations of interaction (Chorosova et al., 2020; Kryukova et al., 2022; Naibaho et al., 2021; Napanoy et al., 2021; Salakhova et al., 2021). Nowadays we face the dominance of the information, digital and virtual world. Therefore, today's students have limited experience in dealing with difficult situations of interpersonal interaction, which can only be gained directly in real-life conditions (Oschepkov et al., 2022; Platonova et al., 2022; Qarkaxhja et al., 2021).

The processes of teacher education transformation are aimed at increasing the practical training of a teacher (Margolis, 2014; Nael & Gnaïm, 2021; Pешa, 2022; Sudakova et al., 2022; Phillips & Chetty, 2018; Zemlyanskaya & Bezborodova, 2021). But, as practice shows, the main emphasis during the period of study of a future teacher is placed on teaching the subject, while social and communicative competencies remain as additionally developed skills (Makhurane, 2020; Rodionova et al., 2022; Zaitseva et al., 2021; Zotova, 2020). As a result, when coming to school, a young teacher struggles in managing difficult situations of pedagogical interaction, often leading to conflicts (Borisova, 2017).

In 2021 researchers conducted the diagnostics of students' conflict management competency. The research was carried out with 187 master's students studying at various pedagogical training programs. According to the results, 90% have a level below the average, and 9% have a low level of conflict management competency. Notably, 75% of students were in-service teachers in schools of Republic of Tatarstan at the time of the survey.

Globally, effective classroom management is regarded as one of the most significant indicators of a teacher's effectiveness, and it should be viewed as a component of the school administration system, which includes student-centered teaching strategies, participatory processes, and continuous quality evaluation of educational work (Karagianni et al., 2023). It is well known that new instructors struggle with the gap between teacher education and classroom management (Adams et al., 2022; Anindya et al., 2020; Susiyowadi et al., 2021). There are a variety of trainings and strategies that are carried out in order to develop the classroom management skills of both in-service teachers and pre-service teachers (Kwok, 2021; Purwanti & Vania, 2021; Shamina & Mumthas, 2018).

As in all areas of life, the use of technological opportunities in teacher training both supports teachers' proficiency in technology and ensures that other teacher competencies are gained (Rodrigues, 2020). In the study conducted by Savelova et al. (2020), online mind-map tools were used to increase the collaborative working competence of pre-service teachers. Augmented reality (Sáez-López et al., 2020) and virtual reality (VR) (Kugurakova et al., 2021; McGarr, 2020), which are more contemporary teaching technologies, can be used effectively in pre-service teacher training.

The use of a VR training simulator in the educational process of teacher training (Kugurakova et al., 2021) will help students prepare for complex situations of interaction in real-life conditions, avoiding harm from teachers' wrong actions. VR simulator is not only a modern digital tool that arouses additional interest and motivates students to learn, but it also has other advantages highlighted by various authors (Kavanagh et al., 2017; Krasnyanskaya & Tylets, 2016; Yelesin & Feshchenko, 2016).

The analysis of virtual products creation in the field of education (Jose, 2021) shows the ample opportunities provided by this technology and the uniqueness of the product depending on the tasks set. Currently, the organization of the learning process using VR environment is gaining more and more demand, which is undoubtedly reflected in studies aimed at improving the process of preparing students in various fields (Abazi-Bexheti et al., 2022).

The authors working on the creation of such VR simulators not only share their experience in their development but note their relevance and effectiveness in teacher training, since the student can be involved in face-to-face simulation training (Lugrin et al., 2016). Students can also receive instant feedback on their

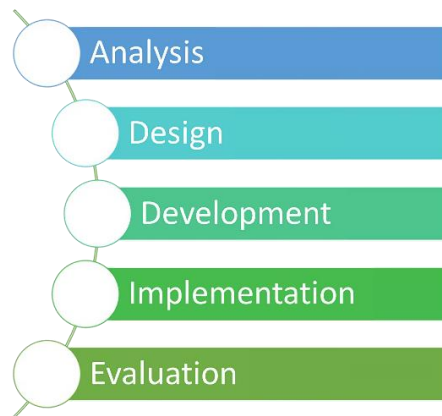


Figure 1. ADDIE model (Nadiyah & Faaizah, 2015; Molenda, 2015)

actions based on the situation assessment (Cárdenas & Álvarez, 2022; Cárdenas et al., 2022). To develop communication competencies, researchers suggest using a VR simulator to improve the public speaking skills needed by a future teacher. The researchers also note the capabilities of a virtual environment in receiving real-time feedback and an additional opportunity to overcome the fear of speaking in front of a real audience (El-Yamri et al., 2019).

When creating a VR simulator for training a teacher to accomplish classroom management, a scenario approach (Almazova et al., 2021; Sorin, 2015) was chosen as it provides the situation analyses. This approach helps to consider the consequences of the made decisions and make a choice from the considered alternatives, considering the relationship of scenarios and the safest variant in its development. The scenario approach, which is more often used in strategic planning in management, is now becoming popular in pedagogy and psychology, where personality management is viewed from the perspective of creating a safe environment (Krasnyanskaya & Tylets, 2016).

Purpose and Objectives of the Study

The proposed virtual constructors do not always meet the needs of consumers. Creating own specific applications allows one to constantly expand and improve them. The purpose of the presented study is to show the opportunities of a scenario approach in the development of a VR application to prepare a future teacher for the actions in complicated situations while teaching. The developed constructor of a branching scenario is based on real cases and represents dialogue branches that provide variability of the chosen behavior strategies in the proposed situations of pedagogical interaction.

RESEARCH METHODOLOGY

Approaches and Methods Underlying the Study

The presented study is based on the integration of a program approach to the development of 3D content and a scenario based pedagogical approach. Therefore, the study was designed using ADDIE model in the instructional design approach (Molenda, 2015). Analysis, design, development, implementation, and evaluation are abbreviated as ADDIE. Instructional designers utilize this technique to create successful instructional materials and learning experiences (Nadiyah & Faaizah, 2015). ADDIE model consists of five stages, which are described in the following pages.

ADDIE model (as shown in [Figure1](#)) is a flexible framework that may be applied to the creation of a variety of instructional resources, including online courses and traditional classroom materials. It stresses a systematic approach to generating and delivering successful instructional materials that fit the learners' and organization's needs.

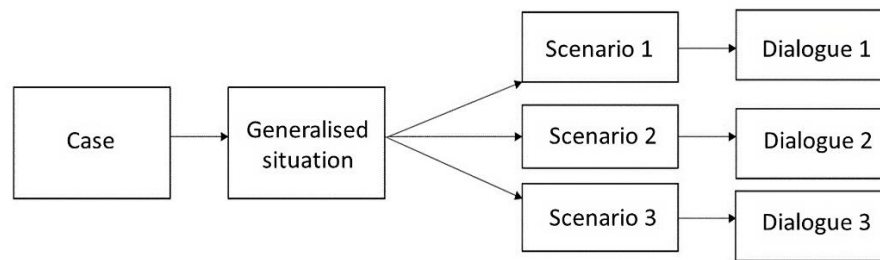


Figure 2. The process of creating scenarios for a generalized situation based on real cases (Source: Authors)

Analysis

This step comprises collecting information about the intended audience, learning objectives, and accessible resources. Included in the analysis is a needs assessment that determines the abilities and information that the learners must gain. The analysis phase also includes the identification of the project's restrictions and limitations.

In this step, literature screening was done, and pre-service teachers and novice teachers were forced to have difficulties with classroom management issues. The results show that pre-service teachers and novice teachers need more training and help with how to run their classrooms. Also, it is suggested that teacher education programs include hands-on experiences and time to think about how to run a classroom. It has been said that teachers do not know enough about how to help students who are acting normally.

Design

Instructional designers utilize the information acquired in the analysis phase to create a strategy for the instructional materials in the design phase. The plan involves the definition of learning objectives, the creation of instructional tactics, and the identification of evaluation measures.

The construction of a situation scenario model was based on real cases developed using the personal experience of young teachers (Figure 2).

The created software is focused on the development of general psychological and pedagogical competencies (in particular, social and communicative) of future teachers; therefore, the authors single out a generalized situation from the case. The final part of the case, based on a real school conflict story, can variably be presented in different branches in order to set different ways of conducting interpersonal interaction. That is, a real case creates a generalized situation with different scenarios containing their own specific dialogues. The choice of a scenario reflects what position a student would choose in a conflict situation. The speed of a correct prediction of the scenario branch by a student, which leads to a "successful" conflict resolution, increases his social and communicative competencies.

Development

At this phase, instructional materials are created based on the design plan. This comprises the creation of content, the selection of media, and the creation of assessments.

In April 2021 at the All-Russian Hackathon Competition "HackEducation: Digital educational innovations", the cross-function team of Kazan Federal University, led by the authors of the study, presented the first joint developments of a VR simulator to prepare a teacher to resolve conflict situations. As part of the graduate thesis supervision, the first cycle of the developed application was tested (Kugurakova et al., 2021). During that stage, an immersive environment was created for organizing a "virtual classroom" with "virtual students". In computer games, there is a stable term NPC- an abbreviation for a non-player controller, so you can call all the virtual students of the virtual class: "NPC student" or "bot student". The bot students were placed in a realistically designed virtual classroom environment and equipped with natural animations, which made it possible to work out the concept of a VR simulator for training social and communicative competencies. In the study (January-May 2022), the work was continued to improve VR simulator: a branching scenario constructor was designed, and specific scenarios with dialogue branches were developed.

Implementation

The educational materials are supplied to the students during this period. This may entail training the teachers, distributing the materials to the students, and offering support as required.

In this stage (September-November 2022), contained a formative experiment. It was organized during the implementation of the course "training in pedagogical conflict management" to test the developed simulator in the process of teaching students about the pedagogical training programs.

Evaluation

This step entails evaluating the educational materials' efficacy and making any required modifications. The assessment comprises measuring the knowledge and abilities of the learners, analyzing the comments from the learners and instructors, and revising the educational materials as appropriate.

It is supposed to operationally include the thought-activity sphere in making behavioral decisions in various situations of complex pedagogical interaction. The research methods were modelling a branching scenario to create the basis for constructing dialogue branches of a VR simulator. This tool was developed in the research laboratory "development of intelligent tools for computer games" of the Institute of Information Technologies and Intelligent Systems of Kazan Federal University (KFU). A formative experiment was organized to integrate VR environment into the educational process of training teachers at the master's programs at the Institute of Psychology and Education of KFU.

Data Analysis

The examination of the scenarios that were produced during the design phase included the solicitation of the opinion of experts. It has been assessed by professionals who have at least a PhD and work in the field of educational sciences and pedagogy. Each scenario was given a score of one (insufficient), two (partially adequate), or three (sufficient) based on how relevant it was, how realistic it was, how clear it was, how complex it was, how authentic it was, how much feedback it provided, how engaged it made the learner, how adaptable it was, and how effective it was.

During the implementation phase, a questionnaire was used so that the participants could compare the application and the materials. The questionnaire items asked for rankings of the text, video, and VR technologies used in each item. They were asked to rank, as follows: 3 highest, 2 partially, and 1 least. Most of the data were interpreted by calculating the averages according to the items.

RESULTS

Analysis

Many studies (Anindya et al., 2020; Dicke et al., 2015; Koptelov et al., 2015; Sabirova, 2015) reveal that teachers have difficulties in classroom management. In the face of these difficulties, fatigue occurs in teachers.

It has been noted that these procedures occasionally result in teacher resignations. Therefore, it is crucial to equip teachers with the necessary skills and knowledge to effectively manage their classrooms and create a positive learning environment. Additionally, ongoing professional development opportunities should be provided to support teachers in enhancing their classroom management strategies.

The idea of creating a VR application used in training teachers arose from the analysis of the collected "cases" - materials of real conflict situations between teachers and students in the schools of Tatarstan, collected by undergraduates during teaching internships. A structural analysis of those cases of young teachers conducted in 2020 (October-December) showed that most of them have difficulty choosing a behavior strategy in a complicated situation of pedagogical interaction. The arose problems were associated with the insufficient skill to quickly respond to emerging dynamic situations of interpersonal interaction. The search for effective options for the development of conflict management competency made it possible to define a virtual environment as one of the means that can improve the quality of education.

Design

In the framework of our study, the scenario approach makes it possible to provide the realism of interaction conditions, where the personal characteristics of both a student and a teacher influence the analysis of the situation and the decision-making on the chosen strategy of behavior. As a result of choosing the answer option, a student (playing the role of a teacher) receives an emotional response from the bot student, reflecting how a real student with the same emotional type would react to the proposed teacher's behavior pattern.

Content of Classroom Management Scenarios Using Virtual Reality

Several cases are considered below and the process of designing branching scenarios, based on these cases, is presented.

Case 1

"A boy named Anton is studying in the 6 "A" grade. He is diligent, studies with pleasure, receives excellent grades. His knowledge is much broader than the school curriculum. The student reads a lot, finds information on the Internet himself, and asks a lot of questions in class. Often, Anton's knowledge surpasses the knowledge of teachers, and he asks teachers provocative questions, demonstrating his intelligence. So, trying to impress the teacher Aigul Aydarovna, Anton shone in the geography lesson. However, the teacher took it as Anton's attempt to discredit her in front of his classmates. So, at the next attempt of the student to show off extra information on the topic, she rudely interrupted him, considering such behavior unacceptable, made a severe remark, reprimand him in a raised voice. There was no momentary continuation of the conflict, Anton did not immediately answer the teacher, however, as it turned out, he was pretty offended, and later began to openly show a negative attitude towards Aigul Aydarovna, although he continued to study geography diligently. Subsequently, the parents and the whole class, who sided with Anton, got involved in the situation. The teacher refused to teach in this class and subsequently resigned."

We can single out *the beginning* of this case, omitting its ending: during a geography lesson, the student decides to show "super knowledge", asks the teacher provocative questions, trying to impress with extra information.

Thus, *the generalized situation*: the student asks a lot of questions, interrupts, it seems that he wants to undermine the authority of the teacher.

Further, on the basis of modelling the conditions for this situation developing, dialogue branches are designed. A student, who is in the position of the teacher, must decide how he will act in this or that case.

Situation modelling is based on a generalization that assumes that bot students, involved in scenario development, are the participants of the learning process. At the same time, the dialogue branches are based on the fact that the degree of cognitive interest varies in different students. Thus, bot student 1 is characterized by a high degree of independence and perseverance in obtaining knowledge. Bot student 2 is characterized by an interest in understanding the relationships between the essences of phenomena and processes. Bot student 3 shows a low interest in deepening knowledge and seldom asks questions "how? and why?" The voice activation of a student playing the role of a teacher gives him the opportunity to feel like in a real classroom at the lesson of a chosen subject, and developers, on the one hand, have the opportunity to unify the application, and on the other hand, personalize it depending on the user's learning profile.

Building dialogues for the 1st case:

Teacher: Today we will talk about ...

Student 1: I have already read about it, let me tell you myself ...

Student 2: Who needs it? How can this be useful in life? ...

Student 3: There is no need to talk to you, everything you say, we can read in the textbook or find it on the Internet.

Teacher's responses to *student 1*:

- You are not alone in the class, let others listen.
- Do not disturb the lesson, when I finish the explanation, you can add something if there is time.
- Well done, it's good that you have such a wide range of interests. Let's try to explain a new topic to everyone together.
- Are you kidding me?! Do not interfere with the lesson, do not interrupt the teacher.
- It's good that you already know this topic, you will help to understand it those who will not have enough of my explanation or those who do not understand.

Teacher's responses to *student 2*:

- Do not ask stupid questions, since the program has it, then you need to study it.
- Let's try to understand the practical value of this issue together.
- Maybe I agree with you, but we must master the program, and this is in the tasks of the Unified State exam.
- Let's not waste time discussing empty questions.
- Think about it yourself and tell me at the next lesson.

Teacher's responses to *student 3*:

- To understand it yourself, first learn to basically understand what you have read.
- Okay, let's work with the textbook. I will write the questions on the board, and you will find the answers in the paragraph.
- How smart everyone is! (with sarcasm) ... Well, let's continue the lesson.
- I do not insist, you can mind your own business.
- Okay, you'll be in charge of preparing the material for the next lesson.

Thus, scenario 1 will contain the choice of one of the response options of the teacher to student 1, scenario 2 will contain the choice of one of the response options of the teacher to student 2, and so on.

Case 2

"7 "B" grade student Veronika Lisina has low grades in mathematics. She does not like the subject itself, and the teacher: Veronika is often rude with her and shows intemperance and irritability in communication. Veronika's behavior in mathematics lessons can be demonstrative and interfere not only with the teacher, but also with her classmates. At one of these lessons, the girl distracted other students from completing assignments by throwing pieces of paper at classmates. Veronika did not respond to the teacher's remarks and calls for educational work. The young teacher Irina Nikolaevna demanded from Veronika to leave the classroom. The girl remained seated, ignoring teacher's demand. The young teacher was not able to continue the lesson, deciding to conduct it in extra time after all lessons, which, of course, led to the dissatisfaction of the whole class."

Highlighting *the beginning* of this case: during the lesson, the student disturbs classmates in completing assignments, does not respond to the teacher's remarks.

Generalized situation: the student shows negative behavior towards the teacher during the lesson.

The modelling of this situation is based on the generalization that both students demonstrate destructive behavior in the learning process, while the dialogue branches are based on the fact that the degree of maladaptation varies for different students. Both student 1–active resistance, with the manifestation of demonstrative negative behavior, both student 2–sarcasm, grandstanding, both student 3–silent demonstrative requirements non-compliance.

Building dialogues for the 2nd case:

Teacher: Today we have to complete the following task.

Student 1: We need it like a hole in the head (hitting the front sitting person with the ruler, and throwing paper on the next row) ...

Student 2 (addressing classmates): Well, as usual, no explanation, only assignments. I'll show "my best" now, better give me the bad mark right away.

Student 3: I do not care (sits with headphones or lies with his head on the desk, pretends to be asleep).

Teacher's responses to *student 1*:

- If you do not need it, do not do it, but do not interfere with others. Otherwise, I'll take you to the Head of the school.
- Get out of class. I will not let you go to class again until your parents come.
- If do you want to get a bad mark, please sit quietly.
- If you do not want or can not do the task, I'll give you an individual one, just for you.
- I offer you to not complete this task, but act as an inspector, evaluating the work of your classmates.

Teacher's responses to *student 2*:

- If you want a bad mark for the task, then get it. And if you do not calm down, you will get the bad mark for the term.
- You will not scare me so easily, go to the board and show "your best", we'll all laugh together.
- Okay, tell me what you do not understand. Let me explain again.
- Stop clowning around and do something if you do not want to complete the task–sit quietly.
- Come to the board and show what moments cause difficulties and why, we will look for answers together.

Teacher's responses to *student 3*:

- I do not care either. With this attitude, I'm not going to certify you.
- Why do you have such an attitude, you are not interested, or you did not understand the topic? Or did something else happen?
- Well, if the student sits quietly, then let him sit, he does not interfere with anyone.

- Then listen to an audiobook or read something, you will get at least some benefit from being in the class.
- Try to complete the task as quickly as possible, and you will have time for your personal studies.

Case 3

"A student of the 8 "B" grade Alexander Slavichev studies with good and excellent marks. He especially likes STEM subjects. But one day, at a math lesson, when explaining a new topic, Alexander was very inattentive, was glued to the phone and interfered with the teacher, openly showing his emotions. A well-experienced teacher, Elena Vladislavovna, made comments to Alexander several times and asked him to listen carefully. The teacher warned all the children that at the next lesson they will have a test, but Alexander continued to go about his business. Alexander got a bad mark for the test. The teacher decided that he copied the work from a neighbor, since the solutions were the same. Seeing an unsatisfactory grade, Alexander began to scream and rail at the teacher, proving that he did not cheat. Elena Vladislavovna threatened to call his parents to school. Alexander continued to challenge the mark and inveigh against the teacher. She suggested that Alexander rewrite the test. The student agreed. After writing the second test Alexander got the good mark. The conflict was resolved. Further on, Alexander was not distracted."

Highlighting *the beginning* of the case: having received an unsatisfactory mark for the test, Alexander began to shout and inveigh against the teacher, proving that he did not cheat.

Generalized situation: the student expresses dissatisfaction with the mark received for the test.

The modelling of the situation is based on the generalization that bot students are dissatisfied with the test results, while the reasons for dissatisfaction among different students are different. Bot student 1–compares his test results and the mark with the results and marks of other students, bot student 2–believes that the teacher is biased towards him, bot student 3–believes that the received mark is lower than his real knowledge:

Building dialogues for the 3rd case:

Teacher: You all have already seen the marks that I gave you for the test on the topic ..

Student 1: Why do I have "satisfactory", but Alexander got "good", if the number of mistakes we have is the same.

Student 2: It could not watch: you never put me higher than "satisfactory", because I'm not your favorite student.

Student 3: I was preparing for the test with a tutor, and essentially everything is correct in my test, you are just nit-picking and lowering the mark.

Teacher's responses to *student 1*:

- There is nothing to compare, I know better. The teacher's grades are not discussed, since I gave you "satisfactory", it means there were reasons on that.
- Come to me both with your tests after the lesson, we will figure it out.
- The number of errors may be the same, but they differ qualitatively. There are criteria that I can introduce you to.
- Well, ok, I will correct your mark from "satisfactory" to "good".
- Oh, not my business. I have already put the marks in the class-book. Do better next time.

Teacher's responses to *student 2*:

Table 1. Evaluation of scenarios

Evaluation dimensions	Case 1	Case 2	Case 3
Relevance	3.00	2.75	3.00
Realism	2.75	3.00	3.00
Clarity	3.00	2.75	2.75
Complexity	2.75	2.75	3.00
Learning objectives	3.00	2.75	2.75
Authenticity	2.50	2.75	2.50
Feedback	3.00	2.75	3.00
Engagement	3.00	3.00	2.75
Adaptability	2.75	3.00	3.00
Effectiveness	2.75	3.00	3.00

- I do not have to like anybody, my job is to teach and evaluate.
- I treat everyone equally, so that you do not have such an opinion about me, I will allow you to rewrite the test, but only for you.
- Like-dislike - these are all abstract categories, they are not relevant to the case.
- Let's build a working relationship. Come after all the lessons, and we will work on the mistakes together.
- I want to understand why you think my attitude towards you is biased. Stay after lesson, we'll try to figure it out.

Teacher's responses to *student 3*:

- Then let the tutor give you marks.
- We have evaluation criteria, and I focus on them.
- I admit that there was little time, or you were worried and could not fully reveal your knowledge. If so, I'll up the mark.
- I offer you to complete another similar task, and I will put an additional mark for it.
- Okay, I'll give you an advanced test assignment on this topic and you will have the opportunity to correct your mark.

With a new passing of a situation embedded in the branching scenario, random bot students with different emotional profiles are selected. The more options will be included in the branches of the generalized scenario, the more interesting it is to observe the response time of the student (playing the role of the teacher) when assessing the emotional type of the conflict presented to him by another bot student.

As shown in **Table 1**, in cases 1 and 3, the situations were assessed as extremely relevant, with a score of 3.0. In example 2, the scenario was still deemed pertinent, although it received a significantly lower grade of 2.75. In cases 2 and 3, the scenarios were assessed as extremely realistic, with a score of 3.0. In example 1, the situation was still deemed plausible, although it received a somewhat lower grade of 2.75. Case 1 scenarios had the highest rating of 3.0 for clarity, followed by cases 2 and 3, each of which received a grade of 2.75. Case 3 was evaluated as having the most complicated circumstances, with a score of 3.00, followed by cases 1 and 2, each with a score of 2.75. The situations in case 1 were ranked highest in terms of satisfying the learning objectives, with a score of 3.00, followed by cases 2 and 3, which each received a score of 2.75. Case 2 scenarios were evaluated as the most authentic, with a score of 2.75, followed by cases 1 and 3, each of which received a score of 2.50. In terms of offering input, the situations in cases 1 and 3 received the highest rating of 3.00, followed by case 2 with a rating of 2.75. Cases 1 and 2 received a rating of 3.00 for their very engaging scenarios, while case 3 received a grade of 2.75. Cases 2 and 3 were evaluated as the most adaptable, with a score of 3.00, followed by case 1 with a score of 2.75. Cases 2 and 3 were deemed the most

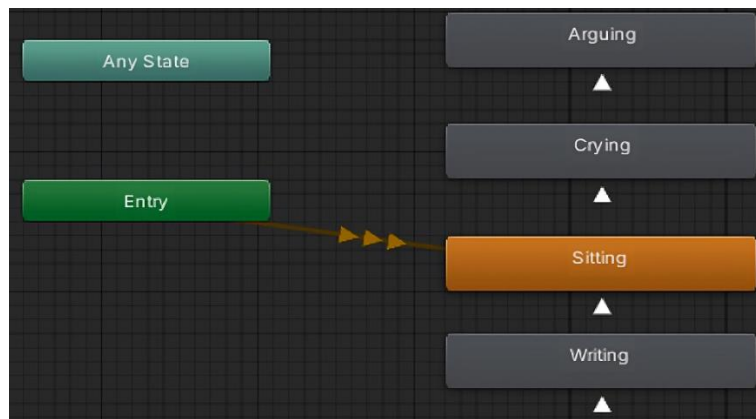


Figure 3. Animation tree (Source: Authors)

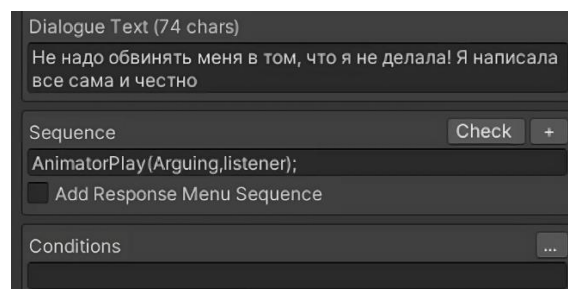


Figure 4. Changing the animation based on the selected response (Source: Authors)

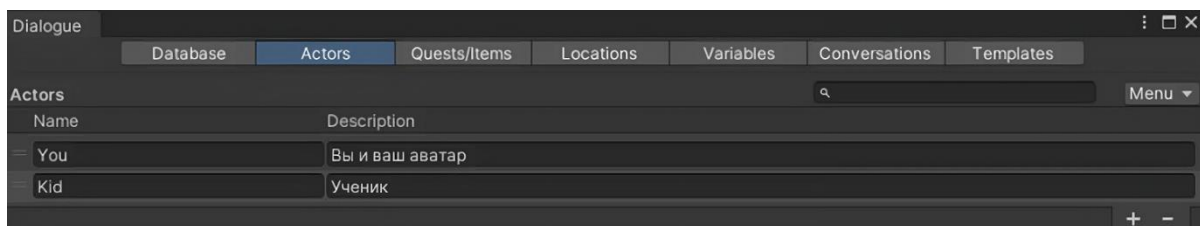


Figure 5. Roles tab (Source: Authors)

effective, with a score of 3.00, while case 1 received a score of 2.75. Overall, the results indicate that the three scenarios received positive ratings for their relevance, realism, learning objectives, feedback, engagement, flexibility, and efficacy. Yet, the ratings for specific criterion varied, with some situations performing better than others.

Development

Stages of programming a virtual reality simulator

When developing bot students (NPC), the character editor “Character Creator” (Character Creator, 2022) was used for modelling. The character described in the case served as the basis for developing the appearance and clothing options

To obtain character animation (Figure 3), IpiSoft Recorder (IpiSoft Recorder, 2022), and Mocap Studio (Mocap Studio, 2022) were used. The developed animations were applied to models of characters in Maya (Autodesk, 2022).

When playing out dialogues, different character animations are used. Their settings are designed in the internal constructor of VR simulator (Figure 4): after selecting the dialogue branch, the required character animation is activated.

To develop a system of dialogues, the “Dialogue System for Unity” library was used. It sets roles, names, brief descriptions, and detailed characteristics for characters (Figure 5).



Figure 6. Scheme of dialogue utterances for one of the cases (Source: Authors)

Dialogue Entry	
ID	16
Title	
Description	
Actor	You [1]
Conversant	Kid [2]
Group	
Menu Text (20 chars)	Ты еще спрашиваешь!?
Dialogue Text (71 chars)	У тебя еще хватает совести спрашивать? Вся контрольная списана у соседа
Sequence	Check +
Add Response Menu Sequence	
Conditions	...
False Condition Action	Block
Script	Variable["Competing"] = Variable["Competing"] + 1
Events	
All Fields	
Links To:	(Link To)

Figure 7. Utterance parameters window (Source: Authors)

To create dialogue branches, the corresponding tab is used, where you can configure and create separate utterances (Figure 6).

For each dialogue utterance, you can fine-tune the parameters by adding conditions for its selection, specifying the events that will occur after the selection, or which scenario will be activated (Figure 7).

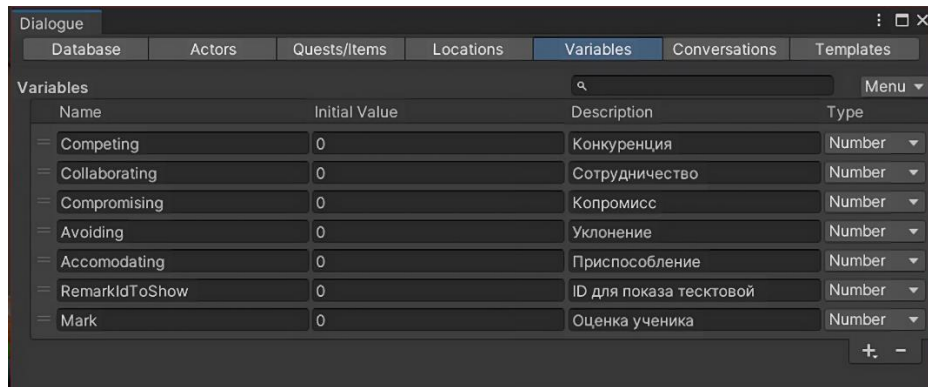


Figure 8. Variables tab (Source: Authors)



Figure 9. Virtual classroom (Source: Kugurakova et al., 2022)

To assess the correctness of the behavior demonstrated by a student while playing the teacher in a particular conflict situation, we developed a model on the basis of the Thomas Kilmenn Conflict Mode Instrument (TKI). The participant should choose the closest options that best describe his behavior in the conflict. The Instrument reflects a person's propensity for one of the ways to resolve the conflict. To describe the model, we created five main characteristic variables. These variables change when the type of strategy selected by the user is chosen (Figure 8).

To make the immersion more realistic there were used natural and artificial light sources, settings for the components of the environment effects, specular maps, and other post-processing elements (Figure 9).

The next stage in the development of the simulator involves expanding the number of conflict scenarios and options for the ramification with different consequences of choices. The branches of each conflict development should be ideally modelled based on the psycho-types of the NPCs. A truly immersive environment should not involve simplifications, and therefore, it is necessary to move from simple situational tasks to more complex ones. This means that it is necessary to include the simulation of emotional influence from other students who present during the Teacher-Student conflict, and emotional influence on them, and, therefore, generation of new pre-conflict situations. That is, include the influence of the emotional response of the class into the dialogue between the student playing the role of the teacher and the virtual bot student, as this dialogue does not take place in a vacuum. The current conflict can be complicated both by the previous background of the student's behavior, which generates an emotional response from other students in the class, and by the attitude of the class towards the teacher. How to fix rather than aggravate the situation?

How to set new rules for communication in the classroom, levelling the previous unsuccessful relationship format? How not to cause a burst of disagreement among the rest of the students in the virtual class? To do this, it is necessary to complicate the dialogue system by adding different reactions of other students depending on the initiating attitudes and their behavior patterns, based on the typology of Scott (1994). Her typology includes "steamroller"/"Sherman tank", "the undercover attacker"/"sniper", "the angry child"/"exploder", "the complainers", "the quiet clams and silent type", "the super-agreeable". If we add to the system of dialogues a description for each student its indirect influence on the behavior of the conflict protagonist, and also refine the virtual simulator with animations that arise according to the emotional response to the circumstances, then immersion in learning will be enhanced. Then it will be possible to describe more complex conflict situations than those described above.

In addition, the conflict situation can be complicated by additional conflicts running in parallel: for example, when the conflict fits both into the main work of the teacher who is presenting new material and in the knowledge evaluation, or when several conflicts develop simultaneously.

Implementation

In the formative experiment students of different master's programs in the field of teacher training were involved: environmental and geographical education, chemistry education, historical and social science education, biological education, life safety education, etc. When organizing an experiment on integration VR environment into the educational process of training teachers at the above-mentioned master's programs, three various digital learning content tools were used. During the "training in pedagogical conflict management", students were offered to solve cases placed in the digital educational resource "pedagogical conflict management" (Digital Educational Resource of KFU, 2022) on the Moodle platform. The content itself was presented in two formats (text-test and video-test), and the solution of the conflicts were performed using VR simulator with the HTC Vive Focus Plus VR headset and the developed software product. After completion of the course, students were asked to give feedback on the effectiveness of the use of digital tools in the educational process (Khamraeva & Golovanova, 2022).

Evaluation

We received feedback from 173 respondents. The results of the answers are presented in the form of a matrix of weighted criteria (Figure 10), where 1 is the lowest characteristic of the criterion, and 3 is the highest. When the amount of information needed to master the topic is examined, the participants think that text materials require more information, with an average score of 2.4. While 99 of the participants think that texts require more information, 25 people think that videos require more information, and 49 people think that VR requires more information. Regarding the second item, "amount of time spent on training", the participants think that VR materials take more time, with an average of 2.4. 102 participants think that VRs spend more time on education. While 47 people gave 3 points for the video, 24 people gave 3 full points for the text. The participants may have thought this way because different skills are needed to prepare for VR.

For the third "emotional component" question, participants indicated, on average, the greatest number of VR items, with a mean of 2.7. Whereas 137 participants awarded 3 points to VR emotional component, 24 participants awarded 3 points to the video and 12 points to the text. The participants' perception of themselves as a participant in the process, as opposed to a passive observer, may have contributed to their perception that VR emotional component was more prominent. On the fourth visual perception question, they reported that, on average, the visual perspectives of the films were 2.5 points higher. In this item, 111 individuals awarded perfect scores to the video, 44 to VR, and 18 to the text. Instructors thought the videos to be more aesthetically appealing. That might be owing to the video content's high visual component.

With an average score of 2.5 on the fifth criterion, "simplicity and accessibility for understanding," VR came out on top as the best option. 103 individuals awarded full points. The results of the poll showed that 13 individuals provided full points for the video, while 57 people gave full points for the written contents. The participant's ratings indicated that the contents of VR experience were easier to grasp. VR comes out on top in the sixth category, which is titled "applicability of the experience gained in practice," with an average score of 2.5, followed by video and text. It is essential, in terms of training, to instruct participants on the importance of considering usability as a teacher of their VR experiences.

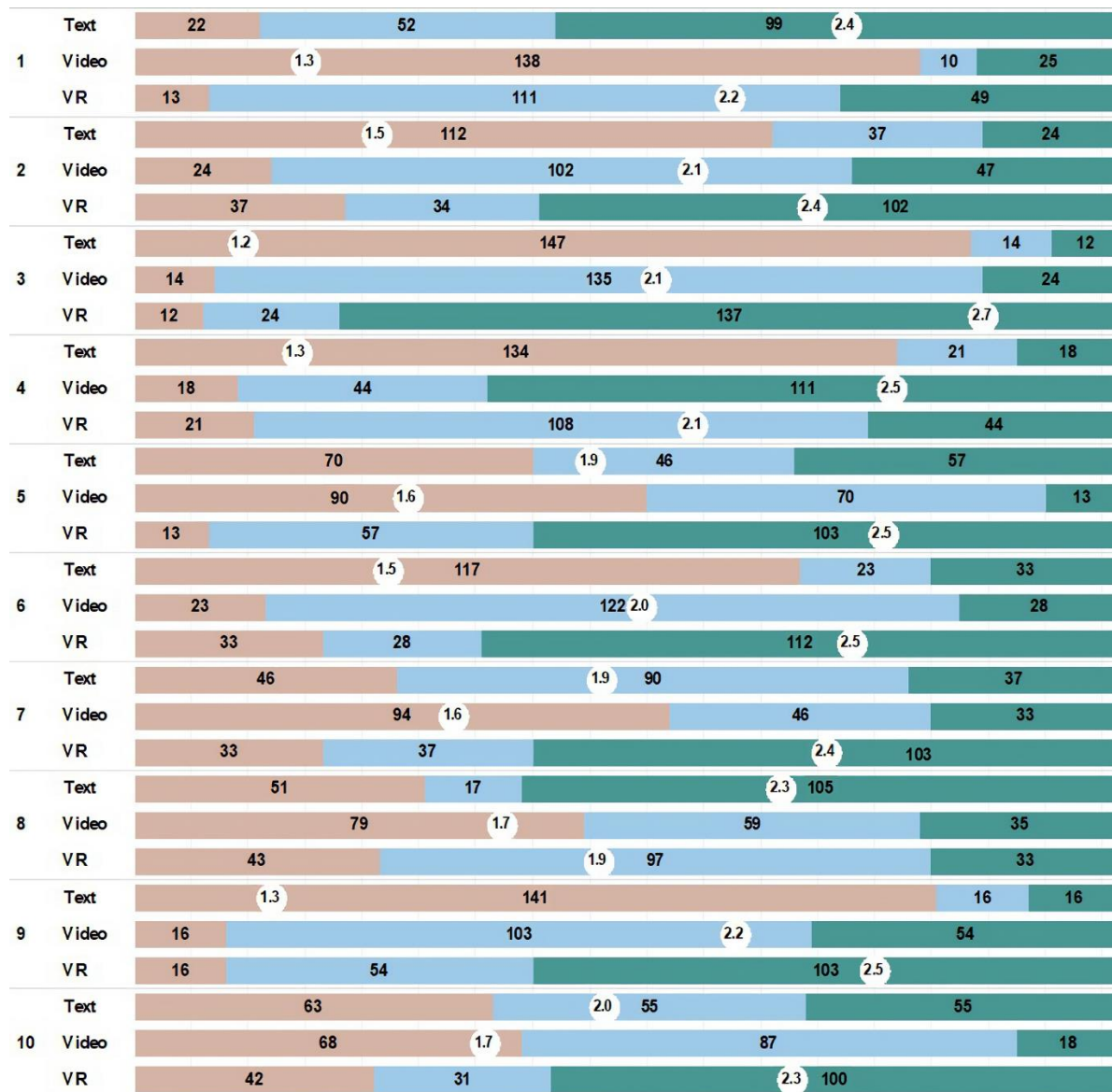


Figure 10. Chart based on evaluation of used materials (number in bar is number of participants that select order of text, video, & VR & number in circle is average of calculated grade for each material) (Source: Authors)

They have an average score of 2.4 on the seventh item, which is efficiency in the development of competency, and they believe that they are competent in the process of generating VR content. After that comes the video and the text. The participant’s awareness may have been raised as a result of the instructor’s background in VR creation and the priority they placed on the topic during the course. Text materials are in first place with an average score of 2.3 when it comes to the ninth criterion, which is titled “simplicity and accessibility in the structure and implementation of training.” The participants believe that the typical school, where they would be working will not provide them with the possibility to use additional video and VR technology tools.

VR comes in first place with 2.2, video comes in second, and text comes in third with 1.3 on the ninth item, which is titled “increasing students’ interest and enthusiasm for studying.” The average score for this item is 2.5. Participants believe that VR pupils will have higher levels of motivation and will draw more attention from students. It’s possible that the fact that it’s interactive and enjoyable for all of the senses plays a role in its popularity. When it comes to the tenth category, “feedback,” VR is now in first place with a score of 2.3, followed by text in second place and video in third place. It has been hypothesized that the participatory nature of VR results in a greater amount of feedback.

When the overall ideas of the participants are analyzed, it is found that the majority of them believe that learning and utilizing VR technologies takes a lot of time, despite the fact that they regard these technologies as being more successful. As VR creation tools grow simpler and more widely available, skeptical beliefs will shift. But it will take the user some time to become proficient in the technology. On the other hand, while it is a favorable situation for them to regard themselves as competent in practice, it may be considered as a challenge for institutions to think that they cannot attain these chances. This is because seeing themselves as competent in practice is a positive situation for them.

DISCUSSION

The study is predicated on two hypotheses. The utilization of scenario-based learning settings in teacher education is our first premise. Our second fundamental assumption is that VR technologies are utilized effectively in teacher education. This research was utilized in a theoretical framework using ADDIE, one of the instructional designs that combines both subjects. ADDIE model has been used in the development of many technology-based educational materials. For example, the ADDIE model was used to develop learning activities for second-life, which is a VR environment (Kwei Wang & Yin Hsu, 2019). ADDIE model was also used in an intelligent VR interactive system for learning pour-over coffee brewing (Yu et al., 2021) and teaching augmented reality learning media for the kinetic theory of gases (Gusmida & Islami, 2017).

On the basis of the ADDIE paradigm, a needs assessment was done with instructors. On the basis of the information acquired from the interns and the assessment of the relevant literature (Adams et al., 2022; Anindya et al., 2020; Karagianni et al., 2023; Susiyowadi et al., 2021), it was decided that the teachers need classroom management training. After finishing the model's analytical phase, the design phase commenced. In accordance with the concepts of scenario-based education (Hursen & Fasli, 2017), useful classroom management scenarios have been developed at this level. Experts have assessed these cases. The scenario analysis revealed that the three scenarios earned positive evaluations for their relevance, realism, learning objectives, feedback, engagement, adaptability, and effectiveness. Nonetheless, evaluations for certain categories varied, with some scenarios receiving higher marks than others. Scenario-based learning activities are used effectively in both pre-service and in-service teachers training (Klassen et al., 2021). The scenarios created will enable the participants to cope with difficult situations that they may possibly encounter (Pedro et al., 2019).

In the third phase of design, VR technology was integrated. The scenarios created in the previous phase were implemented, and VR-based virtual worlds were created. VR provides users the sensation of being immersed in a three-dimensional world and the ability to move as if in a spatial reality (Lee & Shea, 2020). The implementation of a VR training simulator in the education process of teacher training would assist students in preparing for complicated circumstances of interaction under real-world settings, therefore reducing the risk of injury caused by instructors' mistakes (Kugurakova et al., 2021; Lee & Shea, 2020; Nousiainen et al., 2022).

At the fourth application round for "training in pedagogical conflict management," master's students submitted an application. Participants also investigated the usage of video and textual content in VR. At the conclusion of the term, an assessment scale was utilized as a source of data for the evaluation phase. In addition to being the final stage of ADDIE process, the assessment phase provides a comprehensive evaluation of the generated product. Examining the general opinions of the participants reveals that they believe learning and deploying VR technologies is time-consuming, despite their belief that they are more successful. As VR creation tools grow simpler and more widely available, negative perceptions will shift, as it will take the user time to understand. On the other side, while it is a positive sign that they view themselves as competent in execution, it may be problematic for institutions to believe that they are incapable of achieving these prospects. In the study by Lee and Shea (2020), pre-service primary teachers were trained using VR. During the evaluation, 63.2% of the participants mentioned the annoyance they had at the start of the task since they were accustomed to step-by-step exercises. Several pre-service instructors reported having difficulty with the use of VR. Most of the participants expressed that their motivation is increased in VR learning activities and have good experience (Cooper et al., 2019; Kustandi et al., 2019).

CONCLUSIONS

The integration of the developed VR simulator into disciplines focused on developing the skills to manage complex situations of pedagogical interaction can increase the acquisition of practical experience by students. It can also allow and correct erroneous actions without violating the comfort and safety of the learning environment.

The analysis of various complex situations that arise in pedagogical interaction made it possible to compile packages of cases that were used in the development of the scenario constructor. The effectiveness evaluation of the presented VR simulator prototype was based on testing the product on a control group of students studying in various pedagogical training programs. Further development of the project will make it possible to fully implement an innovative solution for using our own software product in teacher training.

VR-assisted learning has already proven to be effective for vocational education and training. VR technologies make it possible to achieve educational results in a short time and to form and develop individual components of competencies related to practice. The number of attempts to master problem solution competency can be conditionally endless as VR-learning is available 24/7. It can be confidently concluded that VR will become a major part of the educational environment in the near future.

In addition to solving the pedagogical tasks the higher school faces in teacher training, the presented project sets tasks, which solution should serve the development of VR technology. Namely we speak about creation and development of an imitation of a complex communication environment, including both verbal signals and non-verbal reactions that create an emotional background of the situation. Creating bots with reactions (facial expressions or other emotional signals) as close as possible to the reactions of a people with different psycho-types is a separate task. The solution of this task can be used in other areas, including training of other specialists. The created tool is aimed at the development of conflict management and sociolinguistic competencies, which are considered to be a part of social and communicative competencies belonging to the group of universal or basic (soft skills). Nowadays soft skills are mandatory for all programs of training specialists in higher education.

The integration of VR technology into the training process of higher education requires close interdisciplinary interaction of specialists: both researchers in the field of pedagogy and psychology of higher education, and researchers in the development of computer graphics, computer games, and VR.

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REFERENCES

- Abazi-Bexheti, L., Kadriu, A., & Apostolova, M. (2022). Research on VR/AR integration in education. In *Proceedings of the 45th Jubilee International Convention on Information, Communication and Electronic Technology* (pp. 563-567). <https://doi.org/10.23919/MIPRO55190.2022.9803398>
- Adams, T., Koster, B., & den Brok, P. (2022). Student teachers' classroom management during the school internship. *European Journal of Teacher Education*, 45(5), 727-745. <https://doi.org/10.1080/02619768.2020.1860011>
- Almazova, N., Rubtsova, A., Kats, N., Eremin, Y., & Smolskaia, N. (2021). Scenario-based instruction: The case of foreign language training at multidisciplinary university. *Education Sciences*, 11(5), 227. <https://doi.org/10.3390/educsci11050227>
- Anindya, A. A., Anisa, A. P. N., & Akmal. (2020). The strategies of novice teachers' in the large class management. *Eduvelop: Journal of English Education and Development*, 3(2), 73-81. <https://doi.org/10.31605/eduvelop.v3i2.603>
- Autodesk. (2022). *Autodesk program*. <https://www.autodesk.ru/products/maya>

- Borisova, E. S. (2017). The problem of conflict management competency in the space of a general educational organization. *Social, Humanitarian, Medical and Biological Sciences*, 19(2-1), 28-32.
- Cárdenas, M. M., & Álvarez, I. M. (2022). Immersive virtual reality environments: A proposal to enhance preservice teacher's communicative competences. In *Proceedings of the International Conference on Advanced Learning Technologies* (pp. 408-410). <https://doi.org/10.1109/ICALT55010.2022.00126>
- Cárdenas, M. M., Álvarez, I. M., Romero, A., & Manero, B. (2021). Teacher training proposal for classroom conflict management through virtual reality. In *Proceedings. IEEE 21st International Conference on Advanced Learning Technologies* (pp. 373-375). <https://doi.org/10.1109/ICALT52272.2021.00120>
- Character Creator. (2022). *Character creator program*. <https://www.reallusion.com/character-creator>
- Chorosova, O. M., Aetdinova, R. R., Solomonova, G. S., & Protodyakonova, G. Y. (2020). Conceptual approaches to the identification of teachers' digital competence: Cognitive modelling. *Education and Self Development*, 15(3), 189-202. <https://doi.org/10.26907/esd15.3.16>
- Cooper, G., Park, H., Nasr, Z., Thong, L. P., & Johnson, R. (2019). Using virtual reality in the classroom: Preservice teachers' perceptions of its use as a teaching and learning tool. *Educational Media International*, 56(1), 1-13. <https://doi.org/10.1080/09523987.2019.1583461>
- Dicke, T., Elling, J., Schmeck, A., & Leutner, D. (2015). Reducing reality shock: The effects of classroom management skills training on beginning teachers. *Teaching and Teacher Education*, 48, 1-12. <https://doi.org/10.1016/j.tate.2015.01.013>
- Digital Educational Resource of KFU. (2022). *Digital educational resource*. <https://edu.kpfu.ru/course/view.php?id=3288>
- El-Yamri, M., Romero-Hernandez, A., Gonzalez-Riojo, M., & Manero, B. (2019). Emotions-responsive audiences for VR public speaking simulators based on the speakers' voice. In *Proceedings of the IEEE 19th International Conference on Advanced Learning Technologies* (pp. 349-353). <https://doi.org/10.1109/ICALT.2019.00108>
- Gusmida, R., & Islami, N. (2017). The development of learning media for the kinetic theory of gases using the ADDIE model with augmented reality. *Journal of Educational Sciences*, 1(1), 1. <https://doi.org/10.31258/jes.1.1.p.1-10>
- Hursen, C., & Fasli, F. G. (2017). Investigating the efficiency of scenario based learning and reflective learning approaches in teacher education. *European Journal of Contemporary Education*, 6(2), 264-279. <https://doi.org/10.13187/ejced.2017.2.264>
- IpiSoft Recorder. (2022). *IpiSoft recorder program*. <https://www.ipisoft.com/download/>
- Jose, E. G. (2021). Virtual reality and education. *Journal of Modern Foreign Psychology*, 10(3), 68-78. <https://doi.org/10.17759/jmfp.202100002>
- Kanbul, S., Zaitseva, N. A., Ikonnikov, A. I., Kalugina, O. A., Savina, T. N., & Evgrafova, O. G. (2020). Determining expert opinions of the faculty of education on the development of distance learning course. *International Journal of Emerging Technologies in Learning*, 15(23), 52-62. <https://doi.org/10.3991/ijet.v15i23.18783>
- Karagianni, E., Papadaki, A., Karabatzaki, Z., & Driga, A. M. (2023). The teacher's key role in the challenge of the effective classroom management. *Research, Society and Development*, 12(2), e20412240054. <https://doi.org/10.33448/rsd-v12i2.40054>
- Kavanagh, S., Luxton-Reilly, A., Wuensche, B., & Plimmer, B. (2017). A systematic review of virtual reality in education. *Themes in Science and Technology Education*, 10(2), 85-119.
- Khamraeva, A. S., & Golovanova, I. I. (2022). The advantage of virtual situational tasks in the development of conflict management competences. In *Proceedings of the All-Russian Scientific and Practical Conference* (pp. 356-361). Kazan University Press.
- Klassen, R. M., Rushby, J. V., Maxwell, L., Durksen, T. L., Sheridan, L., & Bardach, L. (2021). The development and testing of an online scenario-based learning activity to prepare preservice teachers for teaching placements. *Teaching and Teacher Education*, 104, 103385. <https://doi.org/10.1016/j.tate.2021.103385>
- Koptelov, A., Maninger, R., Sullivan, S. L., & Williams, P. (2015). A comparison of classroom management: A study of American, Russian, and Turkish schools. *Journal of Universality of Global Education Issues*, 2, 1-8.
- Krasnyanskaya, T. M., & Tylets, V. G. (2016). Possibilities of the scenario approach in designing the psychological safety of a person. *Psychologist*, 4, 67-78.

- Kryukova, N. I., Chistyakov, A. A., Shulga, T. I., Omarova, L. B., Tkachenko, T. V., Malakhovsky, A. K., & Babieva N. S. (2022). Adaptation of higher education students' digital skills survey to Russian universities. *EURASIA Journal of Mathematics, Science and Technology Education*, 18(11), em2183. <https://doi.org/10.29333/EJMSTE/12558>
- Kugurakova, V. V., Golovanova, I. I., Shaidullina, A. R., Khairullina, E. R., & Orekhovskaya, N. A. (2021). Digital solutions in educators' training: Concept for implementing a virtual reality simulator. *EURASIA Journal of Mathematics, Science and Technology Education*, 17(9), em2008. <https://doi.org/10.29333/ejmste/11174>
- Kugurakova, V. V., Golovanova, I. I., & Kazakov, A. D. (2022). Redaktor scenarijev VR trenazhera dlya obucheniya pedagogov razresheniyu konfliktnyh situacij (English: Script editor VR simulator for training teachers to resolve conflict situations). *Certificate of state registration of software* № 2022684299, Russian Federation. Applicant and copyright holder Fed. state autonomous educational institution of higher education. Kazan federal university - No. 2022683953; application. 06.12.2022; registered in Computer Software Register 138.12.2022.
- Kustandi, C., Ibrahim, N., & Muchtar, H. (2019). Virtual reality based on media simulation for preparing prospective teacher education students. *International Journal of Recent Technology and Engineering*, 8(1C2), 399-402.
- Kwei Wang, S., & Yin Hsu, H. (2019). Using the ADDIE model to design second life activities for online learners. *TechTrends*, 53(6), 76-81. <https://doi.org/10.1007/s11528-009-0347-x>
- Kwok, A. (2021). Managing classroom management preparation in teacher education. *Teachers and Teaching: Theory and Practice*, 27(1-4), 206-222. <https://doi.org/10.1080/13540602.2021.1933933>
- Lee, C. K., & Shea, M. (2020). Exploring the use of virtual reality by pre-service elementary teachers for teaching science in the elementary classroom. *Journal of Research on Technology in Education*, 52(2), 163-177. <https://doi.org/10.1080/15391523.2020.1726234>
- Lugrin, J. L., Latoschik, M. E., Habel, M., Roth, D., Seufert C., & Grafe, S. (2016). Breaking bad behaviors: A new tool for learning classroom management using virtual reality. *Frontiers in ICT*, 3(26), 1-21. <https://doi.org/10.3389/fict.2016.00026>
- Makhurane, F. (2020). The involvement of stakeholders in promoting the wellness of juvenile offenders in selected South African correctional schools. *European Journal of Education*, 3(1), 106. <https://doi.org/10.26417/215wmr86k>
- Margolis, A. A. (2014). Requirements for the modernization of basic professional educational programs (BPEP) for the pedagogical personnel training in accordance with the professional standard of a teacher: Proposals for the implementation of an activity approach in pedagogical personnel training. *Psychological Science and Education*, 19(3), 105-126.
- McGarr, O. (2020). The use of virtual simulations in teacher education to develop pre-service teachers' behavior and classroom management skills: Implications for reflective practice. *Journal of Education for Teaching*, 46(2), 159-169. <https://doi.org/10.1080/02607476.2020.1724654>
- Mocap Studio. (2022). *Mocap studio program*. <https://www.rokoko.com/studio>
- Molenda, M. (2015). In search of the elusive ADDIE model. *Performance Improvement*, 54(2), 40-42. <https://doi.org/10.1002/pfi.21461>
- Nadiyah, R. S., & Faaizah, S. (2015). The development of online project based collaborative learning using ADDIE model. *Procedia-Social and Behavioral Sciences*, 195, 1803-1812. <https://doi.org/10.1016/j.sbspro.2015.06.392>
- Nael, I., & Gnaim, L. (2021). The changes in training teachers' roles performance following academy-classroom practical training model. *Education Quarterly Reviews*, 4(4), 345-351. <https://doi.org/10.31014/aior.1993.04.04.397>
- Naibaho, L., Gunawan, R., Handayani Tyas, E., & Nadeak, B. (2021). Pre-service teachers' soft skills and achievement. *Turkish Journal of Computer and Mathematics Education*, 12(10), 491-496.
- Napanoy, J. B., Gayagay, G. C., & Tuazon, J. R. C. (2021). Difficulties encountered by pre-service teachers: Basis of a pre-service training program. *Universal Journal of Educational Research*, 9(2), 342-349. <https://doi.org/10.13189/ujer.2021.090210>
- Nousiainen, T., Juntunen, M., Häkkinen, P., & Näykki, P. (2022). Virtual reality for collaborative learning in teacher education. In *Proceedings of International Conference of the Learning Sciences* (pp. 589-590).

- Oschepkov, A. A., Kidinov, A. V., Babieva, N. S., Vrublevskiy, A. S., Egorova, E. V., & Zhdanov, S. P. (2022). STEM technology-based model helps create an educational environment for developing students' technical and creative thinking. *EURASIA Journal of Mathematics, Science and Technology Education*, 18(5), em2110. <https://doi.org/10.29333/ejmste/12033>
- Pedro, A., Piedade, J., Matos, J. F., & Pedro, N. (2019). Redesigning initial teacher's education practices with learning scenarios. *International Journal of Information and Learning Technology*, 36(3), 266-283. <https://doi.org/10.1108/IJILT-11-2018-0131>
- Pesha, A. (2022). The development of digital competencies and digital literacy in the 21st century: A survey of studies. *Education and Self Development*, 17(1), 201-220. <https://doi.org/10.26907/esd.17.1.16>
- Phillips, H. N., & Chetty, R. (2018). Enhancing teacher training skills by strengthening the teaching practice component. *Education and Training*, 60(3), 251-262. <https://doi.org/10.1108/ET-02-2017-0024>
- Platonova, R. I., Khuziakmetov, A. N., Prokopyev, A. I., Rastorgueva, N. E., Rushina, M. A., & Chistyakov, A. A. (2022). Knowledge in digital environments: A systematic review of literature. *Frontiers in Education*, 7, 1060455. <https://doi.org/10.3389/feduc.2022.1060455>
- Purwanti, E., & Vania, G. (2021). Classroom management: Applying appropriate strategies to enhance effective teaching. *Journal of Foreign Language Teaching and Learning*, 6(1), 78-93. <https://doi.org/10.18196/ftl.v6i1.10638>
- Qarkaxhja, Y., Kryukova, N. I., Cherezova, Y. A., Rozhnov, S. N., Khairullina, E. R., & Bayanova, A. R. (2021). Digital transformation in education: Teacher candidate views on mobile learning. *International Journal of Emerging Technologies in Learning*, 16(19), 81-93. <https://doi.org/10.3991/ijet.v16i19.26033>
- Rodionova, E. V., Konyukhova, T. V., Lukianova, N. A., & Konyukhova, E. T. (2022). Emotional intelligence of digital generation students: Experience of engineering university. *Education and Self Development*, 17(4), 126-138. <https://doi.org/10.26907/esd.17.4.10>
- Rodrigues, A. L. (2020). Digital technologies integration in teacher education: The active teacher training model. *Journal of E-Learning and Knowledge Society*, 16(3), 24-33. <https://doi.org/10.20368/1971-8829/1135273>
- Sabirova, D. R. (2015). Professional training and support of student-teachers at schools: A view from Britain and Russia. *Journal of Sustainable Development*, 8(7), 214-221. <https://doi.org/10.5539/jsd.v8n7p214>
- Sáez-López, J. M., Cózar-Gutiérrez, R., González-Calero, J. A., & Carrasco, C. J. G. (2020). Augmented reality in higher education: An evaluation program in initial teacher training. *Education Sciences*, 10(2), 26. <https://doi.org/10.3390/educsci10020026>
- Salakhova, V. B., Masalimova, A. R., Belyakova, N. V., Morozova, N. S., Osipova, N. V., & Prokopyev, A. I. (2021). Competitive teacher for higher education: Risk-based models of its development. *EURASIA Journal of Mathematics, Science and Technology Education*, 17(10), em2021. <https://doi.org/10.29333/ejmste/11187>
- Savelova, L., Konopko, E., & Pankratova, O. (2020). Digital technologies and effective practices in teacher training. *CEUR Workshop Proceedings*, 2861, 172-178.
- Scott, G. G. (1994). *The power of the mind: Ways to resolve conflicts*. VIS.
- Shamina, E., & Mumthas, N. S. (2018). Classroom management: Implications for teacher preparation programs. *IOSR Journal Of Humanities And Social Science*, 23(1), 41-44. <https://doi.org/10.9790/0837-2301034144>
- Sorin, R. (2015). It's great to think about difficult issues in a safe and supportive environment: Scenario-based learning in early childhood teacher education. *The International Journal of Early Childhood Learning*, 21(3-4), 9-20. <https://doi.org/10.18848/2327-7939/CGP/v21i3-4/58955>
- Sudakova, N. E., Savina, T. N., Masalimova, A. R., Mikhaylovsky, M. N., Karandeeva, L. G., & Zhdanov, S. P. (2022). Online formative assessment in higher education: Bibliometric analysis. *Education Sciences*, 12(3), 209. <https://doi.org/10.3390/educsci12030209>
- Susiyowadi, A., Aji, S. D., & Muzammil, L. (2021). Improving classroom management competence. In *Proceedings of the 5th Asian Education Symposium 2020* (pp. 298-303). <https://doi.org/10.2991/assehr.k.210715.063>
- Yelesin, S. S., & Feshchenko, A. V. (2016). Virtual reality in education: Doubts and hopes. *Humanitarian Informatics*, 10, 109-114. <https://doi.org/10.17223/23046082/10/12>

- Yu, S. J., Hsueh, Y. L., Sun, J. C. Y., & Liu, H. Z. (2021). Developing an intelligent virtual reality interactive system based on the ADDIE model for learning pour-over coffee brewing. *Computers and Education: Artificial Intelligence*, 2, 100030. <https://doi.org/10.1016/j.caeai.2021.100030>
- Zaitseva, N. A., Sizova, Z. M., Chauzova, V. A., & Larionova, A. A. (2021). Determining the readiness status of university students in STEM education and distance education course. *International Journal of Emerging Technologies in Learning*, 16(19), 124-138. <https://doi.org/10.3991/ijet.v16i19.26047>
- Zemlyanskaya, E. N., & Bezborodova, M. A. (2021). Modeling of practical training of students–future teachers in the conditions of school-university partnership. *Pedagogy: Theory and Practice*, 6(1), 123-128. <https://doi.org/10.30853/ped210018>
- Zotova, I. V. (2020). Development of social and communicative competence of a future teacher in the process of professional training. *SHS Web of Conferences*, 87, 00082. <https://doi.org/10.1051/shsconf/20208700082>

