


Immersive Virtual Reality to improve competence to manage classroom climate in secondary schools

Realidad Virtual Inmersiva para mejorar la competencia de gestion del clima del aula en secundaria

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ABSTRACT

This article describes the Didascalía Virtual-Classroom system, an immersive virtual reality environment (IVRE) that allows teachers to experience and reflect on conflict management in the secondary school classroom. In the context of a master's degree at a Spanish university, 162 preservice teachers (67.3% female, age_{average} = 27.3) participated in a Responsible Research and Innovation experience to assess IVRE's usefulness in fostering

learning about conflict management in preservice teacher education, while reflecting about their perceived self-efficacy on this teaching competence. Data were collected through questionnaires, interviews and focus groups and subsequently analysed using statistical tests and content analysis. Our results confirm that preservice teachers perceive limitations in their self-efficacy for classroom management. On the other hand, the thematic analysis of the focus groups allowed us to identify opportunities and advantages offered by this tool to foster the learning of conflict management competence. Overall, participants perceived that the Didascalia-VC environment could be very useful in initial training and highlighted the immersive power and realistic content as the main advantageous features. In addition, all participants recognized that the experiences provided by this IVRE can foster reflective and critical learning about effective classroom management. At the end of the article, some ideas for further research and improvement of the development of this tool are suggested, as well as its pedagogic potential for use in the master's degree for secondary school teachers currently being carried out in Spanish universities.

Keywords: preservice teacher education, classroom management, classroom environment, virtual reality, secondary education

RESUMEN

Este artículo describe el sistema Didascalia Virtual-Classroom, un entorno de realidad virtual inmersiva (ERVI) que permite a los docentes experimentar y reflexionar sobre cuestiones decisivas de la gestión eficaz de conflictos en el aula de secundaria. En el contexto del máster de formación del profesorado, en una universidad española, 162 docentes en formación (67.3% mujeres, $M_{\text{edad}} = 27.3$) participaron en una experiencia de Investigación e Innovación Responsable, para evaluar la utilidad del ERVI para fomentar el aprendizaje de la competencia de gestión de clima del aula, al tiempo que reflexionaban sobre su autoeficacia percibida en esta competencia docente. Los datos se recopilaron mediante cuestionarios, entrevistas y grupos de discusión, y posteriormente se analizaron mediante pruebas estadísticas y análisis de contenido. Nuestros resultados confirman que los docentes en formación perciben limitaciones en su autoeficacia para la gestión del aula. Por otro lado, el análisis temático de los grupos de discusión permitió identificar oportunidades y ventajas que ofrece este escenario para fomentar el aprendizaje de la competencia para la gestión del clima del aula. En general, los participantes percibieron que el entorno Didascalia-VC podría ser muy útil en la formación inicial, destacaron la importancia de la inmersión del sistema y su realismo. Además, los participantes reconocieron que las experiencias proporcionadas por este ERVI pueden fomentar el aprendizaje reflexivo y crítico sobre la gestión eficaz del aula. Se sugieren algunas ideas para continuar la investigación, mejorar el desarrollo y extender el uso de esta herramienta en el máster de profesorado de secundaria, vigente en las universidades españolas.

Palabras clave: formación inicial del profesorado, gestión del aula, clima del aula, realidad virtual, educación secundaria

INTRODUCTION

Learning to manage everyday conflicts that affect the classroom climate in secondary education is imperative in initial teacher training. However, according to recent studies, prospective teachers are dissatisfied with the purely theoretical nature of this training and consider the practical training received to be deficient (Sarcedo-Gorgoso et al., 2021).

Around 50% of teachers across OECD member countries reported that their training did not include this competence (Organisation for Economic Co-operation and Development [OECD], 2020). In particular, 60% of Spanish teachers reported feeling unprepared to manage the classroom, despite spending the most time maintaining order in the classroom.

Education policies acknowledge the need to address this demand. For example, the Report of the School Board of the Community of Madrid (2022) presents a new regulatory framework to improve social coexistence in schools. Among the training activities offered to teachers are specific face-to-face courses for the improvement of school coexistence and the social climate in the classroom.

However, simulating classroom conflicts has several practical and ethical limitations. For this reason, this paper presents a training scenario in an immersive virtual reality environment (IVRE), a pioneering initiative in Spain, which could foster the learning of the classroom management competence of preservice teachers.

The complexity of classroom management

Classroom management can be defined as any of the actions teachers take to use teaching time effectively to keep students engaged and, through this, foster a climate (environment) that facilitates both academic and socio-emotional development (Doyle, 2006).

Based on the systematic review conducted by Wang et al. (2020), we understand classroom climate as a dynamic and multidimensional phenomenon that refers to the interactions between teachers and students at three levels: *academic-instructional* (characteristics of teaching-learning methodologies), *socio-emotional* (emotional exchanges between teachers and students) and *organisational* (practices for managing disruptive behaviour).

Classroom climate management is a complex issue for several reasons (Doyle, 2006). Firstly, it depends on the quality of collaboration between teachers and students. Secondly, it involves a large number of circumstances and events that occur simultaneously, immediately and, very often, unpredictably. Finally, classroom management involves the regulation of emotional and attitudinal

aspects in order to deal with disruptive and/or conflictive events that arise during class.

In this endeavour, the process of emotion elicitation and regulation that emerges during the assessment of conflict situations shapes the quality of teacher-student relationships. Several studies claim that empathy enables teachers to react more appropriately to disruptive behaviour (Keller & Becker, 2020; McGrath & Van Bergen, 2019). Strategies based on domination (repeated verbal reprimands or the imposition of sanctions) or avoidance (delaying discussion or intentionally ignoring confrontation) appear less effective for classroom climate management (Chang & Taxer, 2020; Martínez et al., 2020). In contrast, assertive teachers who use a firm, positive and respectful tone, and show confidence and consistent expectations, achieve better results in classroom climate management (Iglesias-Díaz & Romero-Pérez, 2021, Inbar-Furst et al., 2021).

Learning to manage conflict in the classroom

We understand conflict as an expressed contradiction that blocks communicative processes (Luhmann, 1984). By blocking communication, conflicts in the classroom undermine interpersonal relationships and can lead to disruptive events (inappropriate behaviour or critical incidents) that hinder the development of teaching.

In this study, we adopt the ecological approach to learning, developed from socio-cultural theory (Vygotski, 1987), which emphasises that learning involves mutually constitutive relationships between individuals and their environments, where both the person and the environment are transformed. This approach is consistent with the focus on conflict as a communicative situation, which therefore requires learning to manage conflict in a context that offers genuine opportunities to interact and to reflect on performance (Ceballos et al., 2016).

According to Schön (1983), reflection on practice reinforces professional learning processes because it allows preservice teachers to re-signify the experience, acquiring greater understanding. In particular, dialogical reflection, in collaborative groups, is often more critical and constructive and allows trainee teachers to better understand what they do in practice (Clarà et al., 2019). Peer feedback can foster motivation to learn and commitment to change (Winstone et al., 2017). Within this framework, this article aims to provide new insights into how to make reflection productive and help prospective teachers build practical knowledge around conflict management in the secondary classroom.

As mentioned before, the complexity of a secondary classroom is difficult to simulate in a practice scenario in which the future teacher can experiment without being subjected to the challenges and tensions that may occur (Huang et al., 2021).

In this regard, it seems interesting to explore whether immersive Virtual Reality (VR) training could be a useful tool, by creating virtual scenarios that simulate everyday classroom situations which, together with the opportunity for experimentation and reflection on practice, provide information on what factors are involved (positively or negatively) in classroom conflict management, within a safe and relaxed environment.

Didascalía Virtual-ClassRoom. An overview of this educational proposal

VR is a combination of technologies that allow the user to be placed inside an artificial 3D world in which he/she can interact with the environment as if it were real. The most important characteristic of VR is immersion: the user has the illusion of “being there”, i.e. he/she accepts to temporarily remove his/her reality and replace it with the reality shown in the virtual world. In VR, as in any illusion, although the user knows that it is not real, this does not change either their perception or their response (Slater, 2018). Multiple studies predict that VR is destined to play an important role in education in the future (Smutny, 2022).

One aspect of VR environments that is very useful in the field of teacher training is the possibility of providing immediate feedback (Chi-Yuan, 2022). In relation to classroom management, VR would allow training in the most effective communication strategies depending on the type of conflict generated. For example, a situation could be simulated in which, after the teacher has been driven to anger, the teacher is taught to practice strategies other than domination or avoidance. The present study aims to make an empirical contribution in this direction. As Huang et al. (2022) point out, successive practice in these virtual scenarios would allow us to gather useful information to improve their design and provide personalised support to users.

These potentialities of VR have been taken into account in the design of the tool used in this work: Didascalía Virtual-ClassRoom (Didascalía VC henceforth), a reactive immersive virtual reality environment (IVRE) that allows trainee teachers to experience, record and reflect on affective and attitudinal issues that are crucial for effective conflict management in the classroom.

Didascalía VC transports preservice teachers to a secondary school classroom, providing a context in which a conflict has occurred that requires their intervention (e.g. two students have been fighting for the past week). During the experience, the system collects different information about the user: where he/she has been looking, how far away the students are, his/her tone of voice and the words he/she utters. Based on these parameters - for example, an aggressive tone of voice with offensive words in close proximity to a student - the system adjusts the behaviour of the virtual students. During the experimental situation,

the preservice teachers (“players”) can choose different strategies to manage the simulated conflict (competing, collaborating, accommodating, compromising, and avoiding).

Didascalía VC has been programmed prioritising user immersion in VR. During its development, we focused on recreating an environment that was as similar as possible to real secondary school classrooms. To model the behaviours of “virtual students”, we conducted a qualitative study (Masó, 2022) that analysed 1411 critical incident reports, reported by secondary school teachers in Barcelona (n=1115) and Madrid (n= 468) during the past two academic years (since 2019). This analysis was complemented by interviews with educational guidance specialists, teachers with successful teaching careers and managers (heads of studies) (details of the techno-pedagogical design can be found in Bocos-Corredor et al., 2020).

The research cited above identified the types of conflicts most frequently reported as “difficult to manage in the classroom” and different strategies that teachers often use to manage them. The conflicts were grouped into three topics: (1) Overt academic disinterest (e.g., getting up without permission, not working in class, falling asleep), (2) Disruptions among peers (e.g. chatting or distracting peers, confrontations between peers in a workgroup) and (3) Disruptions affecting the teacher-student relationship (e.g. talking to the teacher inappropriately, challenging authority, etc.).

On this basis, the present study was designed to answer the following two research questions:

1. How do trainee teachers self-assess their self-efficacy for classroom management in secondary school?
2. How does the Didascalía VC environment contribute to the learning of classroom management competence in secondary classroom management in initial teacher education?

Guided by these questions, the objective was set to explore the extent to which the implementation of the Didascalía-VC IVRE in the Master’s Degree in Secondary Teacher Education could be used to support the learning of the classroom climate management competence.

METHOD

We followed an explanatory mixed methods design with a quantitative-qualitative sequence and data integration in interpretation (Creswell, 2002). The descriptive method was used in the first phase, under the premise that trainee

teachers perceive limitations in self-efficacy to manage the classroom (first research question). In the subsequent phases, a qualitative study of the content of post-practice reflections in VR was conducted. The most interesting data came from the qualitative study, which allowed us to examine the participants' opinions and experiences, according to the meaning they attach to the experience.

Context and participants

The experience to be analysed is contextualised in the Master's Degree in Secondary Teacher Training at the Autonomous University of Barcelona. The data were collected during a practical activity in which the Didascalía VC system was used in eight class groups during the first semester of the 2021-2022 academic year. All students in the Master's programme were invited to participate in the study. Table 1 presents the participants' details, with a total of 162 participants, mostly female (109, 67.3%), average age of 27.3. Thirty-four percent (55 participants) reported teaching experience between one and five years. In addition, four teachers took part in the experience and were responsible for the design and development of the practice in their respective class groups. These teachers had already participated in the user test of the tool (Manero et al., 2022) and received training from the technical team prior to the design of the practice. Participation was voluntary and subject to informed consent.

Table 1
Participants by degree specialisation

Degree specialisation	Frequency	%
Educational Guidance and Counselling	25	15.4
Biology and Geology	15	9.3
Physics and Chemistry	16	9.9
Geography and History	23	14.2
Spanish Language & Literature	18	11.1
Catalan Language & Literature	21	13.0
Modern Languages - French	28	17.3
Modern Languages - English	16	9.9
Total	162	students

Didascalía VC tool

The Didascalía VC system is currently in the TRL 4 (Technology readiness level) development phase. This refers to a phase of validation of components and their layout in a laboratory environment. In addition, this project has been registered as intellectual property with the intention of conducting a test trial of the concept that would allow the tool to be deployed in real environments (teacher training Master's programmes). Didascalía VC is therefore a non-commercial prototype in the research phase. A detailed explanation of the architecture and features of the prototype can be found in Bocos-Corredor et al., 2020. Results of user testing have also been published (Alonso et al., 2021, Manero et al., 2022).

Design of the experience

The classroom experience lasted 2 hours, which is the time allotted for the weekly session of the Psychology of Education module, so the experience design was adjusted to this duration, ensuring sufficient time for the IVRE experience and reflection.

There are four stages in the design:

Stage 1: *Introduction*. In this first part, the structure, objectives and framework underpinning the experience were explained. Time was allowed to discuss queries and suggestions, before signing the informed consent form (about 15 minutes). Participants were then asked to answer the Perceived Self-Efficacy Questionnaire for Classroom Management (about 10 minutes).

Stage 2: *Analysis of classroom conflicts*

After watching some videos, each group was asked to discuss the conflict management process (about 40 minutes). At the same time, one participant per group took turns to experience the IVRE (about 15 minutes per person). Each participant's peers could see, through the computer screen, what the participant saw on the VR device, as shown in Figure 1.

Stage 3: *Focus group discussion* (about 30 minutes). After having participated in the IVRA experience, each group met in a focus group format to reflect on the practice. They were provided with a script with key questions and topics to guide the discussion (see Álvarez et al. (2022) -supplementary material 1).

Stage 4: *Evaluation and closure*. In the next class, the results of the self-efficacy questionnaire were discussed and different strategies for classroom management were debated, providing theoretical references. Finally, participants were asked to answer a short questionnaire. On a scale of 1 (Not much) to 5 (Very), the participants rated the usefulness of the tool for professional training, the impact it had on their levels of interest/motivation and the scope of this technological-

educational innovation. This questionnaire, like the first one, was answered online and was anonymous.

Figure 1

A group during the virtual reality experience. On the right, a screenshot of the “player’s” view



Note. Photo courtesy of the participants.

Data collection techniques

Teachers’ Sense of Efficacy Scale (TSES) (adapted from Slater & Main, 2020). This questionnaire is designed to probe prospective teachers’ self-perception of their competence in classroom management. It contains 30 items, divided into three factors: efficacy in student engagement (eight items); efficacy in instructional practices (eight items); efficacy in classroom management (14 items). Responses were recorded on a nine-point Likert-type scale (not at all able-totally able). Significant Alpha values were obtained for the three scale dimensions: Commitment .802, Instructional Practices .823 and Classroom Management .900. To determine validity, the opinions of three lecturers in the field of educational psychology who taught undergraduate and graduate classes on this topic were solicited. Their comments allowed us to revise the wording of some items to improve clarity. A pilot test was then conducted with five students on an educational psychology course, who reported no problems or confusion in interpreting the items. The administered version is available from the authors on request.

Focus groups. Defined as a carefully planned conversation, this technique allows researchers to gather information about a defined area of interest - the experience of VR practice, in a relaxed setting. The single focus group modality was chosen in which a set of participants and a team of facilitators share space and act as a single group (Morgan, 2002). Group members influence each other as they respond to the ideas and comments that emerge during the discussion.

In addition, participants who had experienced IVRE were invited to a semi-structured interview to look deeper into their experience and hear suggestions for possible improvements.

The answers to the questionnaire could be related to the patterns of action that could be observed in the three IVRE scenarios. The possible programmed actions were linked to the different dimensions that determine classroom climate. All actions performed by users were recorded on the device running the programme for further analysis.

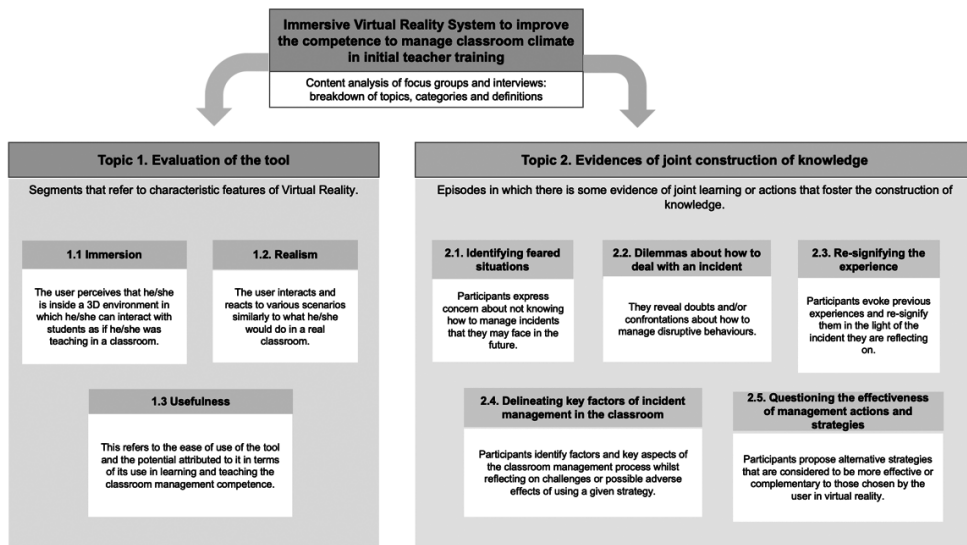
Data analysis procedure

Descriptive analyses were performed on the quantitative data from the questionnaires and a complementary analysis was carried out using the ANOVA test to explore the possible incidence of socio-demographic variables (gender, age and teaching experience).

The qualitative data analysis was based on the verbatim transcription of the audio recordings of the focus groups and interviews. The volume of data totalled 689.67 minutes of audio. A recursive procedure was followed in four stages: inductive exploration, coding, description and interpretation of the data. First, the principal researcher and three authors independently mapped the transcripts with a representative sample of primary data (25%; from groups of different degree specialisations) and the unit of analysis was delimited. Then, through successive approximations of the data regarding the objectives of the study (Mills et al., 2006), each researcher developed a preliminary system of topics and categories in which descriptions, interpretations and examples of each code were tentatively proposed. The end of this exploratory procedure was marked by the fact that listening to further focus groups and interviews did not yield additional categories.

In a third stage, the researchers contrasted and discussed the various category systems, identified convergences, resolved disagreements and agreed on the final version of the codebook (see Álvarez et al. (2022) -supplementary material 2), which included two main topics, i.e. evaluation of the tool (three categories) and evidence of joint construction of knowledge (five categories) (see figure 2). Based on this, the data was then manually coded with the MAXQDA Pro software (v. 20.2.2) using the “smart coding tool”, which allows iterative comparison of the coded segments and marking of the most illustrative segments in each category to generate the final report of results.

Figure 2
Breakdown of topics and codes



Source. Own elaboration.

RESULTS

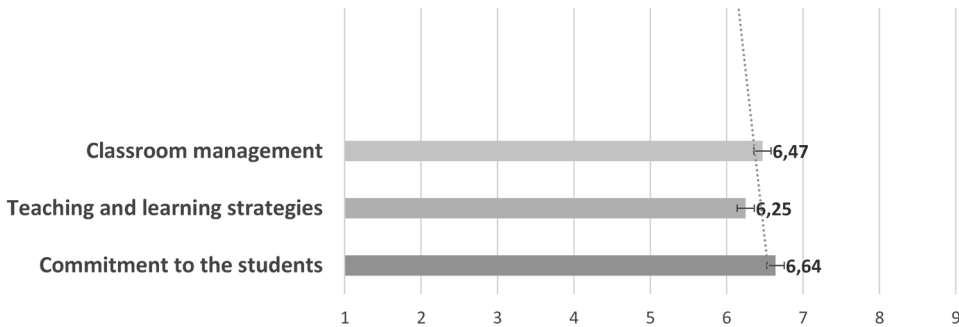
The results are presented in terms of the two research questions that guided this study. Relevant user evidence is provided and will be discussed in the following section, in order to offer, by way of conclusion, reasoned answers to these research questions.

How do trainee secondary school teachers self-assess their classroom management competence?

Figure 3 shows the average values of the three dimensions of classroom management as self-reported by the participants. As can be seen, all scores range between 6 and 7 points, on a scale from 1 to 9 (highest value).

Figure 3

Average values of the dimensions explored. Perceived Self-Efficacy Questionnaire



The highest average values correspond to the dimensions of Instructional Practices and Student Engagement. The lowest values were observed precisely in the dimension of Classroom management. Table 2 summarises the statistics for the latter. Full details of the descriptive analysis can be found in supplementary material 3 (Álvarez et al, 2022).

Table 2

Summary of descriptive statistics for the dimension of Classroom Management

Items (question Q)	Statement: I am able to...	Minimum	Maximum	Average	Standard deviation
Q13	Offer alternative explanations	4	9	7.17	1.23
Q19	Demonstrate academic responsibility	2	9	7.09	1.29
Q16	Diversify assessment	4	9	6.78	1.20
Q15	Implement innovative strategies	4	9	6.77	1.28
Q29	Self-evaluate my class	4	9	6.73	1.26
Q8	Perceive students' level of comprehension	2	9	6.65	1.15
Q25	Support families	4	9	6.62	1.33

Items (question Q)	Statement: I am able to...	Minimum	Maximum	Average	Standard deviation
Q27	Use non-aversive strategies	2	9	6.54	1.53
Q30	Manage classroom climate	3	9	6.32	1.23
Q3	Engage unmotivated students	3	9	6.22	1.22
Q5	Answer tough questions	2	9	6.31	1.51
Q26	Regain students' attention	3	9	6.00	1.21
Q21	Redress disruptive behaviours	2	8	5.56	1.25
Q28	Deal with unexpected behaviours	2	9	5.77	1.50

Note. The table shows the item values for the questions (Q) for the dimension Classroom Management, extracted from the Perceived Self-Efficacy Questionnaire. Values are presented in descending order. Answers were given on a scale from 1 to 9 (highest value). Source: own elaboration.

ANOVAs were performed for the sociodemographic variables gender, age and teaching experience. Only teaching experience showed significant differences for the three dimensions. Engagement: ($F_{1,160} = 6.709, p = 0.10$); Teaching and learning strategies ($F_{1,160} = 7.980, p = 0.005$); Classroom climate ($F_{1,160} = 8.672, p = 0.004$). It should be noted that the majority of the participants in the English and French degree specialisations were those who reported previous experience as teachers in language schools.

How does the Didascalía VC environment contribute to the learning of classroom management competence in secondary education in initial teacher education?

The answer to this second question is constructed based on the topics that emerged in the analysis of the focus groups (FG) involving students from eight degree specialisations of the Master's degree (identified by numbers in the quotations) and the interviews (I) with the students who experimented in the IVRE. Thus, in this section, we first show evidence on the assessment of the potential of IVRE to promote the learning of the classroom climate management competence, and then

provide evidence on how joint reflection on practice in IVRE promotes the learning of this competence.

Evaluation of the tool

The most salient findings regarding the evaluation of the tool's potential, as discussed above, revolved around three aspects. The first two related to distinctive features offered by VR, such as immersion and realism of the learning environment, and the third to the usefulness of this practice for initial teacher training.

Undoubtedly, the most remarkable aspect of the tool was immersion. Most participants referred to feeling like "being" in the real classroom.

It's very cool, because of the virtual glasses and all that, it feels like you're in a classroom, it does feel like you're in a classroom. And I didn't get dizzy or anything. It was cool and you could move around freely. It was like a school.
[GF_1_00:00:50]

We observed that, despite being in an illusion, participants responded as if they were in a real environment. They felt the same sensations of uncertainty, fear or insecurity that teachers usually feel when they face disruptive situations in the classroom.

The best part for me is the moment when the conflict happens, there are like a few milliseconds when you believe it, wow! and you feel powerless.
[GF_5_00:00:19]

Another aspect that was highly rated by the participants, and which enhanced the feeling of realism, was the conflicts that appeared in the simulation, as participants recognised them as very common in secondary school classrooms.

What I particularly liked was the type of conflict that would arise. I found them very realistic and something that could perfectly well happen in a secondary school class, such as a pupil swearing, saying an insult in the middle of the class, or two pupils who do not want to separate or sit together. These are situations that could well happen to me next year, when I start working as a secondary school teacher.
[GF_7_00:02:13]

In terms of the usefulness of this practice for initial teacher training, the participants highlighted some advantages of VR compared to video analysis. They felt that VR more directly appeals to the emotions involved in teaching when facing unexpected situations of this kind. The possibility of having agency, i.e. being able to make decisions (which is not feasible in a video format) that have consequences, was rated positively.

I think the cool thing about virtual reality is involvement, because in the case of videos, you see a situation and you say "I would never do that", it's super-rational, and you think you would do it differently, because you have time to think and give your opinion. Virtual reality allows you to be inside, and live it, be in that situation and learn how you would do it, and what you would say. [GF_3_00:02:18]

However, the realism of the VLE, which was a prominent aspect, was perceived to be limited in the current version because of the lack of feedback. Participants repeatedly noted that their performance was frustrated or constrained by this issue, which affected their willingness or need to interact with virtual learners.

There would have to be some intervention on the part of the virtual learners (...) That is, we need to notice that they react positively to what you have suggested, or that they refuse, which can also be the case. [GF_6_00:04:32]

Participants with less experience in using VR reported difficulties due to their unfamiliarity with the technology.

(...) for example, I didn't control the Joystick at all. And in the first (situation) I had technical problems and therefore it went very badly, because I didn't listen to the learner either and then I think one criterion (to get it right) was to get closer. [GF_4_00:01:41]

To overcome this difficulty, many participants suggested that an initial training session could be offered to familiarise the user with VR and facilitate the handling of the environment.

I would like for there to be a trial available (meaning that, before we move to the first scene, there should be a tutorial to get used to the environment: movement, controls...). [GF_1_00:00:58]

Despite these justified complaints about the development of the tool, in general, we found a positive evaluation, which was also corroborated in the responses to the questionnaire administered at the end of the experience, which was designed in line with the principles of responsible research and innovation. On a scale of 1 to 5 (highest value), the most highly rated aspect was technological innovation (M=4.24, SD=0.661). Participants also rated positively the impact that the Didascalia VC system had on their levels of interest/motivation to learn (M=3.92, SD=0.893), considered it a useful tool (M=3.86, SD=0.893) and stated that this practice should be repeated in the following courses (M=4.06, SD=0.767).

Joint construction of knowledge on classroom management.

This second topic emerged from the analysis of the episodes in which the construction of knowledge, based on joint reflection on practice, was evident. Below, we share comments representative of the five emerging categories.

Identifying “feared situations”. In this category, we coded episodes in which participants expressed concern about not knowing how to manage disruptive behaviours they might face in the classroom.

- *The second scene was the one where the girl (the avatar) said to you “this is bullshit, teacher”, which I think is one of the most common situations we can face in the classroom.*

- *Yes, and maybe without them verbalising it, you realise that half the class is asleep.*

- *Wow, I wouldn’t know what to do in that case.*

- *But I think you’ve solved it well, you’ve tried to cheer them up.* [GF_6_00:08:05]

Dilemmas about how to deal with or manage a given incident. The segments coded in this category reveal doubts and/or confrontations that arose during the discussion on how to manage disruptive behaviours. For example, in relation to the second scenario, the following dialogue speaks volumes:

You have already allocated students to their seats and then you come in and find them changed. What do you do?

(...) I said, “well guys, go back to where I put you”. But they started to make fun, aha! one wagged his finger (referring to the avatar’s response to his performance). Of course, in this case, I was a bit like, what do I do? I see two options: ignore their attitude and go on, so as not to make a big deal out of it, because if not, we prolong the conflict; or I listen to him and I say, “come on, don’t do that, this, that” (...) [GF_7_00:08:38].

Re-signifying the experience. During reflection on practice, participants evoke memories or previous experiences as teachers, trainee teachers, or students and co-review or re-signify them in the light of the incident they are reflecting on.

(...) maybe an isolated case like this, it might be okay to ignore it. I once saw a student in class who had autism and she was spoiling everything the teacher said. She didn’t swear, but she did say impertinent things (...). The teacher didn’t pay attention to her, she continued her lesson without giving her any importance (...). If it’s a one-off thing, you can ignore it, but if it becomes more than that, then that’s another matter. [GF_5_00:21:15]

Delineating key factors of incident management in the classroom. Upon reflection on practice, participants identified typical challenges that may emerge in incident management (due to its situated, multifactorial, and dynamic nature) or were able to anticipate possible unintended effects of using a certain strategy. In this way, they discovered key aspects of the incident management process in the classroom and verbalised them more or less directly, e.g. the need to adjust to the characteristics of the context and educational needs of the class group; regulating the format and context of communication; the difference between the phases of incident management. We noted here that the chance to formulate questions allowed for deeper reflection and facilitated the joint construction of practical knowledge, by linking theory with experience drawn from practice. The following dialogue illustrates this approach.

In the first scene (...) you were explaining something. At this point, you should first say to him, "please, Pablo, can you sit down, we are doing some work, I am explaining the instructions and you have to pay attention ". If he doesn't sit down, what I would do would be to finish my explanation and after ensuring that the rest of the class is occupied, I would go and talk specifically to him to try to persuade him to sit down (...).

I think that would be the first approach, to try to de-escalate the situation and then a second issue, a more personal one, I'd approach the student and ask him what was going on and something like that. [GF_7_00:04:12]

Questioning the effectiveness of management actions and strategies. In addition to identifying and evaluating the management of different conflicts, the analysis of the experience led participants to propose alternative or complementary strategies to those used by the VR user, arguing their relevance. For example:

In the first situation a student suddenly stands up. I reacted by asking her if she thought this was the correct way to behave in a classroom. I became nervous and a bit tense. The feedback I received from my colleagues was that I should have appealed to the emotional side of the student (...) instead of simply appealing to respect and normal classroom behaviour.

What do you think about what your colleagues have said?

It is true that when you know the students, you know if this particular student is behaving in a way that is strange or different to what he or she usually does in class. On the other hand, if you know that this is a disruptive student, maybe you should appeal more to respect for the teachers and the students. [E_7_00:09:26].

DISCUSSION

Following the sequential order of the research, the main findings are discussed below.

Perceived self-efficacy to manage the classroom climate

The results obtained confirm the limitations in the development of this facet in initial teacher training that had been identified in previous research (Sarcedo-Gorgoso et al., 2021). The main shortcomings related to the mastery of teaching and learning strategies to engage challenging students and neutralise problematic behaviours.

In general, preservice teachers reported feeling unprepared to deal with disruptive and/or conflictive behaviours that arise unexpectedly, thus corroborating results recently found in the international TALIS study (OECD, 2020). This finding also evidences the lower willingness found in secondary school teachers to address students' socioemotional needs, in relation to previous educational levels (Iglesias-Díaz & Romero-Pérez, 2021).

IVRE evaluation

In the second stage of the research, a practical exercise was carried out using the Didascalía VC system. In the evaluation of this tool, the most useful element was the feeling of "being in the classroom". Most participants accepted the illusion produced by VR and behaved as they would in reality (Slater, 2018). Contributing to this acceptance is the promise of landing in a safe place, similar to reality but where failure is allowed, with no real-world consequences. This is arguably VR's greatest contribution, as reported by participants: enabling users to embody learning experiences that provoke intense and real emotional sensations, such as those perceived by the teacher when faced with classroom conflict (Huang et al, 2021; Keller & Becker, 2020).

Another aspect that participants rated highly was the realism of the experience, which was reinforced by the type of conflicts that were recreated. The trainee teachers felt that they were learning to handle real conflicts, which enhanced and fostered the transfer of knowledge and thus their professional skills. As Smutny (2022) states, designing educational applications in VR is an endeavour with a high potential to promote motivation and engagement. The possibility of systematic data collection enables the integration of learning analytics (Huang et al. 2022), to better understand the training needs of preservice teachers.

One of the most key aspects that participants complained about was the lack of reactivity on the part of virtual learners. Feedback, as pointed out by previous studies (Chi-Yuan, 2022), is essential for the correction of errors. We consider, therefore, that for effective learning to take place, it is essential to introduce multiple paths that respond to the different options that players can take, assuming that this has a high cost. Despite the complexity and versatility present in classroom management (Doyle, 2006), we must model virtual learners on the reactions of real learners to the different conflict management strategies used by teachers. Increased interactivity in the IVRE may encourage experiencing the emotional tensions involved in classroom management in secondary school (Huang et al., 2021).

We recognise the importance of developing tutorials suitable for learners with heterogeneous background knowledge, in which learners, accompanied by a (virtual) host, can explore resources, content and procedures in a simplified version of the VRE (Huang et al., 2022). This would allow the VR system to be used autonomously, without teacher instruction.

Learning about classroom management

The knowledge that was constructed coincides with findings highlighted in recent studies that we mentioned in the discussion. The most salient topics in the reflection on practice highlighted the following:

As Doyle (2006) points out, organising or reorganising students in the classroom, allocating roles and responsibilities for immediate action and setting or remembering rules were recognised by participants as preventive and essential strategies for promoting a comfortable classroom climate.

To manage possible conflicts that often occur in secondary classrooms, such as those experienced in practice, strategies based on assertiveness and empathy, respecting cognitive-emotional and socio-cultural diversity, were recognised by participants as more effective in the long term (Keller & Becker, 2020; McGrath & Van Bergen, 2019). It is argued that it is important to carry out proactive actions that demonstrate engagement with students, seeking to reason and discuss the causes of disruptive behaviour with the student and/or the whole class (Iglesias-Díaz & Romero-Pérez, 2021; Martínez et al., 2020).

In addition, individual and group psychosocial needs are highlighted as important for well-being and development during adolescence and, as numerous studies have shown, may be linked to disruptive behaviours (e.g. Inbar-Furst et al., 2021).

In the face of classroom conflicts that were perceived as challenging (e.g., questioning the teacher) many participants acknowledged that they felt irritability and anger and, consistent with Chang & Taxer's (2020) findings, they linked these affective states to their decision to use punitive strategies. Although they may be

effective in the short term, these strategies have been linked to disruption-coercion-disruption loops that worsen classroom climate (Martinez et al., 2020), which was carefully considered in the focus groups when discussing more or less effective alternatives.

Joint reflection on practice

We found that complementing experimentation with reflection on practice reinforces professional learning processes (Shön, 1983), in this case, those related to a better understanding of the factors that facilitate classroom management and, particularly, of proactive manners to deal with disruptive behaviours that arise during class. When this reflection takes place in a dialogical context, such as the discussion group that was promoted in the experience presented here, the analysis tends to be more in-depth. We found that strategies such as framing, opposing voice, contrasting alternatives, asking about the dilemma, problematising and modelling (Clarà et al., 2019) allow for a better understanding of the practice. This approach promotes agency (thinking about actions preservice teachers can take with the knowledge they have constructed) and shared responsibility to make feedback effective in future actions (Winstone et al., 2017), which can result in improved perceived self-efficacy for classroom management as future secondary school teachers.

CONCLUSIONS

This study was designed to answer the two research questions. First, we asked how trainee teachers self-evaluate their self-efficacy for classroom management in secondary education. Next, we implemented the Didascalía VC environment in an educational practice in initial teacher training (Master's degree in secondary teacher training) in which we asked ourselves about the possible contribution of this technological tool to the learning of classroom management competence in secondary education.

Firstly, and in relation to the first question, our findings confirm deficiencies in the classroom conflict management competence of trainee secondary school teachers and support the need for training and practice in this competence.

The second conclusion, in our opinion of greater relevance, refers to the validation of the potential of the Didascalía VC IVRE for teaching this competence, basically due to the immersion and realism perceived in the management of the conflict situations that are simulated.

However, there are limitations to the findings of this study. On the one hand, the tool being introduced is still in the development phase. On the other hand, the methodology proposed for its implementation requires further trials, in successive years and in other universities, to continue incorporating the voices of teachers, students and managers from Spanish universities where the Master's Degree in Secondary Education is taught. Likewise, it would be advisable that this VR tool, with the suggested improvements, could be implemented within a training module that takes into account some prior knowledge to the practice and, subsequently, is linked to the practices.

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