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Utility, Interaction and Impact: Envisaging the Smart Classroom Teacher Assistant

Utilidad, interacción e impacto: visualizando un asistente docente para el aula inteligente

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ABSTRACT

Artificial intelligence (AI) in the educational field can play a crucial role in enhancing the teaching-learning process due to its ability to process large volumes of real-time data from both students and teachers. A Teaching Assistant in a Smart Classroom is a tool that enables teachers to interact with the smart environment, facilitating the automation of teaching tasks and promoting a more personalized approach to instruction. The aim of this study is to design and analyze a Teaching Assistant for Smart Classrooms from a user experience perspective. A mixed-methods approach was employed, involving a focus group with current teachers and a questionnaire administered to future teachers, in order to gather and evaluate their opinions and preferences regarding their interaction with and use of the Assistant. The results highlight the importance of the information collected in the classroom. Although the available technologies offer a wide range of interaction mechanisms, the teachers interviewed expressed a preference for interactions and information flows that do not interrupt the teaching and learning process.

KEYWORDS

Smart classroom; Artificial Intelligence; Teacher Assistance; Real-time responses.

RESUMEN

La inteligencia artificial (IA) en el ámbito educativo puede ser crucial para mejorar el proceso de enseñanza-aprendizaje debido a la capacidad de procesar grandes volúmenes de datos con información a tiempo real del alumnado y del profesorado. Un Asistente Docente en un Aula Inteligente es una herramienta que permite al profesorado interactuar con el aula inteligente facilitando la automatización de tareas docentes y promoviendo un enfoque de enseñanza más personalizado. El objetivo de este estudio es elaborar y analizar el diseño de un asistente docente para aulas inteligentes desde la perspectiva de la experiencia de usuario. Se ha utilizado una metodología mixta, mediante un Focus Group a docentes actuales y un cuestionario a futuros docentes,

recopilando y evaluando sus opiniones y preferencias respecto a la interacción y el uso del asistente. Los resultados muestran la importancia de la información recogida en el aula, y aunque los mecanismos de interacción que ofrece la tecnología disponible son variados, los profesores entrevistados optan por interacciones e información que no interrumpan la actividad de enseñanza y aprendizaje.

PALABRAS CLAVE

Aula Inteligente; Inteligencia Artificial; Asistente Docente; Respuestas en tiempo real.

RECOMENDED CITE

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Main contributions of the article and future research lines:

- Se identifican las funciones y características más valoradas por los docentes actuales y futuros sobre un asistente docente para el aula inteligente, centrando la perpectiva en el usuario y sus necesidades para una futura integración en el aula.
- Como lineas futuras de investigación, se plantea el desarrollo de un prototipo funcional del asistente propuesto, así como su puesta en marcha para evaluar su eficacia y aceptación en contextos educativos reales. Además se prevé añadir la perspectiva del alumnado, familias y personal técnico relacionado con el desarrollo de este tipo de tecnología.

1. INTRODUCTION

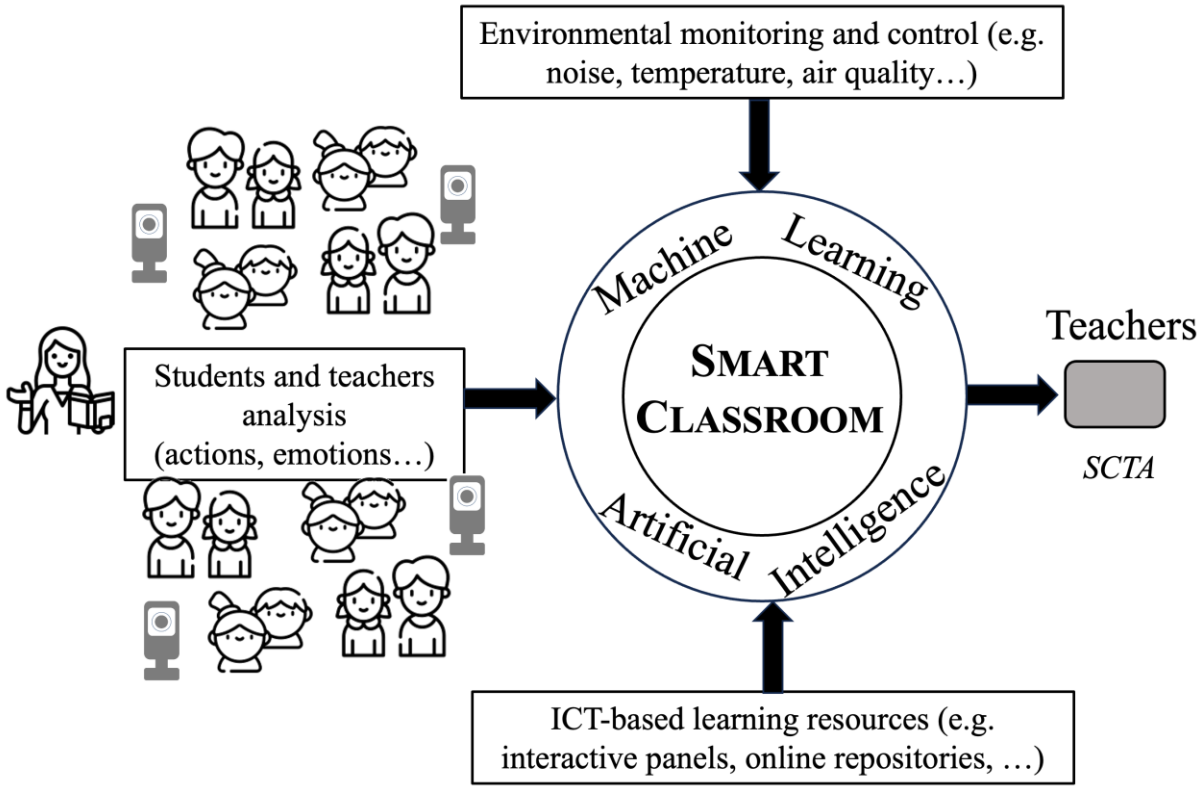
The rapid development of the latest Information and Communication Technologies (ICT) and their use in a variety of landscapes is changing the way people carry out processes (Roztocki et al, 2019). The expected advances suggest that teaching will also benefit considerably from these new technologies (Yáñez-Aldecoa et al., 2015). Smart classrooms are physical learning spaces that, using data from the environment, students and teachers, are able to provide timely and valuable information (Martínez-Ballesté et al., 2024). They are designed to include innovative features and capabilities that improve understanding and performance within the teaching/learning process (Spector, 2014). Within these settings, ICT contribute to collect and process information from students, teachers and the environment (Palau & Mogas, 2019), whilst aiming to facilitate decision-making by means of providing teachers with timely and relevant information (Unciti & Palau, 2023). Figure 1 illustrates the different components of the smart classroom.

In the era of the Internet of Things (IoT), classrooms may undergo a transformation, enabled by a multitude of sensors and smart technologies (Martínez-Ballesté et al., 2024). These innovations pave the way for an enhanced learning experience for both students and educators. By leveraging unobtrusive sensor technology, including cameras and wearables (Ahuja et al., 2019), classrooms can monitor and analyse student and teacher interactions seamlessly. Artificial Intelligence (AI), particularly through data mining and machine learning techniques, emerges as a pivotal player in this landscape. It empowers the analysis and classification of data, facilitating the detection of patterns and prediction of

future behaviours. Consequently, the smart classroom evolves into a cognitive system, dynamically interacting with various agents responsible for aspects such as air quality, emotional states of students and teachers, lighting, and noise levels. In essence, it becomes an integral component of a broader cognitive school ecosystem, capable of interacting not only with its counterparts but also with larger information systems. Communication between agents must guarantee information security and students/teacher privacy.

Figure 1.

Scheme of the elements in the smart classroom, which analyses data collected from a variety of sources and provides teachers with timely, relevant information via the Smart Classroom Teacher Assistant (SCTA).



1.1. Interacting with the smart classroom

Although the smart classroom concept is increasingly gaining interest, to our knowledge there is no research focused on the design of the interaction between humans (*i.e.,* the teachers) and the smart classroom system. As an example, Augusma (2022) presents a comprehensive architecture for a context-aware classroom that includes teaching materials, sensors (cameras, gaze sensors, etc.) and machine learning methods; nevertheless, its authors do not address the design of the user experience (UX), not even the interface. In contrast, the features of the interface are slightly addressed by Wang (2022), who gives an overview of the design ideas of a centralised control system in the smart classroom of the Internet of Things and mentions real-time monitoring and user-friendliness as key features.

Regarding examples in the literature, there are several research papers that include screenshots of interaction interfaces or control panels. These proposals do not address the design of machine-computer interaction and simply show that this component is implemented in the form of a web page. For instance, Ogan (2019) and Ahuja et al. (2019) address the use of cameras in the classroom to

monitor student engagement and, regarding interaction with humans, describes a teacher-computer web interface that displays in real time some statistics about student posture (crossed arms, arms on face...). Solé-Beteta et al., (2020) presents an automatic tutoring system that includes a communication module (the user interface), without giving further details. This tutoring system is illustrated by a platform called Sagittarius, which is able to display information in the form of plot charts. The system described in Gómez-Carmona et al. (2022) and Solé-Beteta et al., (2022) utilises a website dashboard that displays a timeline of emotions, the number of participants and even an emotion average. All of these proposals only provide teachers with timely information and do not provide them with an interface to interact with the system (*e.g.,* send commands).

Regarding the use of AI and IoT in the classroom is monitoring the environment, Tagliabue et al., (2021) describe a data driven indoor air quality prediction in educational facilities based on IoT network. However, authors do not address any aspect related to information display or environment-related alarms. Similarly, Batista et al. (2023) presents an implementation of a classroom monitoring system that only allows offline viewing of statistics and graphs and, therefore, does not provide teachers with any interaction capability nor real-time information.

1.2. Smart Classroom Teacher Assistant

All the data collected within the smart classroom will be stored in an information system which, in general, counts with a website front end enabling access from various locations by different users. Nevertheless, one of the key points of smart classrooms is the ability to provide teachers with timely information. In this line, the real-time interaction with the teacher can be conceptualised via a "Smart Classroom Teacher Assistant" (SCTA). This consists of a tool to improve the effectiveness of teaching and learning, providing both teachers and students with the necessary resources to achieve their educational goals (Unciti & Palau, 2023). This system utilises data collected from devices within the smart classroom and employs AI techniques to analyse it continuously. When certain situations arise, the SCTA notifies the teacher and offers suggestions aimed at improving teaching effectiveness. Additionally, the SCTA has the potential to automate routine tasks, thus reducing teacher stress and preventing burnout (Espinoza-Díaz, 2023).

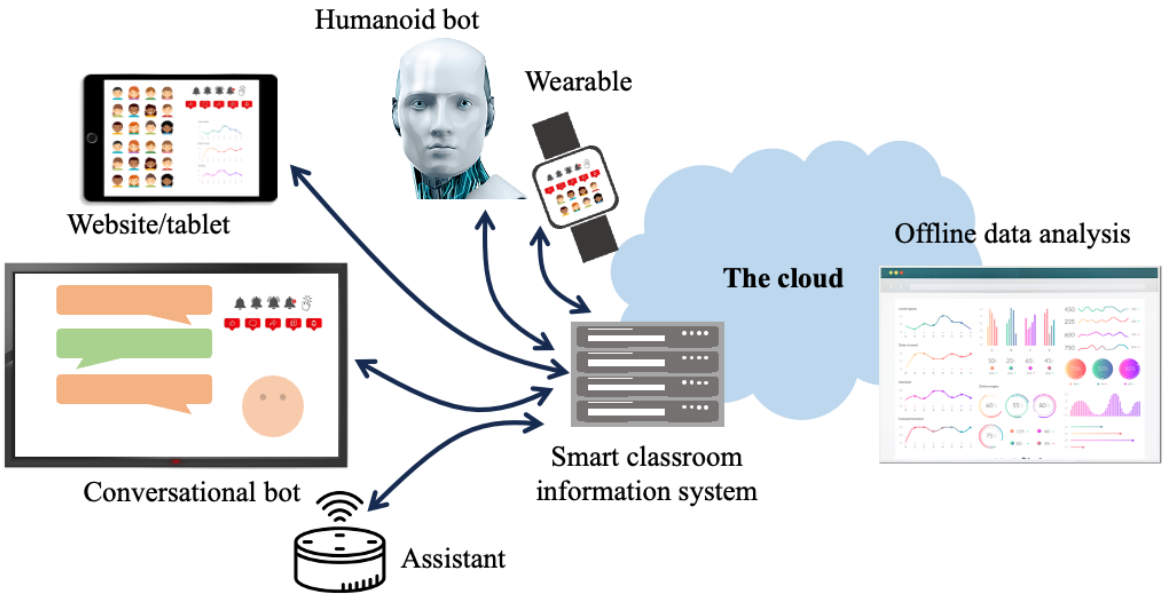
In the proposals reviewed, human-machine interfaces are merely designed as a tool for displaying information and are usually implemented via a web interface. In this scenario, an alert message would be displayed on the screen when a particular situation arises. However, off-the-shelf technologies allow the deployment of additional ways to interact with the SCTA (refer to Figure 2), for instance:

- *Smart watch/wristband*. This wearable device is designed to vibrate when specific situations are detected by the SCTA. It also displays relevant information on its screen, providing the teacher with immediate feedback and guidance without requiring them to check other devices.

- *Digital Assistant*. An alternative or complementary method for interacting with the smart classroom is the use of a digital assistant, such as Amazon's Alexa. Integrating these assistants into the classroom can support a variety of simple tasks, such as playing specific songs, answering questions, and facilitating interactive challenges like multiplication tables, quizzes, and more (Hales et al., 2019). Moreover, the literature highlights various uses of these assistants for automating certain tasks (Khan et al., 2024).

- *Bot interface*. Accessible via tablets or other monitors in the classroom, this bot serves as an intermediary between the teacher and the SCTA system. It can interrupt the teacher when necessary and provide information from the smart classroom through conversation, utilising text or voice recognition for ease of communication.
- *Humanised robot*. This robot is designed to interact with both teachers and students in a human-like manner. It can engage in dialogue, provide assistance, and even intervene in the classroom if needed. Its presence adds a physical dimension to the assistance provided by the SCTA system, enhancing the overall learning environment.

Figure 2.
Different interaction methods for the Smart Classroom Teaching Assistant.



Developing a system for machine-human interaction is not straightforward. In addition to considering a variety of interaction technologies (from keyboards and touchscreens to speech recognition), human-computer interaction aspects such as usability and UX must also be considered. Beyond addressing all aspects of machine-human interaction, it is essential to understand aspects such as perception or the organisation and visualisation of information. However, designing a tool in a way it is viewed as useful by its users is of paramount importance.

2. OVERVIEW OF THE STUDY

Despite growing interest in smart classrooms, research on designing interaction between teachers and the system is lacking. Existing literature mainly mentions user interfaces but doesn't delve into this crucial aspect. In this article, we present a user-centred approach to the concept of the Smart Classroom Teacher Assistant, aiming at answering the following research questions:

- *RQ1 (utility): Is SCTA seen as a useful concept by teachers?* This question aims to assess the perceived utility of the SCTA system among teachers, referring to the SCTA's effectiveness and relevance in addressing specific needs or solving current problems within the classroom domain. Moreover, it is essential to understand whether teachers view the concept positively,

as their acceptance and engagement with the system will significantly impact its effectiveness. We will address the aspects related to the information that teachers could be interested to obtain from the SCTA.

- *RQ2 (user interaction): What is the preferred way for teachers to interact with the SCTA?* This question delves into the preferred modalities of interaction between teachers and the SCTA system. Understanding how teachers want to engage with the system can inform the design and development process to ensure it aligns with their preferences and needs.
- *RQ3 (impact): What is the impact of developing the SCTA in current schools in primary and secondary education?* This question aims to evaluate the real-world impact of implementing the SCTA system in primary and secondary schools. It's crucial to assess the effects on teaching practices, student learning outcomes, and overall classroom dynamics.

3. METHOD

Our research follows a mixed-methods approach and is conducted through the contribution of two groups of users.:

- On the one hand, teachers who debated using the focus group methodology.
- On the other hand, future users: current students of the Degree of Primary Teacher Education at the Universitat Rovira i Virgili, who were interviewed via a survey on the aspects that emerged from the focus group.

3.1. Focus group with teachers

The focus group constitutes a research methodology dedicated to the study of collective opinions and representations, and its effectiveness lies in the central role of group interaction, which serves as the primary catalyst for the generation of information (Acocella & Cataldi, 2021). This technique is valuable because the interaction between the different participants makes it possible to introduce new ideas, which makes it a suitable method to achieve the objectives of the study by collecting information through an interpretative paradigm (Mogas et al., 2020).

The participants were recruited through a call for participation to schools and high schools. This call was made by email, clearly describing the objectives of the focus group session and proposing a specific schedule.

The focus group took place in a digital format via the Teams platform, as it is more accessible and allows participants to take part regardless of their location (Berrondo & Gámbaro, 2023). The consent forms were sent out in advance. Slides on the topic were distributed throughout the session to facilitate discussion. Nine teachers (5 female, 4 male) participated, an appropriate number according to Dos Santos Marques et al. (2021), which suggests that the number of participants should be 4 or 5 (lower than in face-to-face focus groups due to possible technical issues and virtual interaction challenges). Six of the participants are teachers in Primary School, and three are in Secondary School. Table 1 summarises the composition of the focus group.

The video of the session was recorded for further analysis with the software ATLAS.ti. In order to protect the privacy of the participants, no personal identifiers were given in the transcription for this analysis, so that each contribution was linked to a code.

In the initial phase of the focus group, participants were presented a consent form in which they were informed of their rights and the obligations of the researchers. Participants confirmed that they were able to take part in the study and agreed to be video-recorded for research purposes only. Information on the topic was then provided, participants confirmed that they understood the purpose of the focus group and agreed to participate. The researchers took measures to ensure anonymity and adhered to data protection legislation to maintain ethical standards in the research process.

Table 1.
Description of the participants in the focus group.

Participant	Gender	School
1	Male	Secondary
2	Male	Secondary
3	Female	Secondary
4	Female	Primary
5	Female	Primary
6	Female	Primary
7	Female	Primary
8	Male	Primary
9	Male	Primary

The information provided at the beginning of the focus group indicated that the topic is still relatively unexplored. Therefore, this focus group serves to gain basic insights, with the participants taking a central role in this preliminary study. Participants then introduced themselves and stated what level of education they work in; how many years of experience they have in education and what knowledge and interest they have in the topic. The first question was: *What techniques/methods/strategies do you use in the classroom to gather information about students' basic cognitive processes such as attention and perception? What aspects/factors limit the collection of these data?*

The smart classroom system and its corresponding SCTA tool were then presented to the participants. In a nutshell, participants were informed that the data collected from the different elements of the smart classroom (see Figure 1) can be processed by AI techniques so that value added information and alarms can be displayed on a dedicated device for convenient reference (*i.e.*, the SCTA). Following the presentation of the scenario and the tool, questions were asked about it so that a number of considerations could be discussed: the information to be displayed and its utility, the device and the way of interacting with the SCTA, and the limitations and implications of using such a human-machine interaction system.

Regarding utility, we asked the following questions:

- Could the SCTA display information on the environmental aspects of the classroom and the emotional state of the students?
- How could the display of such information on the SCTA support educators in the teaching process and facilitate the recognition of situations inside and/or outside the classroom?

Regarding user interaction, we asked the following questions:

- On which device would you like to use the interface? A tablet, a tablet with alarm sounds, a tablet connected to a wristband or an advanced AI bot as another player in the smart classroom.
- How often would you like to receive notifications?

Finally, we asked for impact and social issues of the use of SCTAs, by raising the following questions:

- Would you consider it a helpful tool or a distraction? (for instance, 'tablet' as a potential distraction for teachers; 'cameras' and other devices as a potential distraction for students).
- How might this tool affect teachers' workload? Could it ease or increase it?
- What challenges might teachers encounter?
- Would all teachers be able to use the tool? Across all levels of education? And in all teaching methodologies?
- Would the costs/expenses be worthwhile?
- How would the educational community react to this: negatively or positively? What stigmas might we encounter?
- What ethical barriers might be encountered in its use?
- Could inequalities arise between schools, leading to the emergence of first and second tier institutions?
- Could differences arise due to family background or educational administration?

For the analysis of the data collected in the ATLAS.ti tool, a deductive method was employed, where the categories (utility, user interaction, and impact) were a priori outlined, based on the research questions.

3.2. The views of future teachers

For the group of future users (current students of the Degree of Primary Teacher Education), we organised a lecture within the subject *Organisation of the School Space, Materials and Teaching Abilities*, corresponding to the 2nd year of the degree. Firstly, similar to what we did in the focus group, we introduced the concepts of the smart classroom and SCTA to the participants. Then we presented some discussion points. As the number of participants was high (29), it was decided to conduct an questionnarie online through the Microsoft platform. The questionnaire underwent a preliminary validation process, which involved consultation with several expert researchers in the field, who reviewed the instrument to evaluate the clarity, relevance, and potential for bias or misunderstanding in the formulation of the questions. The participants signed an informed consent declaration, as in the case of the focus group.

Regarding utility, the question formulated was the following:

- On a scale of 1 to 5, rate the utility of the SCTA in relation to the suggested functions (1 not very useful, 5 very useful): Notification of temperature and air conditions, etc.; Notification of the student's attention status; Notification of the quality of the teaching action.

Regarding user interaction, the questionnaire included the following questions:

- On a scale of 1 to 5, rate the different types of interaction (1 not very useful, 5 very useful): Control panel (on a tablet); Control panel with sound warnings when there is some important information to be shown to the user; Control panel with vibration warnings (on a teacher's wristband); human bot that takes part in the classroom.
- On a scale of 1 to 5, rate the frequency of information updates (1 disagree, 5 strongly agree): In real time, during the lecture; immediately after the lecture; whenever the teacher wants; daily email summary; weekly email summary.

Finally, regarding impact, we included the following questions:

- On a scale of 1 to 5, rate whether you agree with the following sentences (1 disagree, 5 strongly agree):
    - SCTA is a distracting element of the teaching task.
    - The inclusion of SCTA will cause reluctance among teachers.
    - The inclusion of SCTA in some centres will create different categories of schools.
    - The inclusion of SCTA will increase the workload of teachers.
    - The inclusion of SCTA will make teaching easier.
    - The introduction of SCTA will increase the quality of the teaching/learning process.
- In your opinion, what security, data protection and ethical aspects need to be considered?

In order to analyse the results according to the different types of students, we also included some additional questions: Have you done some practice in schools? How good are your digital skills? What do you think about the use of Information and Communication Technologies in the classroom?

3.3. Data availability

The data that support the findings of this study are available from the authors upon reasonable request.

4. RESULTS

In this section we describe the results obtained from the focus group and the survey to students related to utility, user interaction and impact.

4.1. Focus group results (teachers)

In these lines, we include the main points extracted from the video recording of the focus group session.

1)RQ1: Utility of the SCTA. One of the most important uses of SCTA is to provide teachers with information on student's attitude. According to the teachers, there are currently no off-the-shelf tools aimed at real-time data collection on students' basic cognitive processes such as perception and attention. Observation is the means to carry it out, and according to Participant 9, “it is mostly subjective on the part of the teacher, and with all the subjectivity involved, there is a great danger that we fall into labelling of the student and a lack of rigour”. Participant 4 adds, “there is almost no instrument specifically designed for everyday teaching”.

Participant 1 explains: “Technology is a great ally to collect data on attention and perception, both with tools like Kahoot or quiz questionnaires and by measuring the actions students take in response to a

digital element — they have to interact with it, and in the end it's a reaction that I perceive. Another option is small questionnaires in paper or online format, but they are very repetitive and end up contributing nothing". Participant 6 explains: "Certainly I don't collect this information systematically. You draw their attention, try to get them to follow you and take in the content, but at no point you do evaluate or analyse these variables in any way. Instead, you just perceive them in an outcome, an assessment that may come from an online questionnaire, an activity, etc."

Another aspect to highlight is the type of activity. When working in small groups, using active methodologies and engaging in shared teaching, it is easier to pay attention to these aspects. There is an agreement that this aspect becomes more challenging when classes are of a lecture-style nature.

On a very different note, Participant 3 stated that "pausing for a moment from classroom activities and finding a space to relax and become aware could help students and teachers reflect on their status, engagement and readiness to learn". In this sense, displaying information about the classroom environment (temperature, minutes with more noise than advisable...) and activating alarms under certain conditions could help teachers decide when to take these types of breaks.

There are several factors which make the situation very complicated and limit data collection among other aspects. These factors include: size of the classroom, diversity, time, organisation and methodology (Participant 8).

One of the recurring variables in the focus group is class overcrowding, which prevents individual student analysis. Participant 1 explained, "Having 40 students and two teachers at the same time enriches the discourse and improves our perception, which brings us closer to reality, but we are still far from it." Participant 6 said: "In rural schools with smaller classes, it's easier to observe student nuances overlooked in larger settings. Despite tech aiding attention, capturing cognitive data remains a challenge. While students may seem engaged momentarily, their full comprehension isn't always apparent, hindering assessment of learning with new technologies."

Another factor that complicates data collection is the diversity in the classroom, "a very heterogeneous variety of students, high-achieving children, children with social, economic and cognitive problems" (Participant 1), "increasingly the diagnostic problem of students with educational support needs" (Participant 8) and the many different forms of individualised support.

However, one teacher expresses scepticism about the tool's utility, highlighting concerns about stress from constant data monitoring and questioning the effectiveness of artificial intelligence solutions. They emphasise existing challenges and raise ethical questions about addressing negative attitudes or lack of attention in class. The majority of participants in the focus group deem the tool to be valuable, as Participant 6 asserts, "I do believe that having more data records gives us, as educators, more possibilities to act subsequently, with a certain objectivity that we may not have at the moment" or Participant 7 says: "It is a tool that is going to help you; it provides you with data, and you act on that data. It gives you more information that you probably, no matter how well you do a good tutorial action with 25 students in the class, as is my case, and a lot of diversity, sometimes things go unnoticed. It is a tool that will help you. It will give you more information, and you have to be more attentive to that information, but I find that it can work for subsequent actions based on the data it has given me.". It has the potential to assist educators in gauging students' attention and comprehension, identifying those who may be lagging behind. Additionally, it could provide insights into the emotional state of

students, thereby facilitating the identification of various issues, including but not limited to bullying, mental health concerns such as childhood depression, and other factors such as substance abuse.

Furthermore, the attending Primary School teachers were highly trained in neuroscience, where emotion plays a prominent role in the learning process. As Participant 7 states, "Clearly, it will help us immensely because right now, we cannot see the emotion they are feeling, and a person without the desired emotion for learning can make mistakes at any moment. It would provide us with a lot of information for our daily improvement. And outside the classroom as well, in conflict resolution, during recess, etc."

Although many teachers see it as useful, they encounter difficulties related to managing the tool, as Participant 1 states, "I consider it very useful, but I find it a bit challenging to see how I manage it in the classroom when you have so many students, being attentive to many things, at many levels of learning, and different learning strategies, and then adding another layer." On the other hand, Participant 9 expresses uncertainty about teacher training in this regard: "This Big Data as support, great at an asynchronous level, but I don't know, at a synchronous level. Well, maybe later in an analysis process within the teaching team, we can turn our decisions of all kinds into more measurable data. However, just like it will facilitate our work, technically, if there is no training, this runs the risk of the usual issues. Very good from above, but at the real level, it is not applicable. And it would be a shame if that is not provided."

RQ2: User Interaction. This section is about the type of device that the participants think should be used to interact with the teachers and the way in which they are to be informed about certain situations.

All participants agree that alarms, noises or other elements such as bots disrupt the pace in the classroom and can distract both the teacher and the students and become a disruptive element in the classroom.

At the same time, there are very different opinions between the group of Secondary School group and the Primary School group. The Secondary School group agrees that they would like to receive notifications via a vibration system on the smart bracelet. For them, it is important that they can intervene the moment the situation arises. Participant 2 explains: "The alarm could go unnoticed and I can deal with it and analyse or manage it if necessary".

Unlike the others, Primary School teachers would prefer to react only visually and after the fact. Participant 9 says: "When the lesson is over, you get the recording. But if every time there is an interruption or something else, a disruptive notification appears, I think it can affect the quality of the lesson."

There are significant differences between Primary and Secondary School teachers. Secondary school teachers want to receive the signal immediately, emphasising the importance of speed and detection to address issues promptly. As Participant 2 says, "If it can be corrected better by acting directly, as everything that remains in a database sometimes just becomes statistics. I prefer to try to find solutions than draw conclusions." Additionally, they would like to receive a daily summary. Primary School teachers unanimously prefer it to be when the teacher wants to consult it.

RQ3: Impact. In this section, we describe the results according to the impact on families, on teachers and on the society. We also address the associated challenges and limitations.

a) Impact on families. One of the difficulties, the one they see as the most challenging to overcome, is related to families, as Participant 3 states: "I also believe that the challenge here would be the families, who, well, in principle, are quite resistant. I don't think they would receive it very positively." The difficulties would be related to organisational aspects such as the acceptance of data privacy, image permissions, and aspects related to privacy and identity, such as the installation of screens and monitoring of students. Additionally, they find difficulties in justifying this type of tool in the classroom by the management team. In general, there is an agreement among teachers that schools are currently facing a challenging period of many changes: "right now, we should calm the waters a bit, new curriculum, inclusion in classrooms (including all children without resources), parents are realising it, and teachers, well, we are a bit burned out... but I still say that the more information you have, even if you can contrast it later or go to work, I think it's positive."

b) Impact on the teaching staff. Regarding the teaching staff, we encounter various difficulties, one of them is related to the doubts generated by technology and sensors in the environment, which could create a space that is neither safe nor calm for students.

Concerning the use of the tool by the teacher, the utilisation of data can amplify the Pygmalion effect in the classroom, as Participant 6 states: "If you have that student who is always distracted, I don't worry so much anymore. Situations can be provoked, this record is created by the tool and plus the record I generate, what are going to be our options and the attitude we are going to have, and the predisposition to solve or to act based on what appears in these records?"

Regarding the use of technology in the classroom, according to the perceptions of the participants, teachers are still wary of technology. The introduction of these types of tools can be perceived as additional work. According to Participant 6, "when so many things have come at once, that you don't have time to take it all in, and teachers' hours are very limited to deal with everything we have right now. I don't think now would be the time."

Another limiting aspect that has emerged throughout the session is related to the roles of teachers, as Participant 5 states: "The role is precisely to know how to detect and play with it. I think a good teacher or someone on the way to becoming one is able to detect all that you have in the classroom and use tools. Therefore, I don't consider it an assisting element now. I think it can negatively influence the work, and I think there were difficulties for the students to feel protected within the school space."

c) Impact on society. The educational community consists of all elements related to it, with families and teachers being part of it. However, a specific section has been considered for them due to their significant involvement in this tool. At a more general level, as Participant 8 states: "The reactive system, just like the education department, is very concerned about the movements of associations, families, who are raising their voices against mobile devices. We all know that lately there have been nothing but news and articles against the use of electronic devices, the distraction that technology use entails, ..., so this would only fundamentally increase that concern of the education department for sure."

As the previous paragraph hinted, the media also plays a very important role in this aspect, and, as they assert many times, it is not positive.

Regarding the differences between schools and communities, it is something that is already happening and that this could even further amplify, unlike what should be the case, as Participant 6 asserts: "The

function of the education system is the equality of individuals, and this equality, that everyone arrives at the same place with the same conditions, the same opportunities have to be generated so that they can reach this place."

In relation to the generated data, the issue of data storage arises. Participant 6 raises the following questions: "Is the school aware of the students' data? If a student leaves my school and goes to another school, should this information be transferred just like grades? Are the observations important enough to be considered when you have a meeting between tutors? There are many aspects that are not reflected in the grades but are discussed, and these should be taken into account if it were to be used on a widespread basis."

Table 2.

Results of the questionnaire for current students of the degree of primary teacher education. For each question, the average (Avg.) and standard deviation (SD) of the values given by the respondents are shown.

Utility of the SCTA	Avg.	SD
Alert about temperature, air conditions, etc.	4.5	0.78
Inform about students' level of attention	4,6	0,62
Notify of the quality of teaching action	4,6	0,78
User interaction with SCTA by means of		
A control panel (tablet	4,2	0,91
A control panel (tablet) with audible alerts when there is useful information to display	2,8	1,2
A control panel (tablet) with vibration alerts on a wristband when there are situations to display	4,1	0,93
A humanised bot that functions as an additional actor in the classroom	2,8	1,17
Frequency of information reception by means of the SCTA:		
Real-time information, during the class	4,4	0,86
Just after the class	4,0	1,17
When the teacher desires, by accessing the system.	4,6	0,87
Daily summary via email	4,2	1,05
Weekly summary via email	4,2	1,23
Impact of incorporating the TA		
Will distract from the teaching task	2,0	0,80
Will create reluctance among the teachers	2,5	1,02
In some schools will create schools of first and second category	3,1	1,11
Will increase the workload of the teacher	3,0	0,99

Will facilitate the teaching task	4,1	0,86
Enhance the quality of the teaching/learning process	4,5	0.68

4.2. Questionnaire results (future teachers)

The questionnaire described in Section 3.2 was answered by 28 students of the Degree of Primary Teacher Education. Of these, 50% have never done any practice in any educational centre, while the other 50% have already had some experience in this field. Almost 90\% of respondents use technology extensively and only 10% use it sparingly.

Regarding their vision of the integration of technology in the classroom, 64.2% believe that it should be fully integrated in educational institutions, 21.4% are in favour of its integration in certain areas and 14.4\% believe that integration should start in Primary School.

Table 2 shows the results of the questionnaire, which used Likert-type questions ranging from 1 to 5, with 1 being strongly disagree and 5 being strongly agree.

RQ1: Utility of the SCTA. All three aspects of utility that were asked in the questionnaire (\ie~physical context in the classroom, level of student attention, quality of teaching) received high marks from respondents. When presented with the concept of the smart classroom, participants showed genuine interest in the potential of such a tool to help teachers better control the environment and gain valuable insights into what is happening in the classroom.

RQ2: User interaction. As far as the user's interaction with the SCTA is concerned, the preferred method is a tablet with a control panel. The fact that the system works with a wristband that sends vibration alerts to the teacher is also viewed favourably by respondents. In contrast, students are not in favour of the interaction systems that actually interrupt lessons (humanised bot and acoustic warning signals). Regarding the frequency of receiving information, all options receive a similar rating from the respondents. Obtaining information in real time is perceived as positive.

RQ3: Impact. In terms of impact, the aspect with the lowest rate is that the use of the SCTA will distract from the teacher task, while the aspect with the highest rate is that the SCTA will enhance the quality of the teaching/learning process.

The questionnaire raises the need to inform and maintain the privacy and confidentiality of students, utilising the gathered information to enhance the physical, emotional, and learning well-being of students, always respecting their rights.

5. DISCUSSION

The integration of smart classrooms equipped with advanced technology offers a solution to overcome several obstacles mentioned by experts that can hinder effective learning in traditional classroom settings. Specifically, the use of the SCTA system, which gathers objective data on various factors, including students' attitudes, empowers teachers to make evidence-based decisions. Currently, some decisions are made on the basis of common sense, which emphasises the need for a more data-driven approach, as other research has highlighted the value of data-driven decision making (data use) to facilitate student learning and improve student achievement (Schildkamp, 2019). Teachers can use data

from classroom assessments and observations to tailor their teaching practices to the learning needs of their students (Schildkamp et al., 2016). However, technology has great potential in the educational environment and is associated with many teaching and learning tasks, human-centred activities such as reasoning and decision-making will be challenging to replace (Lee et al., 2018).

While some teachers are excited about the teaching opportunities and flexibility they can achieve through the SCTA, others are concerned about the effects that technology and AI can have within the educational community, including privacy and data usage (Oke & Fernandes, 2020).

Gathering information about the classroom environment, students' emotional well-being, their level of engagement, and the quality of teaching methods is perceived by both current and future teachers as a useful and essential tool to ensure an effective teaching-learning process. However, despite its potential usefulness, there are studies aimed at detecting student attitudes and attention, but these are still in the early stages and are highly complex (Unciti et al., 2024). Intelligent systems provide both students and teachers with instructions and feedback that are tailored and personalised to individual needs (Caballero-García et al., 2022). Based on the information collected, the most appropriate method for current and future teachers is to use a tablet or electronic device that can collect this information.

Among the proposed options for the presentation of data, interfaces with reports, interfaces with alerts (either by vibration, lighting or sound) or a humanised bot were suggested. The results of the discussion group and the questionnaire are similar: the most accepted option is the tablet with reports, followed by the option of alerting by vibration. The options that are less accepted by current and future teachers are acoustic factors and the bot, as they are seen as factors that are extremely distracting for both teachers and students. Bots are still perceived as agents with less knowledge, empathy and more abrupt behaviour (Chocarro et al., 2021). It is interesting to note that although technology is a factor that teachers consider necessary in the classroom, participants favour traditional elements over more innovative ways of using technology. Previous publications show a technological model that is still evolving, which implies a change in the way of thinking and working of teachers and students in the use of technology (Caballero-García et al., 2022), with the possibility that not all the possibilities that technology can offer to the educational community are fully exploited (Oke & Fernandes, 2020).

Regarding the frequency with which the device should send information, all participants agree that it is important for the teacher to decide when to retrieve the information. Secondary school teachers and teacher education students consider it important that the information is displayed in real time, in order to respond to the students' needs at that moment. In contrast, Primary School teachers believe that this would not be useful and would tend to distract them.

In terms of the impact that SCTA can have, there is a consensus that knowledge of data can improve the teaching-learning process. Objective data in real time can help in decision making and provide new insights that facilitate teaching activities. In terms of workload, challenges such as understanding the tool, interpreting the data presented, etc. are mentioned, which can be perceived by teacher as an additional workload. Other studies have highlighted the difficulties in integrating technology into the educational environment due to a lack of training, time and technical support (Siyam, 2019); however, if these aspects are covered, AI could be helpful in automating and facilitating administrative tasks and allow more time for face-to-face work with students (Alam, 2021).

There are differences between the participants in terms of teacher resistance. Teachers at Primary schools' express greater concerns in this regard and even include factors such as the privacy and intimacy of users. In contrast to Secondary School teachers and students, who have a more positive view, they state that there may be some people who resist, but not as something significant. In line with the Bahmannia et al. (2020) study, in which Primary School teachers primarily valued competences related to family relationships and ethics rather than technological competences, while Secondary School teachers emphasised aspects such as classroom management.

With regard to the question of whether the tool can be a distracting element, future teachers are of the opinion that it is not a distracting element. Within the group of current teachers there are different opinions. Some believe that it is a distracting element at first, but that they get used to it in a short time. Others, however, see it as a constant distraction for students and teachers, which could cause stress.

This may be related to the experience we have with technology, with future teachers being younger and more comfortable with it (Szymkowiak et al., 2021). Additionally, studies like Jimenez-Hernandez et al., 2020) provide clear evidence that younger teachers are considered more technologically competent.

6. IMPLICATIONS

The implications that this tool would have on the educational system are twofold. On the one hand, it would improve the teaching and learning process by allowing individualisation for each student and providing more accurate data. On the other hand, it would contribute to the management of the classroom by raising awareness of activities and schedules for the student group and even detecting situations such as possible cases of bullying. This, in turn, can have an impact on society by helping to recognise and respond to mental health issues at an early stage and contribute to the development of socio-emotional skills. For the technology and educational industry, the development of a technology that is still relatively under-researched in educational would be an important boost to pedagogical methods by investigating how emotions influence the teaching and learning process. Pokrivcakova (2019) emphasises that for the design and implementation of such a system requires the collaboration of professionals from different fields such as education specialists, psychologists and pedagogues, system and data designers, product designers and statisticians. The involvement of professionals from different disciplines ensures a comprehensive perspective for the successful development and implementation of the system.

7. CONCLUSION

The article has presented a study on the Smart Classroom Teacher Assistant (SCTA), exploring its utility, interaction, and impact. Unlike previous works focusing on user interfaces, this research delves into practical aspects, surveying both current and future teachers to gather insights. Findings show SCTA's value in collecting student information, but preferences lean towards non-intrusive, post-lecture interaction. Divergent views on SCTA's impact highlight persistent concerns about employment, privacy, and data usage despite acknowledging technology's potential. While intelligent systems offer personalised feedback, there's a preference for traditional teaching methods. The frequency of data retrieval remains contentious, with secondary school educators advocating for real-time display, while primary school teachers fear distractions. Addressing challenges like workload and resistance is crucial for leveraging technology's full potential. Future teachers exhibit a more positive outlook, emphasising

the need for training, technical support, and privacy considerations. In this line, it is essential that the SCTA includes a security and privacy panel control, aimed at raising awareness about these issues and describing how the whole system manages these aspects.

The study presents several limitations that should be acknowledged. Firstly, the sample is small and localized, which restricts the generalizability of the findings. Nonetheless, it offers valuable insights into the everyday realities of classroom settings. Additionally, as the study is based on teachers' opinions, the data reflects subjective perceptions shaped by personal experiences, levels of technological familiarity, and attitudes—whether of enthusiasm or concern—toward the potential impact of emerging technologies in educational environments. It is also important to note that the assistant remains at a conceptual stage; the prototype has not yet been implemented in real classroom contexts. As such, participants' feedback is based on hypothetical or imagined use cases, which may limit the validity and practical applicability of their responses. While the study gathers perspectives from both current and future educators, it does not incorporate the views of other key stakeholders—such as students, families, school administrators, policymakers, or the technical teams responsible for development. Including these voices in future research would contribute to a more comprehensive and holistic understanding of how a classroom assistant should be designed, implemented, and integrated into educational ecosystems. The research underscores the teacher's pivotal role in effective tool utilisation, with future directions aiming to develop a prototype informed by study findings and assess its impact on teaching and learning processes.

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