The Smart Classroom: Learning Challenges in the Digital Ecosystem

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Abstract: Digital devices are causing the emergence of new learning ecosystems, including the smart classroom. This model changes the pedagogical intermediation paradigm, redefining educational values and principles. The present paper delves into this scenario through the results of a doctoral thesis funded by the Ministry of Science, Innovation and Universities of the Spanish Government. The research is based on a qualitative approach, involving a field study in four schools in the Valencian Community. The information is collected through the study of the school documentation, in-depth interviews with 23 teachers and participant observation sessions. This information is analysed under the postulates of discourse analysis. The results show that teachers see the smart classroom as an innovative paradigm that facilitates active learning. However, the focus tends to be on technologies, which are assumed to optimise learning. Teachers opt for the implementation of technology-mediated methodologies, such as the flipped classroom, PBL or gamification, but these often operate more at the formal level than at the applied level. Despite this, a learning ecosystem is emerging that is significantly different from the traditional one, involving a change of logic in which digital technologies adopt the centrality formerly held by the textbook or the teacher.

Keywords: smart classroom; educational technology; digital platforms; digital transformation; learning process

1. Introduction

The use of technologies and, more specifically, of digital platforms is causing a profound transformation of the educational system as well as of the teaching and learning process [1]. This phenomenon can be seen not only in the widespread and increasingly intense presence of these devices as everyday work tools in schools but also in the emergence of a new educational ecosystem in which digital platforms act as a core element.

This process involves a change in educational resources, which are now being progressively digitalised [2]. However, it also entails a mutation in the ways of conducting and conceiving education, which are being impregnated with digital logic. This process has been described in the academic literature as a “digital transformation” [3,4] and, more recently, as the “platformisation of education” [5], which involves schools adopting both digital resources and the practices and values associated with them as their own.

As a result, new approaches for teaching and learning in the digital society have been gaining momentum in recent years, including technology-enhanced gamification, the flipped classroom, educational robotics, STE(A)M learning and computational thinking, among others. New digitally mediated learning ecosystems are also emerging, including the so-called smart classroom, a model characterised by the establishment of synergies between digital devices and the practices in which they are used [6].

With regard to the latter, the smart classroom requires the introduction of “smart” resources [7], i.e., the digital equipment necessary to be able to work with digital technologies and platforms on a daily basis [8]. This covers a wide range of possibilities, from the
basic provision of computers, interactive whiteboards and an internet connection to the introduction in the classroom of more sophisticated technologies such as IoT (Internet of Things) systems [9], haptic elements [10], robots [11], drones [12], 3D printing [13], Scratch programs [14], AI or augmented reality [15,16].

In addition to the changes in educational resources, the reorganisation and reconfiguration of spaces with respect to the traditional classroom structure is also championed. There is a move towards more open structures that allow for flexible activities and groupings [17], with large, open spaces, organisation into corners and specific areas, multipurpose furniture, etc.

Furthermore, the smart classroom claims to be a transformative model that breaks from the traditional approach of teaching and learning. This phenomenon can already be sensed in the aforementioned elements and materialises especially in the redefining of classroom practices. Thus, new educational values and principles linked to the competences approach [18,19], to the so-called soft skills [20], to active methodologies [21] and to the constructionist and maker perspective of learning [22] are introduced.

In summary, the review of the academic literature suggests that the implementation of the smart classroom involves changes in three different dimensions: educational resources, teaching and learning practices and the roles of students and teachers, as summarised in Table 1.

<table>
<thead>
<tr>
<th>Transformations</th>
<th>Literature</th>
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<tr>
<td>Educational resources</td>
<td>[7–16]</td>
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<td>Teaching and learning practices</td>
<td>[17–21]</td>
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<td>Roles</td>
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However, the focus of the academic literature on transformations in resources and practices does not transfer to other dimensions of great importance such as roles (which are less frequently studied) or to the axiological principles that guide activity in the smart classroom. Nevertheless, this model advocates a holistic restructuring of the traditional paradigm of pedagogical intermediation. In this way, based on daily work with digital technologies and platforms, new, more personalised and deregulated, lighter and more flexible learning formats are promoted, associating digital work with pedagogical innovation.

Within this scenario, some questions such as the following arise: Are teaching and learning resources and practices really being transformed? Is the role played by teachers and students changing in this new model? What principles and values govern classroom activity? What is the role of teachers and students in this new model? Additionally, what are the principles and values that guide classroom activity? In short, what does the implementation of the smart classroom mean for today’s schools and what does it contribute to innovation?

Taking these questions as a starting point, this article explores the smart classroom and the transformations it is bringing about, also focusing on aspects scarcely explored in the academic literature, such as role transformations and axiological principles, through a doctoral thesis research project funded by the Spanish Ministry of Science, Innovation and Universities (reference: FPU16/04009). For this purpose, firstly, the methodological details of the research are presented (Section 2). Subsequently, the main results are described (Section 3), organised around four dimensions of analysis: (a) the educational resources used in the smart classroom, (b) the teaching and learning practices that are developed, (c) the changes produced in the educational roles, and (d) the new axiological principles that guide the activity in the smart classroom. Finally, the most relevant conclusions are discussed and synthesised (Section 4).
2. Materials and Methods

This paper is based on a research project focused on analysing the changes that digital platforms are generating in the work of early childhood and primary education teachers. Within this framework, an investigation is undertaken for the smart classroom model, among other digital learning ecosystems.

The research is based on a qualitative methodology that is aimed at conducting an in-depth analysis of the restructuring undergone by the school organisation and is concerned with revealing the ins and outs behind the platforming of the school and, in this case, behind the implementation of the smart classroom model.

This approach is realised in the methodological proposal of “thinking by cases” [23], in which knowledge is generated through continuous questioning and dialogue between recent academic literature and the reality of the school and its agents. In this way, the “case” is thought about and constructed as the process progresses. In line with this approach, a spiral research design has been used, which allows the case to be thought from the “outside in” in a five-stage process, as shown in Figure 1.

![Figure 1. Research design.](image)

In the first phase, the research is designed, establishing its objectives and starting hypotheses, with the aim of delving deeper into the transformations of the smart classroom. In the second phase, recent academic literature related to this educational model is reviewed in order to study the object from the outside.

To complement this information, in the third phase, a field study was carried out in four preschools and primary schools in the Valencia Region (three state schools and one state-funded private school), the most relevant data of which are presented in Table 2.

### Table 2. Characteristics of the schools participating in the field study.

<table>
<thead>
<tr>
<th>Holder</th>
<th>School 1</th>
<th>School 2</th>
<th>School 3</th>
<th>School 4</th>
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<tr>
<td>Context</td>
<td>State</td>
<td>State</td>
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<td>Private</td>
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<td>Students</td>
<td>Semiurban</td>
<td>Urban</td>
<td>Rural</td>
<td>Urban</td>
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<tr>
<td></td>
<td>475</td>
<td>300</td>
<td>400</td>
<td>225</td>
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These four schools were selected intentionally, following the purposeful selection strategy [24] based on criteria previously established in the research design. In all of them,
teachers and students work on a daily basis with digital platforms in the classroom and are committed to the implementation of new learning formats and new digital ecosystems, among which the smart classroom stands out.

To collect information, different techniques and instruments were used in order to approach the phenomenon studied from various dimensions and perspectives, which are shown in Table 3.

Table 3. Research techniques and instruments.

<table>
<thead>
<tr>
<th>Research Technique/Instrument</th>
<th>Participants</th>
<th>Research Purpose</th>
<th>Analysis Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documents Analysis</td>
<td>-</td>
<td>Exploring the formal dimension of ICT in schools</td>
<td>Documentary analysis</td>
</tr>
<tr>
<td>Platforms Analysis</td>
<td>-</td>
<td>Studying the characteristics of the platforms used in the smart classroom</td>
<td>Documentary analysis</td>
</tr>
<tr>
<td>Participant observation</td>
<td>Students, Teachers, School Directors</td>
<td>In-depth examination of the smart classroom reality</td>
<td>Documentary analysis</td>
</tr>
<tr>
<td>In-depth interviews</td>
<td>ICT Coordinators, Teachers (tutors and specialists), Novel teachers, ICT training area staff</td>
<td>Understanding teachers’ views on the smart classroom</td>
<td>Conversational analysis</td>
</tr>
<tr>
<td>Field diary</td>
<td>-</td>
<td>Gathering information and organising fieldwork</td>
<td>Documentary analysis</td>
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Firstly, in order to form a preliminary understanding of the four schools, their academic documentation was analysed, including the school’s Educational Project, the Digital Plan, the Annual General Programme, etc. This allowed an exploration of the role that technologies and digital platforms play in the formal dimension of the school and of the conceptions and expectations that teachers have of the smart classroom.

Following this, a deeper examination of the reality of each school was made by carrying out systematised participant observation sessions of classroom situations [25] based on the proposal of digital ethnography [26], which is aimed at observing practices in technology-mediated environments. In this sense, the objective of the sessions was to observe in depth and in real environments the transformations that the smart classroom introduces with respect to the traditional model, i.e., the educational resources that are used, the practices that are developed, the tasks that teachers and students carry out, the objectives they pursue, the learning approach that underlies the practices, etc. In each one, observations were carried out in three classrooms, in different subjects, observing between four and six sessions per classroom. The resources and digital platforms used during the sessions were also analysed, investigating the role they play in the teaching and learning process.

This work was complemented by conducting individual in-depth, semistructured interviews with teachers who perform different functions in each school, such as management teams, ICT coordination and teachers, and both tutors and specialists. In total, 23 people were interviewed. Prior to this, ad hoc scripts were designed and discussed with three experts in the field of educational technology and four teachers from the preschool and primary education stages. The interviews were audio-recorded, always with the authorisation of the interviewees, resulting in a total record of 1071 min (18 h). Subsequently, the interviews were transcribed verbatim and sent to the interviewees, who reviewed them and were able to make changes and contributions, before finally authorising their use in the research.

A field diary was used transversally [27], in the form of anecdotal records, in which the most relevant details and observations that appeared during the process were documented.
Following the development of the field study, in the fourth phase, the information gathered through the plurality of techniques and instruments used was analysed and the results were synthesised. To this end, the approaches of discourse analysis [28] were followed. Specifically, conversational analysis was used to analyse the interviews, while documentary analysis was used to analyse the information from the other instruments and techniques. This phase focused on four dimensions: the educational resources used in the smart classroom, the pedagogical practices undertaken with them, the roles adopted by students and teachers, and the axiological principles that guide the work in the classroom.

Finally, in the fifth stage, the main conclusions are summarised.

3. Results

As explained above, the research investigated the transformations derived from the implementation of the smart classroom, analysing how classroom practices and conceptions change. The aim was to reveal how teachers interpret and implement this model, studying its link to educational innovation.

With this premise in mind, the main evidence extracted from the research is presented below, organised around the four dimensions derived from the analysis of the academic literature and summarised in Figure 2, which aims to answer the questions posed in the introduction.

![Figure 2. Dimensions of analysis and presentation of results.](image)

3.1. Smart Classroom Educational Resources

Educational resources are a fundamental part of organising and undertaking work in the smart classroom. Focusing attention on this dimension, all the classrooms studied used a wide variety of educational tools and materials that combined analogue and digital support.

As far as analogue educational resources are concerned, manipulative materials were seen as being of particular importance. Teachers argued that these resources favour the development of skills and abilities because they allow the implementation of hands-on and experimental learning experiences. Within this typology, models, video clips, experimentation and science material, puzzles and building blocks and, especially, games of different types (board games, logic games and symbolic games) stand out.

It should be noted that gamified learning is a characteristic element of all the smart classrooms studied, both in physical and digital format. Teachers indicate the importance of entertainment and student motivation in the development of the learning process, noting that, with these resources, students “think they are playing, but they are learning a lot” [29] (l. 404). This is an indication that in the smart classroom, it is not only the resources that
change but also the practices and axiological principles which guide the work, as will be discussed in later sections.

Often, these educational resources are used jointly in the classroom through flexible groupings, organisation into thematic corners or learning environments. The application of personalised learning proposals in which students work autonomously, regulating their own pace of learning, is also activated. Flexibility is transferred to the organisation itself and to the furniture present in the classroom, which in the vast majority of cases is multipurpose and allows the space to be transformed with little effort and time, for example, through the use of shelves that can be converted into chairs, or “paint to make magnetic walls and paint to make blackboard tables” [30] (l. 141–142).

Continuing with the analysis of educational resources, it is worth noting that, despite the focus on digital technology, none of the classrooms dispense with printed materials, such as books, notebooks, worksheets, posters, diagrams and maps. In fact, the teachers explicitly state that they consider it essential to maintain these educational resources and to continue educating their students in analogue culture. In line with this, they claim the importance of not “losing pencils and writing” [31] (l. 132), pointing out that both models “go together perfectly” [32] (l. 263–264). These statements are of great interest because they show that teachers do not perceive analogue and digital logics as antagonistic, despite the contradictions that often exist between them. On the contrary, they see them as complementary options. This means that the smart classroom is based on hybridisation, both in terms of resources and in terms of culture and operating logic.

However, despite this coexistence of models, there is a greater tendency towards the introduction of digital educational resources, a typology of resources that some authors refer to as “smart resources” [7], thereby demonstrating the centrality they occupy in the smart classroom model, which is clearly based on the concept of technology as innovation.

Focusing on this type of resource, all the classrooms studied have digital infrastructure and equipment. However, a great diversity of formats and interpretations of the smart classroom was observed among the schools participating in the research. This is reflected both in teachers’ visions of the model and in the different ways of putting it into practice. To a large extent, this is due to the possibilities of each school in terms of acquiring resources or making them available.

The schools with more resources advocate the implementation of as many technological resources as possible, as one of the teachers interviewed acknowledged, stating that, with regard to technology, “I try to introduce as many as I can and more into the classroom” [33] (l. 394). This is confirmed in the observations, where the use of a wide variety of technological resources such as digital platforms, computers, digital tablets, interactive whiteboards, interactive monitors, Chromebooks, Scratch programs and even 3D printing devices, drones, educational robotics resources and a Chroma key screen was noted.

In contrast, low-income schools implement the smart classroom with only the basic digital infrastructure to be able to work with digital platforms on a daily basis. This option includes an internet connection, a computer for the teacher and digital devices for the students which, in most cases, are shared in these schools (in pairs or groups of four).

Despite the disparity between these formats, teachers described them as smart classrooms in both cases. This suggests that technological equipment plays a central role in the model—since digital work is valued by all participating teachers as an essential and characteristic requirement of the smart classroom—without concealing the fact that other aspects also come into play in its very definition.

This phenomenon is directly highlighted by the teachers participating in the research, who stated that in the smart classroom it is necessary to find a symbiosis between what they call technological innovation and methodological innovation. In other words, they pointed out that the incorporation of digital resources in the classroom cannot be understood without the implementation of certain teaching and learning practices and strategies.
This position was made clear when one of the teachers who works in a school with limited resources (and therefore has little digital equipment and a limited catalogue of “smart” resources) argued that “I have a classroom of the future. Because I’m starting to have digital equipment. We also have work in teams, cooperative learning… a bit of everything, right?” [32] (l. 205–207). The teacher’s statement shows that digital educational resources are only one of the pillars with which the smart classroom is built. Consequently, it is necessary to investigate the other pillar mentioned by the teachers: the teaching and learning practices.

3.2. Teaching and Learning Practices and Methodological Change

As previously explained, the smart classroom constitutes a particular learning ecosystem, in which educational resources and practices combine synergies to favour a change in the educational paradigm. In this sense, all the teachers participating in the research not only agreed that in order to transform learning it is necessary to introduce digital technologies, but they also stressed the importance of innovation in teaching strategies. This aspect is particularly important since, in fact, in their statements, teachers prioritised the updating of practices over the renewal of educational resources, stating that transformation derives more from a change in ways of doing things. This view is clearly reflected in the following statement by one of the teachers interviewed, who pointed out that updating “depends more on methodology than on technology […] I don’t think technology per se achieves anything; it’s more a mix of all that work and the way things are done” [34] (l. 422–425).

It should be noted that this position of the teaching staff needs to be qualified, as they do consider a minimum change in resources to be essential, which involves introducing digital technologies into the classroom. However, once this objective has been achieved, they emphasise that the transformation that must take place in the ways of doing things must be more profound and notable, with much greater depth than that concerning the tools used. Thus, teachers point out that an inherent feature of the smart classroom is the need for new resources to also be associated with innovative uses and formats, arguing that “the key to the effective introduction of technologies is the methodology” [35] (l. 1198–1199).

A strong consensus emerges around what teachers describe as “methodological change”, which implies a holistic transformation of the teaching and learning process, both in terms of learning tools and “changes in the way classes are taught, in the learning model” [31] (l. 40–41); in short, changes in the ways of teaching and learning.

They advocated a reformulation of educational practices with respect to the traditional method, through the inclusion of new organisational and didactic strategies. Among these, the teaching staff particularly highlighted five strategies which they included under the category of “active methodologies”: project-based learning, service learning, flipped learning, cooperative learning and gamification.

During the classroom observations, examples of the application of these five teaching strategies could be seen, which were directly cited by the teaching staff as indicators of the methodological change, underlining that they are more up-to-date strategies, in line with the current reality and the characteristics and interests of the students. All these teaching methods are combined with the use of devices and digital platforms, and the teaching staff argued that it is the combination of both elements that makes it possible to transform the educational model. However, what does this transformation translate into? There are two main results that emerge from this question: the change in the ways of understanding the teaching and learning process, and the change in the ways of executing it.

With regard to the first transformation, it is worth clarifying that the new teaching strategies do not respond to the same level of categorisation according to the logic applied by teachers to organise the teaching and learning process. Cooperative learning, flipped learning and gamification are at more specific levels, being used for specific activities and at specific times. On the other hand, project-based learning and service learning respond to a more global approach, forming the core strategies of classroom activity.
However, regardless of this hierarchy and structuring, teachers insist on highlighting all these strategies as indicators of pedagogical updating and educational innovation in the smart classroom, placing them on the same level in terms of discourse. This suggests that the transformation of the educational paradigm is not limited to the practical level, but also operates through a network of narratives legitimised at the social level and reproduced by teachers, which present the technological–methodological change in schools as a real “Copernican shift”. As a result, the innovative vision of digital technologies and the learning ecosystems linked to them are consolidated in the collective imaginary and are accepted as social consensus. In this way, the ways of understanding education and the teaching and learning process itself are transformed.

Focusing on the transformations in the ways of executing the teaching and learning process, not only do the new didactic strategies involve new narratives, but they are also associated with specific practices and approaches that differ substantially from the formats of the traditional educational paradigm. As a result of the assumption of the postulates of project-based learning and service-learning as new core approaches, teachers stressed the importance of orienting the teaching and learning process towards the creation of final products that require students to put skills and abilities into practice, and which reflect the level of competence achieved.

In most cases, the creation of this final product involves the use of digital platforms through the generation of videos, infographics or content for web pages that enable the transfer of learning and its dissemination and projection to the outside community. As the teachers stated, “we use all the digital applications that allow us to generate products” [34] (l. 177–178).

All these initiatives are presented as being innovative, which leads to a redefinition of practices, but also involves a major paradigm shift, now based on three basic pillars: digital work, the constructionist vision and the competence approach. In this way, priority is given to the development of skills, competences and abilities—i.e., the dimension of doing, rather than the development of knowledge, which is more associated with the traditional approach to learning.

In line with this new conception, the following statement made by one of the teachers stands out: “The students get bored listening to you talking. Your theoretical explanations here in the classroom should be very brief. They have to be [. . . ] doing activities continually and changing activities from time to time” [33] (l. 553–556). This quote is significant not only because it illustrates the change in the way the teaching and learning process is understood and executed, which is now moving towards deregulation and prioritising student activity over teaching content, but also because, linked to this, it provides a sense of a reconceptualisation of the educational roles of teachers and students, as discussed below.

3.3. Educational Roles

Regarding educational roles, teachers affirmed that the implementation of the smart classroom supports and promotes a substantial mutation of the role of teachers and students with respect to the traditional paradigm of teaching and learning, pointing out that “the role changes completely; it has nothing to do with responsibilities and tasks” [29] (l. 206–207).

They identified with the role of the teacher as a guide, energiser and facilitator of the teaching and learning process, a teacher who guides students in the autonomous construction of their learning and motivates them in the process. This mutation in their role is summarised in the following quotation, pointing out that the important thing is no longer to instruct students in content, “but to provide them with ways to create things” [30] (l. 370).

Consequently, the role of the learner also undergoes intense transformations, because the focus of action now shifts from the teacher to the learner. The latter goes from occupying the role of “object” or recipient of learning, as in the traditional educational paradigm, to becoming an active subject and protagonist of the new teaching and learning process. The focus is now on their activity, their creation of products, and the aim is for them to
From this emerges a vision of students as makers, as constructors of their own learning [22]. These results indicate the establishment in the smart classroom of an approach that we can call "digital constructionism", in reference to the centrality of the creation of products with digital technologies and platforms in the current teaching and learning process. This approach is also presented as the optimal learning model, as is evident when teachers emphasise that “creation is already the best” [33] (l. 607–612).

At this point, we may wonder how this digital constructionism translates into the classrooms studied, and to what extent pupils establish themselves as makers. Based on the classroom observations, it was observed that, in some cases, pupils did create digital content and generate learning products using digital platforms. However, the vast majority of these products reproduced formats that could be produced with analogue materials, such as slide presentations, infographics, diagrams and digital concept maps—which the teachers highlighted as being innovative in nature. This phenomenon is in line with the generation of associations between “smart” resources and innovation and educational improvement, already mentioned in the previous section. At the same time, it is evident that the transformations frequently operate more at the formal level than at the applied level.

Looking more closely at the reality of the classrooms studied, it can be seen that these activities in which the pupils acted as product creators, despite being the ones that are most highlighted and vaunted, constituted a minority in the daily work in the classroom. On the contrary, on most occasions students interacted with smart resources in much less active ways, far removed from this maker perspective, which in some classrooms was incidental or non-existent.

Analysing the role of the students, it can be seen that, for the most part, their activity was not based on the generation of products and the creation of content, but on the execution of mechanical tasks. Among these, teachers notably highlighted as being innovative the activity of answering questionnaires organised around the closed-response model, in which the student’s action is limited solely to selecting and clicking from among predetermined options. These questionnaires are based on traditional and eminently technical approaches, which reproduce the classic behavioural model of stimulus–response. However, on the other hand, they claim to be educational innovations because they use gamification (and so-called active methodologies) and involve the use of technology. This gives them this “aura of innovation” that envelops both the resources and the smart practices.

Finally, the role mainly adopted by students is that of consumers of content, either by watching videos or by reading presentations, infographics and web content. This role is similar in its foundations to that of the receiver of information that operates in the classic paradigm, although it implies a change of great transcendence that, in this case, concerns the teaching staff. Now, the contents are not taught and directed by the teacher, but by the educational resource itself. Thus, the centrality that in the traditional paradigm was held by the teacher is now transferred to the digital platform. This implies a profound redefinition of the teaching and learning process and the role of the teacher within it.

These findings point towards the understanding that the adoption of the maker role by students is still far from being widespread. Moreover, they reflect the survival and restoration of technical learning roles, which are now camouflaged and concealed by a digital gloss. However, this does not imply the absence of transformation—quite the contrary. In the background lies a profound metamorphosis of the axiological principles that guide and structure the activity of teachers and learners and the process of teaching and learning. This is a phenomenon that has emerged in the results presented so far, which is explored in further depth below.

3.4. Axiological Principles of the Smart Classroom

As reflected in the previous sections, the smart classroom represents a holistic redefinition of the educational model. This phenomenon is defended by the teachers who
participated in the research, who argue that its implementation constitutes “a complete change [. . . ] a totally different way of looking at teaching, an impressive methodological change, a change in assessment, a tremendous pedagogical change” [32] (l. 649–650). Additionally, it is precisely in the transformation of the axiological principles that guide and structure the activity in the classroom where the metamorphosis can be observed with the greatest intensity.

Based on this premise, the following question arises: what are the new principles that organise the work in the smart classroom? With regard to this query, it is worth remembering that teachers link this educational model to an approach that places the emphasis on the product. This constitutes a paradigm shift with important implications for the organisation of work and the construction of knowledge because the focus now shifts from the process (from learning) to the product, i.e., to the output; to the final result. In this sense, one of the axiological principles governing work is productivity, understood as the students’ ability to produce, to generate products.

As previously discussed, this emphasis on product creation sometimes operates only on a formal level, but has no real, practical application in the classroom. In other words, although classroom programmes and teachers’ discourse are based on this constructionist orientation and emphasise the role of students as “product creators”, these activities have little impact in global terms. However, they contribute to legitimising the smart classroom model at a discursive level, as well as its innovative and transformative nature.

On the other hand, in some classrooms an excessive focus on this product-based vision has been detected, transferring all responsibility for the teaching and learning process to the students. In this approach, teachers limit themselves to offering students the resources and some guidance and then “They start to do. They start to learn” [33] (l. 545). This is defended by teachers as “a way of making them independent and autonomous” [36] (l. 186). However, to some extent this view implies a devolution of responsibility to the learner, while relegating the processual dimension inherent in the learning process. This leads to a loss of depth and significance in learning, as well as to a technocratic conception of the process as a whole.

This product-based vision is combined in the classroom with the use of digital technologies. Although these practices involve a reorientation and reformulation of the teaching and learning process, it has been detected that, in these cases, “smart” resources are not usually used for their intrinsic potential, but are mainly used for a sensationalistic purpose, in order to make it so that “the product presented by the child can be more attractive, more visual” [34] (l. 74–75). This suggests that the products created are not limited to aspects related to learning but must fulfil certain characteristics in order to present themselves as attractive and thus be positively valued by society. Additionally, it is mainly for this reason that work with digital technologies comes into the picture.

In the context of these questions, research has shown that in many cases “smart” resources are used for similar purposes to those that can be achieved using other more traditional tools. However, with digital technologies, a more striking and apparently more innovative and modern effect is achieved. This phenomenon is even mentioned by some teachers, who explain that digital technologies and the practices undertaken with them are often instrumentalised, because in reality “the same things you can do with technologies you can do without them. And sometimes they require less preparation” [37] (l. 705–706). However, they recognise that incorporating digital work adds to the perception of innovation, noting that “no matter how much material you prepare, it’s never going to beat the technology and its so-called ‘magic’” [38] (l. 93–94). This indicates that the implementation of digital technologies in classroom practices gives the activities a “smart” aura that is highly valued and appreciated socially, as it corresponds to the hegemonic concept of what education should be like in today’s digital society, and the role that teachers and students should adopt in the process. Therefore, innovation aimed at obtaining social returns also constitutes another of the emerging axiological principles.
Linked to this aspect, two new principles emerge: transferability and performativity. With regard to transferability, emphasis is placed on the importance of learning being “useful” and transferable [39]. This approach runs the risk of imposing a utilitarian vision of education, which focuses solely on its exchange value and is once again aimed at obtaining social profit. This phenomenon is observed when the teachers highlighted the objective of showing the work carried out in the smart classroom “above all to parents [. . . ] everything we do” [40] (l. 179–180).

Additionally, as far as performativity is concerned, it is detected in both its etymological readings as spectacularisation and as a focus on performance. The first meaning is visible in the aforementioned sensationalist use of smart resources and in the fallacy of innovation that gravitates around some practices. Finally, as far as the focus on performance is concerned, this could clearly be seen when, among other cases, one of the teachers stated that “one of my theories, in other words, my motto: I don’t do anything that is not going to be effective. I’m very clear about that” [32] (l. 437–438).

The appropriation of such narratives and approaches by teachers in terms of their obsession with productivity and performance is an indicator of the endogenous commodification or privatisation of education [41], based on the export of private sector methods and values.

In short, a new educational model is emerging that is no longer oriented towards the development of learning processes, but towards the generation of products that are socially attractive, that is, that meet “market standards”. It is, therefore, a profound redefinition of the educational paradigm, a phenomenon that will be discussed below.

4. Discussion

The research shows that the smart classroom is an emerging educational model that is progressively gaining popularity among teachers, who conceive and defend it as being an innovative and flexible model. In this respect, they highlight its potential to transform and renew the teaching and learning process, based on the establishment of powerful synergies between digital educational resources and the implementation of “active” teaching strategies [9,21]. This approach is in line with the hegemonic social discourse and is also reproduced in the recent academic literature, which emphasises the innovative possibilities offered by the smart classroom [8,17].

Despite this widespread belief, there are also critical voices that denounce the perversion and instrumentalisation of some of the approaches used in the implementation of the initiative. Nevertheless, they also recognise that they themselves do not escape its influence, precisely because of the notoriety and prestige it is gaining in the social sphere and because of the innovative aura it has [3,5].

In this sense, it can be seen that teachers tend to link the use of so-called “smart resources” [7] with educational modernisation, arguing that they are more motivating and attractive resources for students [15]. Thus, as a result of the complex interaction between the discourses and practices used by teachers and the approaches that govern the social sphere, the associations between smart resources, methodological change and educational improvement are legitimised. These links are generalised to everything mediated by digital technologies, which leads to perceiving the implementation of new learning ecosystems, such as the smart classroom, as models with great innovative and optimising potential, despite the fact that, in many cases, in-depth innovation understood as educational optimisation occurs more at the formal and discursive level than at the applied level; in other words, it is more performative than efficient [1,5].

The smart classroom, in this sense, is much more than an educational model. It constitutes a paradigm shift that establishes a different organisational logic, in the sense that it involves new tools, but also new ways of doing, acting, organising and thinking about the teaching and learning process [42–44].

These new forms do not respond to a static and unambiguous model. On the contrary, as a result of the flexibility inherent in the smart classroom, the research has made it possible
to appreciate the plurality of interpretations and meanings that teachers attribute to this concept. This is due to multiple factors, including the characteristics of the school and, in particular, the availability of resources and the autonomy to acquire and manage them. Thus, in the four schools that participated in the research, multiple formats of the smart classroom could be observed. However, in all the cases studied, three common requirements or characteristics were met: daily work with technologies and digital platforms, the reorganisation of spaces and groupings, and the application of strategies linked to what teachers call “methodological change”, in other words, the so-called active methodologies.

Based on these three aspects, and as reflected in the presentation of results, the implementation of the smart classroom causes intense mutations in classroom work and in the educational model [6], which materialise in changes in resources, practices, educational roles and, especially, in the axiological principles that guide the teaching and learning process, as summarised in Figure 3.

**Figure 3. Smart classroom transformations.**

In line with these transformations, it should be noted that not everything is new in the smart classroom. It continues to use resources and approaches that do not constitute an innovation, but in some cases even represent a restoration of technical approaches that were already prevalent in the educational environment in the 1970s, such as the behaviourist approach. However, the concepts and objectives pursued by this model do differ significantly from those of the traditional approach to teaching and learning.

As opposed to the processual vision characteristic of pedagogical practices, this new paradigm establishes product-based vision, which is claimed to be a more practical and applied approach, which pursues the acquisition of skills, abilities and competences by students [18–20], and which places the emphasis on the dimension of doing. This is an approach which, once again, is presented as a radical innovation, but which revives the idea of practical knowledge known as “téchnē” by the ancient Greeks, understood as practical execution, as opposed to knowledge of a more reflective nature.

From this vision of the product is derived an important change in educational roles, advocating a student being understood as a maker [22] and governed by productivity, social gain, transferability and performativity. In most cases, this maker role does not materialise, so the orientation of these transformations does not correspond to what is explicitly advocated, at least as far as their applied dimension is concerned. However, this does not detract from the depth and importance of the metamorphosis introduced by

**Table:**

- “Smart resources” (digital platforms, computers, digital tablets, interactive whiteboards, interactive monitors, Chromebooks, Scratch programs, 3D printing devices, drones, educational robotics resources, Chroma key screen).
- Manipulative materials (models, video clips, experimentation and science material, games, puzzles and building blocks).
- Printed materials (books, notebooks, worksheets, posters, diagrams and maps).
- Digital constructionism
  - Teacher: content search.
  - Student: consumer of contents.
- Active methodologies: project-based learning, service learning, flipped learning, cooperative learning and gamification.
- Three basic pillars: digital work, constructionist vision and competence approach.
- Emphasis on product.
- Innovation aimed at obtaining social returns.
- Transferability.
- Performativity.
the smart classroom. Instead, it is rather an indicator of its complexity, and of how the transformations operate on the basis of plays of tension and distension, of contradictions and veiled changes.

Thus, although the maker role is still far from being a widespread reality, it is not absent from the educational scene. On the contrary, it is having an even greater impact than is explicit, permeating the very essence of the teaching and learning process through the emergence of a kind of “makification” [45], an obsession with productivity and performance. This implies the establishment of a totally different organisational logic and school culture; that of doing [46], as opposed to that of knowing or being.

All of this shows that the new digital learning ecosystems, such as the smart classroom, operate on the basis of the same operating logic governing the digital technologies that underpin them. In this way, the mutation that they introduce constitutes a silent revolution, since it does not occur so much through formal changes as through transformations in the discourses and thoughts that the teachers maintain [47]. Thus, although some of their transformations become as invisible and ubiquitous as the digital technologies themselves, they manage to act holistically and on the very structure of the organisation.

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References and Notes
