

Article

Development of Transdisciplinary and Complex Learning in Inclusive Educational Practices

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Abstract: This study examines the process of creating digital resources to meet the specific educational needs of primary education students at a school in the province of Valencia (Spain). The resources were developed by students of the Teaching program at the University of Valencia as part of the special educational needs subject. The research focuses on transdisciplinarity and the use of new technologies and sustainable development objectives to enrich the educational experience at the school as well as to study this approach with students pursuing a bachelor's degree in Primary Education. To analyze students' perceptions of this practice and compare their reflective and transdisciplinary thinking, a validated questionnaire was administered to a sample of 39 participants. In addition, seven focus groups were organized. The results demonstrate that via transdisciplinarity and the use of technological resources, students enhance their abilities to address complex situations, fostering creativity and innovation by relating different areas of knowledge in real and contextualized settings. Furthermore, an increase in reflective capacity and research skills is highlighted, contributing to better understanding and learning based on digital technologies.

Keywords: inclusive education; digital resource; transdisciplinarity; complex learning; reflective thinking



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1. Introduction

This study examines the process of developing digital resources to meet the special educational needs (SEN) of primary education students at a school in the province of Valencia. The resources were developed by students of the Teaching Program at the University of Valencia within the framework of the special educational needs (SEN) subject. The research focuses on the basis of transdisciplinarity and includes the use of new technologies and the sustainable development goals (SDG) as a central theme. These elements were essential in the development of the educational experience in the school and its subsequent study with the group of university students.

1.1. Transdisciplinarity and Complex Thinking in Teacher Training

Transdisciplinarity, which involves a collaborative and interactive approach among various fields of knowledge, is considered a key framework for tackling complex problems and fostering innovative educational practices [1]. It is where inter-scientific dialogue takes place and can be used to address contemporary challenges that manifest differently depending on the context [2].

With this in mind, one of the main purposes of this study was to identify an educational practice that addresses the challenging need of training future teachers to deliver education within context and that develops the professional and social demands of the 21st century.

“Meaningful learning offers experience and helps improve a person’s socio-emotional behavior, which can then be applied later in life” [3] (p. 584).

As an educational method, transdisciplinarity is used to address complex challenges by identifying problems in a real context and analyzing them with the people involved as a group. The goal is to develop a strategy, in this case, the study of a resource, implement said strategy and subsequently carry out an evaluation of the process [4].

Furthermore, for learning to be considered meaningful, practical experience should be emphasized. To increase the frequency of such experiences and to actively participate in the process of fostering collaboration between different institutions and groups, several interrelated conditions need to be considered, as discussed by Merçon [5]: trust [6,7], the development of shared perspectives, learning and action for innovative practices, collaborative transformation, and project management. With this in mind, it is crucial to emphasize the importance of adequate training and learning for all individuals involved [8].

1.2. New Technologies for Inclusive Learning: Transdisciplinary Approaches

To achieve effective inclusive education, it is crucial to embrace new technologies as essential tools for developing transdisciplinary and complex learning in teaching practices.

New technologies have the potential to offer interactive, accessible, and personalized learning experiences. This can be beneficial for all students, including those with and without SEN [9]. There are a number of support and adaptation tools that already exist to meet the specific needs of minors. For instance, Comix is a software tool designed to enhance the reading experience for students with reading difficulties or visual disabilities. It enables them to view comics and picture books in a digital format, making the information more accessible and user-friendly. Virtual learning environments offer the flexibility to customize the pace and difficulty level of activities to meet the unique needs of each student. This personalization enhances the learning experience by making it more meaningful and relevant. However, in order to fully utilize the potential of these technologies in an inclusive context, it is important to adopt a proper pedagogical approach and engage in careful planning. In this regard, teachers play a fundamental role in the selection, implementation, and evaluation of the technologies used by making sure that they are aligned with the learning objectives and the needs of the student body [10].

These new technologies can play a crucial role in the development of transdisciplinary and complex learning. As noted by Munna and Kalam [11], new technologies enable students to access a variety of resources and perspectives, connecting different areas of knowledge. They also promote holistic understanding, complex problem solving, online collaboration, and communication among students, teachers, and families, creating inclusive and networked learning environments. This approach allows school children to understand concepts in a practical way, promoting a deeper and more meaningful understanding [12]. By adopting a transdisciplinary approach, teachers can give students the chance to explore topics from various perspectives and encourage them to make connections between ideas and concepts from different fields of study.

Complex learning includes problem solving and understanding difficult situations, in which students must use their knowledge and skills from various areas to tackle interdisciplinary challenges [13]. This approach helps students develop critical thinking, creativity, and analytical skills, equipping them to tackle the challenges of the real world. In addition, complex learning promotes autonomy and self-regulation in learning. This means that students are required to make informed decisions and collaborate in order to solve complex problems [14].

In the context of inclusive education, transdisciplinary and complex learning becomes even more important. By integrating different disciplines and addressing complex challenges, we encourage the full engagement of every student, regardless of capabilities or individual requirements [15]. This approach broadens learning opportunities and allows students with different learning styles and rates of development to find meaningful ways to participate and demonstrate their understanding.

With all this in mind, the objectives of this study were as follows: addressing the SEN of real primary school cases by creating a digital resource that promotes inclusive and quality education (aligned with SDG 4 and 10); learning to design engaging learning situations using digital resources; analyzing the potential of reflective thinking and digital competence in students; and promoting transdisciplinary and complex learning in future teachers.

In this study, SEN refers to the varied requirements of students with disabilities or learning difficulties. It is essential to explicitly address SEN in order to emphasize inclusivity and acknowledge the need for tailored approaches. By integrating SEN considerations into the objectives, the study underscores its commitment to diversity, equity, and accessibility in education. This explicit focus on SEN contributes to the discourse on inclusive education and highlights the study's potential impact on creating a more inclusive and equitable educational environment.

2. Materials and Methods

2.1. Design

An evaluation process was conducted to analyze the digital competence, creativity, and reflective thinking of the participants in relation to high-quality inclusive education. The main goal was to assess the impact of implementing the digital resource. In this sense, the scope of the research was oriented towards a descriptive mixed approach methodology, using a collective case study design, which is appropriate for the focus of our study and our research objectives [16,17].

In line with Stake [18], this methodology intends to provide a deeper understanding of the selected cases, studying the nuances of each one of them and the direct relationship they have with the context of the intervention. To collect the data, a questionnaire with pre- and post-tests without a control group was used. In addition, focus groups were created, and the discussions were recorded in writing using the Padlet tool. Later, the data were triangulated, and the information was classified and coded in order to find arguments, probabilities, or frequencies that support our findings [17]. To ensure that the results were logically connected, a link was established between the study objective and the participants' perceived ease of use of the digital resource they had to create, following the Technological Acceptance Model (TAM) by Davis et al. [19]. This allowed analyzing the post-test questionnaires after the activity and the results from the Padlet focus group discussions.

2.2. Context and Participants

The social construction of knowledge [20,21] emphasizes the importance of placing students at the center of the educational process and highlights their role as the true protagonists of the learning process. Therefore, a study was conducted to seek input from two complementary groups. The first group of individuals consisted of 39 university students who were studying to become primary teachers. Their future role as teachers will involve choosing and developing educational resources to use in their classrooms, which will help facilitate the teaching process for the second group. The second group consisted of 4 elementary school teachers who were working with children with special educational needs (SEN) in a mainstream school. The first group creates a didactic resource (social stories) designed to aid the teachers in their practices, while the latter group provides valuable feedback to the university students regarding the efficacy of this resource.

The university students were enrolled in group A of the special educational needs (SEN) subject, which is taught in the 2nd year of the Primary Education Teaching degree. The study was carried out during the 2022–2023 academic year at the University of Valencia. It is worth noting that the majority of the students in the group were women (79.5%). Their ages ranged from 19 to 21 years. One student had been admitted after completing vocational training, while the others completed and passed the Spanish university admissions test to gain admission. Approximately a quarter of the class combined their studies with paid employment (25.6%), and all students were enrolled in the subject for the first time.

The activity of this study was carried out in the Escuela 2 educational center. The school is an educational cooperative based in La Canyada, Paterna (Valencia). It is a secular school that is dedicated to providing a comprehensive education and inclusive environment for all its students. The school's goal was to actively engage in society. It currently has over 500 students, including SEN students, enrolled in preschool, primary, and secondary. Some elementary school children had autism spectrum disorder (ASD), a neurodevelopmental condition marked by challenges in social interaction, communication, and repetitive behaviors. Recognizing and addressing the specific educational needs of these students is vital to creating an inclusive learning environment that supports their academic and social development.

The school promotes cooperative learning and the active participation of all educational agents. Student participation is organized via councils, which include teachers, service personnel, and the students themselves. As established in its educational project, the school is described as inclusive, welcoming everyone, and respecting equal opportunities. To achieve this, commitment is crucial and is rooted in the understanding of diversity as a valuable resource. Emphasis is placed on project-based learning, creating conducive learning environments, allowing freedom of movement, implementing specific learning corners and workshops tailored to different learning styles, practicing collaborative teaching, and utilizing hands-on materials. Additionally, flexible groupings and multigrade classrooms are encouraged.

2.3. Instruments and Activity for the Development of the Digital Resource

To carry out the activity, the university students were divided into seven groups of 3–4 people based on the characteristics of students with autism spectrum disorder (ASD) and the different levels of support they might need. Each group conducted a guided search with their professor to find different digital tools, like comics, to design their own digital teaching resource. Real cases of teachers who work in a school with students with ASD and who are in need of a digital resource to effectively meet the students' needs were presented. Using this information, the students created a digital educational resource tailored to the case. This resource involved the development of a social story. Subsequently, a pilot intervention was carried out in the school. During this time, the students received feedback from the teaching staff. Following the feedback, a peer evaluation was conducted to assess the usefulness and practicality of the developed resources. The evaluation also considered factors such as accessibility and aesthetics of the resource.

Ultimately, the aim of the activity was to create a series of social stories for the Escuela 2 school. The first part of the activity explored the definition and purpose of a social story, with a primary focus on ASD. Next, the technological tool called Comix was introduced and made available via teacher help documents on the website (<https://makebeliefscomix.com/> (accessed on 27 March 2023)). Subsequently, the students focused on conflict resolution and selected the theme, situation, setting, and characters of the story. This particular focus was chosen in response to the identified needs of the schoolteachers, as it was considered a topic that would benefit all students. Via a social story, children are taught about, for example, the act of sharing toys with their peers during playtime. The next step involved creating a digital educational resource with alternative versions tailored to the characteristics of the students, such as gender, age, ethnicity, and level of communication development. Finally, a deadline was set for delivering the task so that it could be sent to the school to receive feedback. In addition, each group presented their resources in the university classroom to share the learning experience.

An evaluation sheet was designed, considering a series of criteria and dimensions, to record the process and final outcome of each group (Table 1).

Three aspects were evaluated: the designed resource, the public exposure, and the applicability in a real context. To assess the digital educational resource, three dimensions of analysis were used based on previous studies [22]: aesthetics (font, size...), technical (device from which it can be accessed, format...), and pedagogy (underlying model...). The

group presentation was evaluated on several aspects. First, the theoretical aspect was considered, focusing on how well the proposal was adapted to the characteristics and needs of students with ASD. Second, practical issues, such as accessibility, were taken into account. Finally, formal issues related to communicative competence, such as prosody, were also considered. Finally, the feedback from the schoolteachers was considered, taking into account the functionality, realism, and applicability in the classroom.

Table 1. Evaluation form.

Digital Educational Resource (40%)		Group Exposure (30%)		School Implementation (30%)	
Dimension	Aesthetics Technical Pedagogy	Variable	Adjustment to SEN Accessibility Communication	Element	Teacher feedback

To assess the activity's impact on learning and the development of reflective thinking skills, teamwork, digital competence in the professional field, and information management, the students completed a pre-test and post-test questionnaire. An ad hoc questionnaire, validated by Sabariego et al. [23], was used. The questionnaire aims to study people's perceptions of the activity and consists of a total of 28 items, organized into 3 dimensions that explore the role of learning contexts as spaces for reflection. The dimensions are measured using a seven-point Likert-type scale, ranging from "a little" (1) to "a lot" (7), and assess the following: 1. perception of the learning process developed via transdisciplinary methodologies (7 items); 2. contributions of these methodologies to the learning process (14 items); and 3. experience assessment and satisfaction (7 items).

In addition, focus groups were created, and discussions were recorded using the Padlet tool. A total of 10 questions were posed for groups of students to answer and share their reflections on the creative process of the resource. This was carried out to complement the information obtained from the questionnaire.

2.4. Procedure and Data Processing

This research was approved by the Human Research Ethics Committee (HREC–2637453) of the University of Valencia.

The questionnaire was administered online at both the pre-test and post-test stages, with prior confirmation to ensure participants had access to mobile devices and/or computers to complete the test. Participants were informed that they had approximately 15 min to complete each questionnaire and all 39 students answered both of them. A descriptive quantitative analysis was conducted with percentages to process the data using the statistical software SPSS Statistics version 28. This approach provides insight into the means and distribution of the collected data.

The research objectives raised in the focus groups were as follows:

1. Deepen students' understanding and evaluation of transdisciplinary methodologies in the active learning process [24] via discourse analysis [25,26] and evaluate the learning process in terms of knowledge construction, skills, and professional development.
2. Identify proposals to improve university teaching (strong and weak points) based on experience.

The study used Padlet as a technological tool to facilitate the focus groups. This tool enables collaborative work and enhances both face-to-face and virtual communication [27].

A facilitator was assigned for the entire class, and a coordinator was appointed to manage the Padlet data for each focus group. The sessions lasted an hour and a half and were conducted after the development of the proposed activity.

Ten questions were formulated for the discussion. These questions were grouped and related to the four dimensions of content analysis according to Sabariego et al. [23]:

Dimension 1. Perception of the learning process via transdisciplinary and reflective methodologies and the technological tools used. The three questions in this dimension refer to the objectives of the tasks, their contextualization, and their advantages and disadvantages:

1. What tasks did you do in the Comix social story activity included in this transdisciplinary proposal? What was the purpose of the activity? Describe briefly.
2. What was your reaction when the professor presented the activity? Why did you have that reaction?
3. While you were doing the tasks, what were some of the difficulties or advantages you noticed? How did you solve the problems you encountered?

Dimension 2. Contributions of the technological tools and methodologies to the learning process. The three questions in this dimension provide examples and take into account how the methodologies and technological tools used in their academic and professional future can be applied. It also aims to assess the workload level of the tasks, their implications, and the commitment needed. A key aspect of this dimension is to recognize the importance of being aware of the learning process when utilizing technological tools and transdisciplinary, reflective methodologies, as well as to acknowledge the distinctions between these approaches and traditional methodologies:

1. What have you learned with this activity?
2. How did you learn with this activity? What contributions has it made to your learning process?
3. What skills did you need to develop with this activity in relation to the subject?

Dimension 3. Experience assessment and satisfaction. This dimension includes two questions for the focus groups. The objective is for the participants to explain their answers and validate their satisfaction (reflection, involvement, autonomy, and the value of teamwork) by incorporating different variations of the activity proposal. They should also provide justifications for their assessments, explaining the reasons behind their different opinions:

1. Imagine that next year you have to be the teacher of the subject; would you use this activity for the students to learn better? Justify your answer.
2. What do you value as the most positive and least positive of this activity in your learning process?

Dimension 4. Proposals for improvement. This dimension includes the final two questions, which aim to identify ways to improve the approach to the activity and promote self-criticism and self-reflection.

1. What do you suggest to the teachers to improve this activity for the next course?
2. What would you change in your way of acting and thinking if you were asked to do this activity again?

The goal of the qualitative analysis of the information collected in Padlet was not to seek representativeness of the results but rather to enable the emergence of generalizable statements regarding their significance [28]. The following actions were carried out [29]:

1. Reading the answers from each focus group.
2. Thematic grouping of the most important ideas according to the different dimensions studied.
3. Selecting the most outstanding concepts and answers expressed in the focus groups.
4. Interpreting the main ideas extracted from the focus groups in each dimension.

2.5. Data Analysis

The answers from the questionnaire were exported to the SPSS program for further analysis. The results were then illustrated in the form of graphs and data, thus facilitating the final evaluation of the activity. Furthermore, and in relation to the focus groups, a set of questions related to the questionnaire was prepared using Padlet to collect data. The

aim of this process was to collect additional data and nuances that could not be obtained via the questionnaire. Content analysis was conducted on the Padlet data for the focus group using Atlas.ti version 9 to examine and code the textual content of the interview and educator materials to identify patterns, themes, and emerging categories [30]. This involved searching for repetitions, similarities, and differences in responses, as well as identifying themes that naturally emerged throughout the interview. Subsequently, a category catalog was developed based on the research objectives to address the queries of the current study.

3. Results

3.1. Quantitative Results: Pre- and Post-Activity Questionnaire

The results presented below are part of the most significant responses.

First, a trend is observed that indicates a general improvement in the four dimensions, given that the average scores of the post-test are higher than those obtained in the pre-test. The means of the pre-test ($M = 4.2$, $DT = 0.67$) and post-test ($M = 4.3$, $DT = 0.65$) stand out in Dimension 1. This is because the use of transdisciplinary methodologies in the proposed activity could potentially result in a significant improvement in the students' perceptions of the learning process.

Second, an approximate value of 0.05 was observed in Dimension 2 (Contributions of the methodologies to the learning process), which turned out to be more significant than the rest of the dimensions, both for students and for teachers in the post-test phase. The results were particularly significant for the group of teachers: pre-test phase ($M = 5.65$, $SD = 1.34$) compared to the post-test ($M = 6.45$, $SD = 0.64$), $t(52) = 2.95$, $p = 0.002$. This could be because teachers have the opportunity to broaden their pedagogical approach, allowing them to design activities and assessments that integrate multiple disciplines and challenge students to think critically and creatively.

Finally, the analysis of the participants' perceptions regarding reflection and commitment in teacher training revealed notable findings. In terms of commitment, a frequency analysis conducted using SPSS indicated that the majority of students associated commitment with key concepts such as cooperation (45%) and collaboration (35%). Additionally, varying perspectives emerged, with a subset of participants (15%) viewing commitment as voluntary, while others (5%) considered it mandatory. These results suggest a consensus among participants regarding the importance of commitment to teacher training, with differing opinions on its nature and implications.

3.2. Qualitative Results: Focus Group

The results extracted from the seven focus groups are detailed below. It is important to highlight that the data that students consider most significant and relevant in each dimension have been collected. The criteria for selecting the most relevant data from the focus group discussions were established based on a content analysis approach. This involved identifying recurring themes, key insights, and unique perspectives shared by the participants. Data points that closely aligned with the central themes, the four dimensions, and the objectives of the study were prioritized, ensuring that the selected responses provided valuable insights into the perceptions, experiences, and attitudes of the participants regarding the topic under investigation.

Dimension 1. Perception of the learning process developed through transdisciplinary methodologies.

The answers obtained from the seven groups indicate that the students assimilated the content of the proposal and were able to describe all the tasks carried out in the activity and their objectives: "The tasks we followed consisted of collectively thinking about the conflict situation we wanted to represent, choosing our characters and the most appropriate setting for the comic, thinking about the dialogue and creating each of the final versions. The objective of the activity was to create a social story in comic format, adapted for children with ASD and to show conflicts and possible resolutions" G1 (L.G.).

With regard to the emotional aspect, the novelty that this type of practical and visual activities represents for students in usually theoretical subjects stands out. The most generalized reactions are positive with phrases such as “I liked it very much” G1 (M.C.); “It was a different and very enriching idea” G1 (I.M.); “I liked the idea because it was not something conventional” G7 (P.M.); “I found this activity to be more interesting than the one previously proposed about delving into one of the disabilities” G2 (R.A.); and “I found it very interesting because it taught us to put the theoretical concepts of the subject into practice” G4 (A.A.).

In the same way, students found the real application of the activity to be interesting: “I was very excited to learn that our comics were going to be of some use” G3 (K.R.); “I was very excited to be able to help in a school and participate in a real situation” G3 (S.B.); and “I was impressed because we had never done anything like it, to help resolve conflicts in a specialized school for students with autism spectrum disorder” G6 (S.R.).

In some cases, the proposal of the activity produced shock, surprise, curiosity, and even a certain level of fear from not having carried out an activity like this before: “I was a bit afraid because I had never done anything similar and I had never worked with pictograms or similar materials” G4 (L.C.); “At first it shocked me because it was something new that we had never done before, but at the same time I was curious and found it fun” G6 (L.C.); “At first we were a bit anxious, because we had never done it and we didn’t really know what a social story was, but after gathering information everything became clearer” G5 (L.V.); and “At first we felt a little uncertain, because we didn’t really know what a social story was and we had never used a platform to create digital comics” G5 (P.Y.).

Regarding the difficulties encountered, they highlight the use of digital tools in the creation of comics and pictograms or the ideation of a story with social content: “It was difficult for me to create the comic with all the details that it had to include” G6 (L.C.); “The difficulties were working with the ARSAAC pictograms, because we had never done it and we did not know how to present the activity so that the children to whom this activity is directed would understand and learn from our social history” G6 (S.R.); and “Not knowing how to use the Comix tool, but we easily solved it by switching to Canva” G2 (R.A.). There are also students who did not encounter too many difficulties and thrived using teamwork: “In general, we worked without too many difficulties and when there was any aspect that challenged us, we worked on it together” G1 (M.C.); and “We did not find great difficulties. From the beginning we worked collaboratively, and communication has been the foundation of the project” G1 (I.M.). In relation to how to solve these problems, the answers reflect that they looked for tools and resources more adapted to their possibilities and what they wanted to do and that they made use of group work for decision making and solving difficulties.

In terms of the advantages of the activity, the applicability in future teaching work, learning how to use ICT resources and group work are the most reported: “I think that this has been one of the projects in which we have learned the most, since we have put ourselves in the place of the children and we have objectively analyzed how we could handle the different daily situations that happen in the classroom” G3 (M.M.); and “The ideas and support of my classmates, in addition to the previous knowledge that I had learned in the subject” G7 (A.I.).

Dimension 2. Contributions of these methodologies to the learning process.

The responses given regarding what they have learned show that they are aware of encountering useful methodologies for their academic and professional growth: “This activity has provided us with a new way of learning and communicating information, as well as improving our social and communication skills. We have learned to work in a group and to express ourselves in a creative and attractive way, which is important for our future academic development and especially as teachers” G3 (S.B.); and “Personally, I have learned to see from another perspective how to deal with students with ASD and how to help them” G6 (A.J.V.).

With regard to how they have learned, the responses mainly highlight how putting theory into practice has led them to search for resources and solutions: “For this activity, above all, we have learned by doing and debating. That is, because it was more of a practical project, the only way in which we have been able to advance has been by facing the problems that we have been encountering” G7 (A.I.); “By using visual tools such as comics, we can see in a more realistic and direct way how the situation could be presented with cartoons” G7 (E.A.); and “I have learned that the best way to learn anything is to be motivated and interested in the subject” G3 (M.M.).

In terms of the skills required by the activity, students are aware of the transversality of the tasks, which include digital, creative, communicative, social, and emotional competencies, search and analysis of information, teamwork, and knowledge transfer: “We have developed and put into practice different skills, which have also been strengthened. First of all, the making of the story has required the use of creativity, the ability to create something new and original. In the same way, the implementation of digital competence has been of vital importance. Through it, we have learned to use valuable new tools and applications as visual resources for the classroom. The learning and use of ARASAAC is remarkable. In turn, communicative and collaborative skills have been necessary” G1 (I.M.).

Dimension 3. Experience Assessment—Satisfaction.

The overall assessment of the activity is very positive, and the difference in the transdisciplinary methodology compared to the traditional one that students are used to is also clear: “The vignettes and visual information are more attractive and easier to process and remember than the written text. They help summarize and simplify the information, to organize and structure it, and to show practical examples of concepts like the ones we are working on in the classroom” G5 (L.R.); “I think it is a good activity to encourage the development of other skills, as well as to put knowledge into practice in a more creative way” G5 (L.V.); “It teaches about conflict resolution while exercising new skills in not-so-common platforms and their possible use for future tasks” G7 (P.M.); and “It allows students to work under a more meaningful learning process. They do not only carry out a search for theoretical contents, as usually happens but also internalize and understand these contents in order to apply them to useful tools” G1 (I.M.). There is even one participant who indicates “I would actually not use the activity only to learn better, but also to verify that the knowledge of the curriculum has been acquired and that it can be applied in a real case” G7 (A.I.).

The answers that evaluate the positive aspects of the learning process highlight the use of new ICT tools, as well as consolidating knowledge of the subject in a practical way, the development of social skills or teamwork: “Being able to create a useful resource that can be used in a school. In addition to working dynamically on the contents of the subject” G2 (A.G.); “Learning to work on specific topics in a different way and with the help of new tools” G5 (L.R.); “It allowed me to work collaboratively with my friends to develop a comic” G3 (N.L.); and “It has offered us a dynamic practice directly related to the contents of the subject as well as helping us improve our digital skills” G4 (A.A.).

There are very favorable comments in the assessment of the least positive aspects of the tasks: “I have not been able to find any negative aspect for my learning, since nothing that we have done during this activity has been an obstacle for me” G6 (L.C.); “As for negative aspects, I really can’t think of anything worth mentioning” G7 (P.M.); “I can’t find anything negative” G7 (E.A.); “This activity was an overall good experience and, therefore, all aspects were positive” G1 (L.G.). However, some students do mention the lack of time: “The time to prepare the comic was a bit limited, which generated some pressure and stress to be able to finish it on time” G3 (N.L.); and “I would have liked to use more class time and in general more time to carry out the activity. But it has been very rewarding to be able to reach consensus on all the work to create the ideal comic” G3 (K.R.).

Dimension 4. Proposals for improvement.

The most general suggestion for improvements addresses more educational needs: “Perhaps a positive change would be to expand the different stories, so that not only ASD is worked on, but a wider variety of disorders” G5 (S.M.). Others, on the other hand, propose greater monitoring of the activity, in addition to having examples from previous years, more resources, and sharing the results: “If I had to change or improve something, it would be the monitoring by the professors and that they provide us with more resources, we could also share our work with all classmates in order to learn from each other” G7 (P.M.); and “The only thing I would change is to provide more pages like ARASAAC to do the work or more tools to make the comic, in addition to Comix” G6 (L.C.).

Finally, regarding self-criticism and self-reflection, the changes in the way of acting that are most repeated are those related to the planning and organization of the work and the attitude towards the proposal: “I would change our organization to carry out the work since time was a bit tight” G4 (L.O.); “We would use more time to think and organize our ideas more. In addition, research a little more about ASD” G5 (L.R.); “I would do more extensive research and planning beforehand” G5 (L.V.); “I would have organized the work from the beginning to be able to ask all the questions before starting” G2 (R.A.); “I think I would maintain a more open attitude” G3 (M.M.); and “I would change my attitude and work to carry it out in a more creative way” G7 (A.I.).

4. Discussion and Conclusions

The results obtained reveal that these transdisciplinary methodologies were well received by the participants, who showed an adequate assimilation of the content of the proposal, as well as a clear understanding of the tasks and objectives of the activity. In addition, the students positively valued the novelty and applicability of the activity, given that it allowed them to create useful teaching resources for children with ASD.

On the one hand, promoting the expansion of perspectives and fostering interdisciplinary connections helps students develop a more comprehensive and holistic understanding of knowledge, which enables them to effectively tackle complex problems related to specific educational needs. On the other hand, these methodologies promote creativity and critical thinking by encouraging the generation of new ideas and the thoughtful examination of the connections between different subjects, in this case, to develop an educational digital resource.

Moreover, teachers were encouraged to collaborate and exchange knowledge from different areas, which leads to an enrichment of the educational experience and promotes a more holistic vision of teaching. In addition, students were given the opportunity to explore and connect ideas from different disciplines, which generated a greater sense of belonging and motivation to learn. They develop transferable skills as they learn to apply concepts and approaches of a discipline in different contexts, thus strengthening their ability to adapt and solve problems.

These findings are consistent with previous studies that highlight the importance of hands-on and meaningful activities for learning [24].

The incorporation of new ICT tools also proved to be beneficial for students, as it encouraged their learning and development of communication skills. Technology has proven to be a powerful tool in the educational process, improving the interaction and participation of university students [9,13]. The interest shown in participating in a real situation and using these tools reflects their motivation to explore and learn via innovative resources.

Despite the positive aspects, some students found difficulties in the use of digital tools, the ideation of stories with social content, and the use of ARASAAC pictograms. These difficulties can be attributed to a lack of previous experience or the need for greater familiarity with these technologies and pedagogical approaches. However, and in line with Gabarda et al. [22], the majority managed to overcome these difficulties by working as a team and adapting the tools to their needs, which highlights the importance of collaborative work and resilience in the field of education.

In terms of the contributions of these methodologies to the learning process, the students noted that they offered a new approach to learning and exchanging information, enhancing their social, creative, and communication skills. The transversality of the implemented tasks was also highlighted as a positive aspect, given that it promoted the development of digital and collaborative skills, knowledge transfer, and teamwork. The literature has shown that interdisciplinary approaches promote more meaningful learning and a broader perspective on knowledge [8]. As a whole, students expressed a very positive assessment of the experience. They appreciated its usefulness for their future teaching and for learning how to use ICT resources. They also highlighted the opportunity to work in a more dynamic and creative way, which allowed them to develop relevant skills for their academic and professional development. These results corroborate the importance of providing meaningful learning experiences with online resources which are transferable to the professional context [1,31].

The proposals for improvement and self-reflection presented by the students offer valuable guidelines for future activities with a transdisciplinary approach. Suggestions for addressing more educational needs and expanding the range of conditions in the stories are especially relevant to ensuring inclusiveness and diversity in the educational process. The request for greater follow-up by teachers and the availability of previous examples and additional resources are aligned with the importance of guidance and pedagogical support in innovative activities. Likewise, and in line with Beltrán-Martín [26], sharing the results with others to learn from their work reinforces the value of exchange and collaboration between students and teachers in the field of education.

In terms of self-criticism and self-reflection, students recognized the need to improve the planning and organization of work, as well as the attitude towards the proposal. These aspects are essential to enhance metacognitive learning and self-regulation in students [32]. The dedication to previous research and planning, along with an open attitude to listening to different perspectives and proposing improvements, indicates a greater involvement and willingness to learn and grow in the educational process [33–35].

Based on the conclusions drawn from the study, some *limitations* and potential avenues for *future research* can be identified. While the results indicate a positive reception of transdisciplinary methodologies by participants and underscore the benefits in terms of content assimilation, understanding of tasks and objectives, and value of novelty and applicability, certain limitations should be acknowledged. First, despite the positive outcomes observed, some students encountered difficulties in the use of digital tools, ideation of stories with social content, and utilization of ARASAAC pictograms. These challenges may stem from a lack of prior experience or familiarity with the technologies and pedagogical approaches involved. Therefore, future research could focus on developing targeted training programs or interventions to enhance students' proficiency and confidence when utilizing digital tools and integrating diverse content into educational resources.

Moreover, while the incorporation of new ICT tools was generally beneficial for the development of students' learning and communication skills, it is essential to address the observed difficulties and barriers to ensure equitable access and participation for all students. Additionally, further investigation into the effectiveness of specific pedagogical strategies or interventions to mitigate these challenges would be valuable. For example, exploring differentiated instruction approaches or providing scaffolding support tailored to students' individual needs could enhance their learning experiences and outcomes.

Furthermore, while the study highlights the positive contributions of transdisciplinary methodologies to the development of social, creative, and communication skills, as well as the promotion of digital and collaborative skills, knowledge transfer, and teamwork, future research could delve deeper into the specific mechanisms and processes underlying these outcomes. Longitudinal studies tracking students' progress and development over time could provide valuable insights into the long-term impacts of transdisciplinary approaches on students' academic and professional growth.

Consequently, two *practical implications* of this study include the potential integration of transdisciplinary methodologies into educational curricula to enhance student engagement and foster holistic learning. Additionally, the provision of ongoing professional development opportunities for educators focused on transdisciplinary teaching methods and digital literacy empowers them to create dynamic learning environments that cater to diverse student needs and promote meaningful learning experiences.

In conclusion, while the study offers valuable insights into the positive assessment of transdisciplinary methodologies by university students and their potential benefits for education, addressing the identified limitations and pursuing further research endeavors will contribute to advancing understanding and maximizing the efficacy of such approaches in educational settings.

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