



Article

# Inclusive Education through Digital Comic Creation in Higher Learning Environments

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**Abstract:** This research aims to promote diversity and inclusion among higher education students by examining the integration of technology into project-based learning (PBL) for English as a foreign language (EFL) teacher candidates. Based on a mixed-methods approach and convenience sampling ( $n = 84$  participants), this study involved pre-service teachers who collaboratively employed several authoring tools to create 16 digital comic strips for teaching English. The focus of the project was on inclusivity, cultural diversity, and affective education. This study consisted of five stages corresponding to different critical thinking skills: comprehension, negotiation, creation, presentation, and evaluation. The instruments used for quantitative data included a pre/post-survey based on two validated scales. Qualitative data were gathered through class discussions and semi-structured interviews. The results, analyzed through SPSS and QDA Miner Lite, revealed that teacher candidates lacked prior experience using digital tools to create EFL-inclusive materials. However, the study also highlighted increased awareness of inclusive education and strong advocacy for the integration of transformative technology in teacher training programs.

**Keywords:** inclusive education; diversity; digital comic strips creation; teacher training

## 1. Introduction

Comics have long been recognized as a powerful and engaging medium for education, captivating readers with their visual storytelling and concise narratives (Akcanca 2020; Das and Singh 2022). The use of comic strips in education spans various disciplines, from history and science to literature and mathematics (Koutníková 2017; Strong et al. 2023). In language learning, comics offer a unique blend of text and imagery, providing learners with contextualized language use and cultural references. The combination of visual and textual elements not only enhances language comprehension but also promotes creativity and critical thinking skills (Nurchurifiani and Zulianti 2021; Zimmerman 2008). As technology continues to play an increasingly significant role in education, the incorporation of digital comics presents a valuable tool for language instruction (Joannidou and Sime 2021; Themelis and Sime 2020). Recent studies have shown that comic strips can improve reading comprehension and vocabulary acquisition, and encourage readers to engage with academic material (Deligianni-Georgaka and Pouroutidi 2016; Robbani et al. 2021). Furthermore, comics are considered an inclusive medium, capable of addressing diverse learning styles and accommodating learners with varying abilities. Researchers have explored the benefits of using comic strips to teach complex topics, removing barriers and making content more accessible to students with different educational needs (McGrail and Rieger 2016).

While there is a rich body of literature on using traditional comics in EFL classrooms, the integration of authoring tools to create digital comic strips in language learning from an inclusive perspective remains relatively unexplored. A search of the existing literature reveals a scarcity of studies that focus on the effective implementation of digital comics for inclusive language instruction (Themelis and Sime 2020). The novelty of this research lies in

**Citation:** Belda-Medina, Jose. 2024. Inclusive Education through Digital Comic Creation in Higher Learning Environments. *Social Sciences* 13: 272. <https://doi.org/10.3390/socsci13050272>

Academic Editor: Nigel Parton

Received: 1 March 2024

Revised: 6 May 2024

Accepted: 15 May 2024

Published: 19 May 2024



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its aim to evaluate the competence of EFL teacher candidates in collaboratively creating digital comic strips for the language classroom from an inclusive perspective. By engaging teacher candidates in the design and production of instructional materials, this study seeks to equip them with valuable digital and pedagogical skills essential for modern language teaching practices. Therefore, this research aims to assess the digital skills in creating comic strips for the EFL classroom among teacher candidates and to examine their perceptions regarding the use of such comics in language learning.

Additionally, this study also seeks to measure teacher candidates' attitudes towards inclusive and diverse education. Inclusive education involves tailoring teaching methods to accommodate the diverse needs and backgrounds of learners, promoting an environment where every student feels valued and supported. By utilizing digital comic strips as a medium for inclusive language teaching, this research aims to ascertain the extent to which teacher candidates embrace and advocate for inclusive educational practices in their future professional careers. Therefore, this research's aim is to assess the potential of creating and using digital comic strips in the English as a foreign language (EFL) classroom to promote inclusive education and enhance language skills, by evaluating teacher candidates' digital skills, investigating their perceptions regarding digital comic strips, and examining the impact on their attitudes toward inclusive and diverse education.

## 2. Literature Review

### 2.1. *Comic Books in Education*

Using comics in education has several benefits, including improving literacy skills, making learning more engaging, providing a visual representation of knowledge, and helping students to think, create, and write more effectively (Akcanca 2020; Pange 2022). The combination of images and words in comics allows for a multifaceted approach to conveying complex ideas, making them particularly effective in different subjects such as history, science, and social studies (Koutníková 2017; Strong et al. 2023). Research has shown that comics can improve reading comprehension, stimulate critical thinking, and promote student creativity (Krusemark 2017; Putri and Prodjosantoso 2020). Moreover, the benefits of using comics in education extend to different ages and learning styles, as comics are aimed at visual learners and can make abstract concepts more comprehensible (Jamal et al. 2019). They also provide opportunities for collaborative learning, as students can work together to create, analyze, and interpret the content (Zimmerman 2008). Furthermore, comics can be a powerful tool for engaging readers and enhancing cultural awareness (Rodríguez-Vázquez and Aguaded 2016).

The advent of digital comics has added a new dimension to this educational tool. According to Aggleton (2018), digital comics are defined by their publication in a digital format, containing a single-panel image or series of interdependent images, and having a semi-guided reading pathway. This definition encompasses various visual and functional features, including visible frames, iconic symbols, and a reader's autonomy over the reading process. Digital comics may also include hand-written-style lettering and different multimedia elements such as audio clips, interactive animations, and hyperlinks. These multimedia enhancements can provide a richer, more immersive experience for the reader, allowing for deeper engagement with the content and a more dynamic storytelling approach (Azman et al. 2014; Kirchoff and Cook 2019).

The features of digital comics offer unique opportunities and challenges in the educational context. The semi-guided reading pathway allows for a personalized reading experience, while the digital format enables easy distribution and accessibility. However, Aggleton's (2018) definition also emphasizes the importance of retaining reader control over pacing, distinguishing digital comics from animations or films. This nuanced understanding of digital comics highlights their potential as a versatile and engaging medium in education, thus justifying the need for further research.

Thanks to the recent emergence and availability of authoring tools such as Pixton and ToonDoo, students can now create their own digital comic strips. These tools promote engagement and creativity, enabling students to visually express their ideas, even if they lack traditional artistic skills (Kohnke 2019). They enhance the learning process by aiding in the summarization of content and strengthening reading, writing, critical thinking, and communication skills (Nurchurifiani and Zulianti 2021). The customization options provided by these tools, combined with the ease of revision in a digital format, encourage personalization and continuous improvement. Furthermore, the digital nature of these comics also facilitates easy sharing and collaboration, promoting a collaborative learning environment where students can showcase their work, receive feedback, and draw inspiration from their peers (Kiliçkaya and Krajka 2012; Puspasari 2019).

## 2.2. Digital Comics in Language Learning

The integration of digital comics in language learning has been recognized as an innovative approach to engage students and enhance their linguistic skills (Kirchoff and Cook 2019; Muyassaroh et al. 2019). Digital comics, with their combination of visual and textual elements, offer a unique medium for language acquisition and cultural understanding (Rutta et al. 2021; Zimmerman 2008). Research has shown that they can be particularly effective in improving language skills and components across different educational levels, such as reading (Cimermanová 2015; Saputri et al. 2021) and writing (Kiliçkaya and Krajka 2012; Megawati and Anugerahwati 2012), as well as vocabulary and grammar (Cabrera et al. 2018; Novanti and Suprayogi 2021). Furthermore, digital comic strips have emerged as an effective tool for informal, out-of-class language learning.

During the COVID-19 pandemic, the prominence of digital comics in language learning increased significantly. A quantitative study (Castillo-Cuesta and Quinonez-Beltran 2022) conducted during this period assessed the impact of using digital comics to strengthen English vocabulary knowledge. Engaging with interactive digital comics, the experimental group worked on EFL vocabulary, completing various exercises remotely through an LMS during the COVID-19 pandemic, leading to substantial enhancements in vocabulary acquisition, as evidenced by the results. Another study (İlhan et al. 2021) delving into the use of digital comics in distance learning during the pandemic also showed positive effects on students' academic performance and their perspectives on distance learning. The study examined the impact of digital comics developed using the Pixton program on sixth-grade students' learning results. It was found that these comics increased academic success and promoted positive attitudes toward the course.

Additionally, integrating digital comic creation tools into language learning can significantly enhance students' creativity, critical thinking, and technological skills (Kohnke 2019). These tools provide students with a platform to express themselves, engage in storytelling through sequential art, and demonstrate their understanding of content. Through the creation of their digital comics, students engage in the process of analyzing and reinterpreting narratives, thereby enhancing their comprehension. Digital comics can be used to cultivate students' imaginative faculties to effectively convey diverse stories. This medium further encourages collaboration as students exchange ideas and feedback, mirroring real-world teamwork dynamics (Megawati and Anugerahwati 2012). With the advent of modern technology, particularly artificial intelligence (AI), the use of generative AI tools such as Fantoons and ComificyAI to produce digital comics will pave the way for innovative educational experiences (Bedi 2023).

Moreover, the incorporation of digital comics can also enhance students' intercultural awareness and promote inclusive education (Themelis and Sime 2020). The use of authoring tools such as Pixton, ToonDoon, Comicado, and similar platforms allows for learners to personalize their stories, adapting them to their interests. This customization provides a means for generating a more varied range of stories, diverging from conventional comics and superheroes that have recently come under scrutiny for promoting mainstream ideologies (Davis 2019; Kent 2021). The visual storytelling inherent in digital comics helps

contextualize diverse cultural, ethnic, and gender contexts, including people and stories that are underrepresented. According to Joannidou and Sime (2021) the process of creating and sharing these comics encourages empathy and ultimately leads to a richer learning environment.

### *2.3. Inclusive Education through Comic Creation in Higher Learning Environments*

Digital comic creation has been increasingly recognized as a powerful tool for promoting inclusive education in higher learning environments. Research has shown that this method significantly enhances student engagement and motivation, particularly among those who are less inclined towards traditional learning methods (Jamal et al. 2019). By converting complex information into visually appealing and interactive formats, digital comics facilitate a deeper understanding and retention of information. This method not only makes learning more accessible but also benefits students with disabilities or those located in remote areas by providing easy access to educational content.

According to Cabrera et al. (2018), encouraging students to create their own narratives enhances their creativity and critical thinking skills. This approach enables students to engage critically with content, fostering a more profound educational experience that goes beyond passive learning. The ability of digital comics to be widely shared and accessed also supports a more inclusive educational environment, ensuring that all students, regardless of their physical capabilities or geographical locations, have equal learning opportunities.

However, the integration of digital comics into educational settings is not without challenges. Issues such as technical compatibility, slow loading times, and the need for consistent content quality can undermine the effectiveness of digital comics (Saputri et al. 2021). Moreover, there is a significant demand for teacher training to ensure educators are well equipped to incorporate digital comics into their curriculum effectively (Rutta et al. 2021). These challenges highlight the need for institutions to invest in both infrastructure and professional development to fully leverage the benefits of digital comics in education.

Research on the use of digital comic creation in the English as a foreign language (EFL) classroom is limited, particularly regarding teacher candidates. However, a significant study by Themelis and Sime (2020) addressed this gap by illustrating how digital comics can be integrated into technology-enhanced language learning to foster inclusivity and engagement. Their research not only explores the practical applications of digital comics in education but also synthesizes findings from cognitive psychology, neuroscience of storytelling, and educational theory. Therefore, the current research aims to assess the potential of creating and using digital comic strips in the EFL classroom to promote inclusive education and enhance language skills. This includes evaluating teacher candidates' digital skills, investigating their perceptions of digital comic strips, and examining the impact on their attitudes toward inclusive and diverse education.

### **3. Objectives**

The following objectives were formulated to assess the potential of creating and using digital comic strips to promote inclusive education and enhance language skills in the English as a foreign language (EFL) classroom:

- Evaluate the digital skills of teacher candidates in collaboratively creating comic strips for the EFL classroom.
- Investigate the perceptions of teacher candidates regarding the use of digital comic strips in the EFL classroom.
- Examine the impact of creating digital comic strips on teacher candidates' attitudes toward inclusive and diverse education.

These objectives are aimed at addressing the research question that explores how the creation and use of digital comic strips in the English as a foreign language (EFL) classroom

affects teacher candidates' digital skills, their perceptions of digital comics, and their attitudes towards inclusive and diverse education.

## 4. Materials and Methods

### 4.1. Research Context and Participants

Based on convenience sampling, this study was conducted with a population of 84 third-year college students ( $n = 84$ ) enrolled in an applied linguistics course at a middle-sized university in Alicante (Spain). In terms of gender distribution, 21% of the participants were male, 77% were female, and 2% identified as non-binary. All of the participants were under the age of 30, with an average age of 21.5. With regard to nationality, 81% of the participants were native to XX, while the remaining 19% were international students from countries such as the USA, UK, Germany, France, Romania, Israel, Morocco, Japan, Argentina, and Cyprus. The classes were held twice a week, with each session lasting two hours, over a period of four months. The students' English proficiency levels varied between B2 and C1 according to the Common European Framework of Reference for Languages (CEFR), and 12% of the participants were native English speakers. The curriculum incorporated theoretical concepts along with information and communication technology (ICT)-based projects. The pedagogical approach employed was project-based learning (PBL), supplemented by a flipped classroom methodology. For the projects, the students were randomly assigned to teams consisting of 5 to 6 members. They were given the task of collaboratively designing four digital projects aimed at teaching English to their target students. This particular research focused on the second project, which centered around the integration of digital comic strips in the English as a foreign language (EFL) classroom from an inclusive perspective.

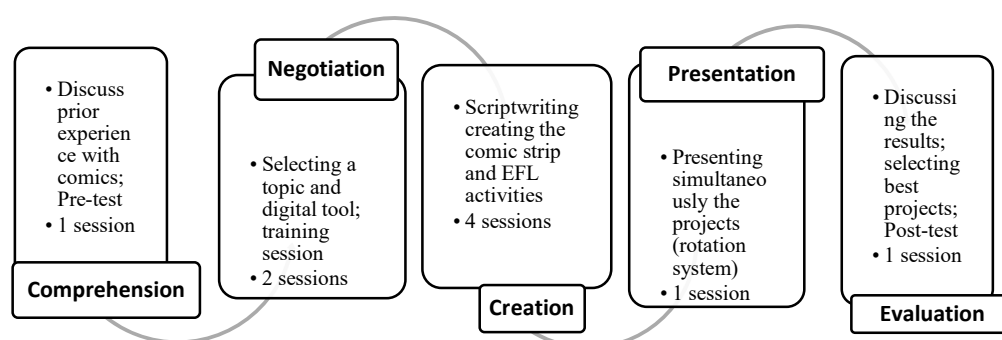
### 4.2. Instruments and Procedure

The research used a mixed-methods approach, collecting both quantitative and qualitative data. For the quantitative data, two surveys were conducted. The pre-survey consisted of 21 items, comprising sociodemographic information, previous experience with comics, and knowledge of comic books, as well as attitudes towards the use of digital comics for inclusive and diverse education (14 items) drawn from Selong et al.'s (2021) research. The post-survey, on the other hand, included 29 items and was designed to assess perceptions about the use of digital comics in the EFL classroom (15 items) based on Puspasari's (2019) study, and it replicated the attitudes section to determine any significant difference post-treatment. For data analysis, the quantitative data were processed using IBM SPSS Statistics 20 software, while the qualitative data gathered through semi-structured discussions were analyzed using QDA Miner Lite. This research adhered to the ethical guidelines of the institution, and informed consent was obtained from all participants. Furthermore, to ensure participant confidentiality, all data were anonymized throughout this study.

Students were given scaffolded instructions to guide them in creating their digital comic strips. They began by negotiating a topic for their story, ensuring it embraced an inclusive and diverse perspective, such as addressing special needs, and cultural or affective diversity. Once the topic was decided, they were tasked with considering the target language level appropriate for their primary or secondary education students. The next steps involved scriptwriting, which required the inclusion of diverse characters, and selecting a digital tool such as Pixton, Toondoo, or ComicPo. Although there was a short practical session introducing some of these digital tools, no specific platform was mandated upon the participants. Instead, they had the autonomy to negotiate and select the tool that best fit their needs and preferences. To further enhance inclusivity, students were encouraged to incorporate different elements such as sounds, speech balloons, and captions or description boxes. Notably, some teams went a step further by adding audio descriptions and sign language interpretation to accommodate students with visual and

hearing impairments, ensuring a more inclusive learning environment. Finally, based on their created digital comic, students had to design two EFL activities: one focusing on vocabulary learning and the other on reading comprehension.

The research procedure was structured into several stages, as illustrated in Figure 1. In the initial stage (1 session), participants engaged in a discussion about their childhood experiences with comics and their knowledge and familiarity with inclusive stories. They explored their perspectives on the impact of reading comic books on language development and subsequently completed the pre-test. The second stage (2 sessions) involved the random allocation of participants into teams. Once grouped, they were provided with the necessary instructions about the project. The instructor guided them in conducting research to make informed decisions about selecting a digital tool and an inclusive topic for their comic. The third stage (4 sessions) was dedicated to the collaborative creation of their digital comic strips. The fourth stage (1 session) focused on the teams simultaneously presenting their projects in the class-room through a rotation system, as further explained below. In the last stage (1 session), participants engaged in a discussion regarding their findings, voted to determine the best projects, and concluded the process by completing the post-test.



**Figure 1.** Research stages and critical thinking skills.

All the project presentations took place simultaneously following a rotation system. The 84 participants were originally divided into two separate groups attending different class sessions, each comprising 42 students and eight project teams (approx. 4–5 students per team). Each team was tasked with printing out a poster and bringing a laptop with the digital version to the presentation. On the day of the presentation, each team was conveniently numbered (teams 1, 2, 3, etc.) and arranged separately within a large classroom.

During these presentations, one student designated by the team members assumed the role of a speaker, presenting the digital comic, while the other members played the role of the audience and readers for the rest of the teams. In these small groups, the speakers each had 15 min to present their comic strips and discuss the project with other classmates in a rotation system. This system aimed to increase students' engagement, reduce language anxiety, and improve peer interaction. Participants read comics (poster and digital format), discussed the results, completed the EFL activities, and moved around the classroom every 15 min while the instructor observed their interaction and assessed their presentations. In the following session, students selected the best digital comics in various categories (story, design, EFL activities, and oral presentation) using Mentimeter.

## 5. Results

### 5.1. Digital Comic Strips Created by Participants

The teams collaboratively created sixteen digital comic strips that focused on various inclusive themes, with seven comics centered on special needs, four on ethnic and cultural diversity, and five on gender and affective diversity, as shown in Table 1.

**Table 1.** Summary of the 16 digital comic strips created by teacher candidates.

Category	Title	Topic	Summary
Special needs	Blind and Brilliant	Visual impairment	This story highlights the achievements of a visually impaired boy named Tom.
	Malala	Down syndrome	A story about Malala, a superheroine with Down syndrome showcasing her unique talents and world adventures.
	Silent Superstar	Hearing impairment	The story is about the journey of a deaf student who overcomes challenges to become a superstar.
	Timmy's FiSRT Bay of School	Dyslexia	A comic about a dyslexic student's first day of school, emphasizing support and understanding.
	The Amazing Sophia	Autism	This comic strip focuses on the amazing abilities of a student with autism, celebrating her uniqueness.
	A Beautiful Smile	Asperger's syndrome	The story is about Zoe, a student with Asperger's syndrome and her journey to connect with other classmates.
	Wheels of Change	Physical mobility	This comic strip focuses on two children in wheelchairs playing sports, highlighting their perspectives and challenges.
Ethnic and cultural diversity	Summer Drama	Ethnic diversity	The story explores the impact of bullying based on ethnic and cultural differences and the power of unity.
	The Romani Journey	Gypsy culture	The comic shows the adventures of Romani children and families, highlighting their history and culture.
	At War Against the Stars	Refugee children	The narrative shows the struggles and resilience of children fleeing conflict and seeking refuge among the stars.
	Every Voice Matters	Cultural and religious diversity	This story focuses on Fatima and Rachel, and traditions related to different cultural and religious groups.
Gender and affective diversity	Shero's Adventures in Womenland	Gender stereotypes	The story describes the adventures of a superheroine named Shero as she challenges gender stereotypes and fights for equality in Womenland.
	Spread your Wings	LGTBiQ	This comic strip focuses on the relationship between two young women, promoting acceptance and understanding.
	Eat your Prejudices	Same-sex parenting	This story challenges stereotypes and prejudices about same-sex parenting through the story of two mothers.
	The Rainbow Fish	Affective diversity	The narrative highlights affective diversity and the importance of acceptance through a rainbow fish.
	PromQueen	LGTBiQ	This comic follows Jamie, a 19-year-old college student navigating self-acceptance within his community.

These stories created by participants featured a wide range of comic styles ranging from the classic superhero to science fiction, manga, and fantasy genres, as shown in Figure 2. Notably, several of these digital comics included multimedia elements such as sounds and animations that enhanced the storytelling experience. Additionally, certain comics incorporated QR codes, allowing for readers to scan and access audio files containing dialogue and accompanying EFL activities, further enhancing the educational and interactive aspects of the comics.





Figure 2. Samples of four digital comic strips (from top left to bottom right): Timmy’s FiSrt Bay of class, Malala, The Romani Journey, and PromQueen.

### 5.2. Data Results

The pre-survey results showed that teacher candidates’ prior experiences in creating print or digital comics ( $M = 1.2$ ) as well as EFL-inclusive projects ( $M = 0.5$ ) were low, as shown in Table 2. These scores were determined using a five-point Likert scale (1 no experience to 5 highly experienced). The results also showed that there was strong agreement regarding the relevance of using inclusive and diverse EFL materials ( $M = 4.6$ ), although participants’ satisfaction with the college materials in this sense was more moderate ( $M = 3.0$ ). In fact, pre-service teachers believed that their instructors demonstrated low awareness of inclusive and diverse education in the classroom ( $M = 2.5$ ), rated on a five-point Likert scale ranging from 1 (not at all aware) to 5 (completely aware).

Table 2. Prior experience in comic creation and attitudes towards inclusive materials.

Pre-Test: Section 1	M	SD
Previous experience in creating EFL-inclusive projects	0.5	0.9
Previous experience creating (digital or paper) comic strips	1.2	0.8
Satisfaction with the inclusiveness and diversity of EFL materials in college	3.0	1.3
Relevance of using inclusive and diverse EFL materials	4.6	0.6
In-service teachers’ awareness of inclusivity and diversity in education	2.5	0.9

In the pre-survey, teacher candidates were asked to provide the names of some famous comic characters based on pictures. The results shown in Table 3 revealed a significant gender-based discrepancy, highlighting a considerable bias towards male characters



despite the majority of teacher candidates being female students. Male characters like Spiderman, Thor, Batman, the Hulk, and Captain America exhibited familiarity percentages ranging from 74% to 98%, whereas female characters like Invisible Woman, Storm, Raven, and Jean Grey were notably less recognized. This discrepancy underscores the prevailing gender imbalance in popular media, as male characters exhibit a much higher familiarity percentage at 77%, while female characters fall behind at only 30%.

**Table 3.** Familiarity with famous male/female comic characters.

Character	Gender	Perc.	Character	Gender	Perc.
Spiderman	M	98%	Batgirl	F	51%
Thor	M	89%	Black Widow	F	49%
Batman	M	87%	Green Lantern	M	47%
The Hulk	M	82%	Invisible Woman	F	21%
Captain America	M	74%	Storm	F	15%
Wonder Woman	F	61%	Raven	F	8%
Wolverine	M	60%	Jean Grey	F	6%

The pre-survey contained 15 items aimed at measuring participants' attitudes towards the use of digital comics in the EFL classroom based on Puspasari's 2019 study. As Table 4 illustrates, respondents seemed to believe that digital comics have the potential to create a meaningful learning environment (#1 M = 4.0) and found them appealing for encouraging creative English learning (#2 M = 4.2). Teacher candidates did not perceive the creation of digital comics as particularly burdensome. The scale also included negatively worded statements to prevent the acquiescence bias present in self-reported surveys. They found the process to be manageable in terms of time (#3 M = 2.1), straightforward in application (#4 M = 1.9), and not overly challenging to execute (#5 M = 2.4). They also felt that digital comics were generally easy to use (#6 M = 3.3) and expressed willingness to use them in teaching English in the future (#7 M = 3.3). Additionally, participants recognized the positive aspects of digital comics in attracting learners' interest (#8 M = 4.3), motivating EFL learners (#9 M = 4.1), enhancing understanding of the target language and culture (#10 M = 4.1), facilitating contextual language learning (#11 M = 4.0), promoting student-centered learning (#14 M = 3.8), and highlighting specific grammar and vocabulary items (#13 M = 3.6).

**Table 4.** Attitudes towards the use of digital comic strips in the EFL classroom.

#	Statement $\alpha = 0.851$	M	SD
1	Digital comics can create a meaningful learning environment	4.0	0.8
2	Digital comics appeal to and encourage creative English learning	4.2	0.7
3	Digital comics in the EFL classroom are very time-consuming	2.1	1.0
4	Digital comics are too complicated to be applied	1.9	0.9
5	It is hard to create digital comics for the EFL classroom	2.4	1.1
6	Digital comics are easy to use	3.3	1.0
7	I will use digital comics in teaching English in the future	3.3	1.0
8	Digital comics are a positive way to attract learners' interest	4.3	0.7
9	Learning English by creating comic strips is a good way to motivate learners	4.1	0.7
10	Digital comics make the target language and culture understandable	4.1	0.8
11	Learning with digital comics facilitates language learning in context	4.0	0.7
12	Creating comic strips promotes learning through student-centered work	3.7	0.7
13	Digital comics are an excellent way to highlight grammar and vocabulary	3.6	1.0
14	Digital comics promote student-centered learning	3.8	0.7
15	Digital comics put language use in real communication	3.9	1.0

The second section of the pre-survey comprised a 14-item scale adapted from Selong et al. (2021), tailored to the research objectives, and aimed at gauging participants' perceptions regarding the utilization of digital comics for inclusive and diverse education. This segment was replicated in the post-survey following the treatment to assess any differences after students collaboratively created inclusive digital comic strips and presented them in the classroom. The comparative analysis of pre- and post-survey scores, as depicted in Table 5, reveals notable trends. Participants generally exhibited positive attitudes towards the efficacy of digital comics for fostering inclusive and diverse education. Notably, there were significant increases in mean scores from pre- to post-survey in several areas. For instance, participants showed a substantial increase in their agreement regarding the effectiveness of digital comic strips in enhancing creative skills (pre M = 3.4; post M = 4.3). This indicates a clear positive shift in perception, suggesting that the collaborative creation of digital comic strips had a tangible impact on participants' perceptions of their creative potential. Similarly, there was a notable increase in participants' belief in the ability of digital comics to foster collaboration (pre M = 3.4; post M = 4.1). This suggests that the collaborative creation process not only enhanced participants' individual creative skills but also fostered a greater sense of teamwork and cooperation among students. Furthermore, participants demonstrated a significant increase in their belief that digital comics could help students better understand the importance of inclusive and diverse education (pre M = 2.9; post M = 4.3). This indicates that the creation and presentation of inclusive digital comic strips served as an effective educational tool for promoting awareness and understanding of diversity and inclusion issues among students.

**Table 5.** Attitudes towards the use of digital comics for inclusive education.

	Statement $\alpha = 0.805$	Pre		Post	
		M	SD	M	SD
1	Digital comic strips are an effective media to increase my creative skills	3.4	0.74	4.3	0.80
2	Digital comic strips are an interesting media to use in collaborative creative projects	3.4	0.96	4.1	0.67
3	Digital comic strips enhance students' ability to think critically	3.3	0.87	3.6	0.75
4	Digital comic strips can help students better understand the importance of an inclusive and diverse education	2.9	0.83	4.3	0.89
5	Digital comic strips can enhance students' ability to understand other students' needs and situation	4.1	0.85	4.2	0.78
6	I feel motivated to use digital comics in inclusive and diverse education	3.1	0.88	3.8	0.75
7	I feel comfortable sharing my ideas about inclusive and diverse education through comic strips	4.0	0.95	4.1	0.97
8	Digital comic strips can incite students to learn more about inclusive and diverse education	3.9	0.94	4.1	0.89
9	Digital comic strips can raise awareness about inclusive and diverse education in the EFL classroom	3.1	0.85	4.2	0.78
10	I believe other colleagues and in-service teachers will support the idea of using comic strips from an inclusive and diverse perspective in the EFL classroom	3.3	0.97	3.2	0.71
11	I feel too shy to share my ideas with other students about inclusive and diverse education through digital comic strips	2.0	0.98	1.9	1.04
12	Comic strips do not allow me to express my thoughts on inclusive and diverse education more clearly or openly	1.9	0.92	1.8	0.90
13	Using digital comic strips from an inclusive and diverse perspective can have a negative impact on the classroom environment	1.4	0.68	1.4	0.76
14	I believe EFL classes and materials in general (textbooks, activities, etc.) should be more inclusive and diverse	4.1	0.97	4.2	0.98

The Wilcoxon signed rank test was utilized as a non-parametric analysis for ordinal data to determine if there was any statistically significant difference between pre- and post-treatment scores, with a significance level set at  $p = 0.05$ . This test is suitable for analyzing paired data when the assumptions of normality are not met, making it appropriate for ordinal data like Likert scale responses. Significant differences were found in all items except the last five, as shown in Table 6. For instance, participants displayed significant improvements in their beliefs regarding the effectiveness of digital comics in enhancing creative skills, fostering collaboration, and promoting critical thinking. They also showed increased confidence in the ability of digital comics to help students better understand the importance of inclusive and diverse education and to comprehend the needs and situations of others.

However, participants’ perceptions regarding their own hesitancy to share ideas through digital comic strips (items 11 and 12) and their skepticism about the support of colleagues and in-service teachers for integrating inclusive digital comic strips in the classroom (item 10) remained relatively unchanged after the treatment. This suggests that while participants felt confident in their own abilities to utilize digital comic strips for inclusive education, they may have perceived potential barriers or challenges in gaining support from in-service teachers. In general, participants maintained strong beliefs that EFL classes and materials should be more inclusive and diverse both before and after the treatment, indicating a consistent stance on the importance of inclusivity in language education.

**Table 6.** Perceptions of inclusive digital comics (pre/post-test).

	1	2	3	4	5	6	7
Z	-5.982 <sup>b</sup>	-5.372 <sup>b</sup>	-3.463 <sup>b</sup>	-6.718 <sup>b</sup>	-2.565 <sup>b</sup>	-5.410 <sup>b</sup>	-1.067 <sup>b</sup>
Asymp. Sig. (2-tailed)	0.000	0.000	0.001	0.000	0.010	0.000	0.286
	8	9	10	11	12	13	14
Z	-2.460 <sup>b</sup>	-6.199 <sup>b</sup>	-0.392 <sup>c</sup>	-0.355 <sup>c</sup>	-1.414 <sup>c</sup>	-1.000 <sup>c</sup>	-1.342 <sup>b</sup>
Asymp. Sig. (2-tailed)	0.014	0.000	0.695	0.723	0.157	0.317	0.180

<sup>b</sup>: Based on negative ranks. <sup>c</sup>: Based on positive ranks.

Regarding qualitative data, the analysis of participants’ comments on the need for inclusive and diverse materials in the EFL classroom revealed several prominent themes, as shown in Table 7. In the analysis, prominent themes were identified based on the recurring topics and ideas expressed by participants in their comments. Each theme was assigned a code, and the frequency of each code was calculated as a percentage of the total number of comments analyzed. The percentages in Table 7 represent the frequency of each theme relative to the total number of comments analyzed. First, many participants stressed the significance of empathy and awareness that inclusive materials can foster among students. They perceive these materials as powerful tools for expanding students’ perspectives and helping them better understand the experiences and challenges faced by others. Additionally, some participants highlighted practical challenges associated with implementing inclusive materials, such as difficulties in creating content and the time required for effective implementation.

However, a counterpoint emerged from a few participants who advocated for the early introduction of inclusive materials in education, emphasizing the importance of normalizing diversity and inclusivity from a young age. Teacher training emerged as another critical theme, with several participants emphasizing the need to equip current and future educators with the skills and strategies necessary to effectively utilize inclusive materials in the classroom. Furthermore, participants stressed the importance of raising awareness about the use of inclusive materials and called for better representation of diverse

communities, including ethnic, cultural, and affective diversity, in all educational materials. Overall, the participants recognized the potential of inclusive materials to positively impact students, promote equity, and create a more respectful and inclusive learning environment.

**Table 7.** Qualitative data. QDA Miner (code frequencies).

Theme	Freq.	S	Verbatim Transcription
Empathy	86.2%	61	"Inclusive materials are necessary because they help people feel valued and fight against discrimination in the classroom."
		28	"They are valuable tools for broadening students' perspectives."
Early introduction	75.4%	7	"Starting early can help students understand and appreciate cultural and other differences."
		55	"Teachers should use comic strips early in education because they can be used to stop prejudices about someone's appearance"
Teacher training	68.3%	23	"In my opinion, it's important to include inclusive materials to make people and teachers think about it and be more emphatic seeing what some people feel in some situations."
		12	"It is necessary to include activities based on diversity because it is essential that students and teachers learn in an inclusive environment. That way, they will become more respectful people and they will feel safer."
Awareness	65.8%	75	"I think that it is crucial to include inclusive materials in class because it creates a more comfortable atmosphere. Besides, you can also learn about the differences between people. It is very useful."
		19	"I believe that there is a huge need for inclusive materials in the classroom since they help create awareness about subjects that are taboos or are not discussed in general, and inclusivity might encourage many of us to rethink our old way of thinking"
Underrepresentation and practical challenges	38.2%	48	"We experienced some difficulties in finding adequate images and creating inclusive content, partly because we could not find inclusive characters on the web."
		81	"We were concerned about the time it takes to create and implement such materials and the lack of electronic devices in the classroom "
Controversial subjects	16.2%	32	"I was worried that discussing sensitive subjects such as transgender topics while working together on our story could cause disagreements and harm our progress."

## 6. Discussion

In line with previous research (Akcanca 2020), the findings emphasized the limited understanding and proficiency in employing digital tools in an innovative and transformative way among EFL teacher candidates. This lack of experience not only restricts the potential for innovative teaching approaches but also reflects the broader issue of inadequate preparation for integrating technology into language instruction, as discussed by Puspasari (2019). The initial consequence entails the requirement for curriculum reform in teacher education programs to incorporate extensive instruction in digital literacy and technology integration, specifically within the area of EFL instruction.

This study also highlights a lack of technical training in using authoring tools to produce digital comic strips. This discovery supports the arguments made by Selong et al. (2021), who advocated for empowering teachers through technological proficiency in a more creative manner. Insufficient training, limited exposure, and an inadequate grasp of pedagogical principles may be the reasons behind the lack of knowledge among EFL teacher candidates in creatively and effectively utilizing digital comic strips (Kohnke 2019; Pange 2022). This lack of knowledge hinders the adoption of innovative teaching methods and restricts the ability of future educators to create digital content, as emphasized by

Selong et al. 2021. Additionally, this highlights the importance of targeted professional development programs that specifically focus on equipping future educators with the necessary technical skills to effectively create and utilize digital resources in diverse educational settings.

The results concerning the limited experience in utilizing EFL materials and digital comics for inclusive education, particularly the notable gender-based disparity in familiarity with comic characters, emphasize the necessity for more comprehensive and inclusive educational resources. This is in line with previous research that highlights the importance of culturally responsive teaching approaches in language education (Rodríguez-Vázquez and Aguaded 2016; Saputri et al. 2021). To cultivate the creativity and critical thinking skills of prospective teachers for diverse and inclusive education, the curriculum could include collaborative tasks for creating digital comics. This underscores the significance of purposeful and inclusive integration of technology in educational materials to cater to a diverse student body. Furthermore, this finding indicates an urgent requirement to integrate inclusivity training into teacher education programs, ensuring that future EFL educators possess the awareness and competence to develop content that embraces all students, regardless of their backgrounds or identities.

The benefits of empowering teacher candidates with digital and critical skills through the creation of collaborative digital comics are highlighted by the qualitative data obtained from semi-structured interviews and class presentations. In line with Themelis et al.'s research (2020), comics can be a valuable resource for advancing inclusive and technology-driven language learning. Their findings proposed that the creation of digital solutions, exemplified by the CIELL app, can enhance the accessibility and attractiveness of comics for learners with varying requirements and capacities. This approach not only promotes engagement and creativity but also cultivates a sense of community and cultural sensitivity among students (McGrail and Rieger 2016). The positive feedback received from students further emphasizes the transformative impact of this method on their learning experience. Despite the scarcity of studies on this matter, it becomes evident that there is a need for enhanced digital training and increased inclusive awareness within current EFL teacher education, aligning with the recommendations proposed by (Blume et al. 2019).

## 7. Conclusions

Three primary conclusions arise from this research: Firstly, there is a significant knowledge gap among future educators regarding the effective use of comics in language instruction. This knowledge deficit can be attributed to factors such as inadequate training, limited exposure, and a lack of understanding of pedagogical principles and technological resources. These factors collectively highlight the need for more comprehensive training programs aimed at utilizing comics as an educational tool for language learners.

Secondly, there is a critical inadequacy in the preparation of EFL teacher candidates, specifically in their competence to effectively utilize digital comic strips for language instruction. The limited experience and confidence in developing EFL-inclusive digital materials, along with a lack of technical training for authoring tools, emphasize the urgent requirement for more extensive training initiatives.

Lastly, this study emphasizes the transformative potential of empowering teacher candidates through collaborative digital comic creation. Qualitative data clearly illustrate that this approach not only enhances students' creativity and inclusivity but also fosters a sense of community. Despite the limited existing research in this area, this study strongly advocates for enhanced digital training and increased awareness of inclusivity within current EFL teacher education programs.

There are several limitations to this study. The generalizability of the findings may be limited due to the specific context and sample size. The focus on EFL teacher candidates in a particular setting raises concerns about the broader applicability of the results. Although attempts were made to ensure diversity, there is potential for future research to expand the sample size. Recommendations for further investigation include exploring the

use of digital comic creation in different contexts, conducting studies with larger sample sizes, and examining the long-term effects. It would be valuable to conduct a longitudinal study with the pre-service teachers upon entering the profession to investigate whether they continue to advocate for inclusive educational practices and integrate digital comic creation into their teaching methodologies. Moreover, conducting in-depth studies on the design and implementation of training programs would provide valuable insights. Additional research is necessary to enhance teacher education practices in the integration of digital comics into language instruction.

**Funding:** This research has been funded by the Redes Program of the Institute of Educational Sciences (ICE) of the University of Alicante (code 4391).

**Institutional Review Board Statement:** This study was conducted in accordance with the Declaration of Helsinki, following the guidelines provided by the Ethics Committee of the University of Alicante on the website <https://bit.ly/UAethicsCommittee>. All data was treated anonymously, and participants gave written consent.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in this study.

**Data Availability Statement:** Due to privacy concerns, the data supporting the research findings is not publicly accessible but can be requested from the corresponding author.

**Conflicts of Interest:** The author declares no conflicts of interest.

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