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The Effects of Genially-Based Interactive Media through Flipped Learning on Literacy and Writing Skills of Students with Autism Spectrum Disorder

Fatin Nadifa Tarigan [1]* , *Alwi Fahruzy Nasution [2]* , *Fikriyah Iftinan Fauzi [3]* , *Siti Aminah Hasibuan [1]* , *Assa Jidah [1]* , *Alkisah Ikhlas Halawa [1]*

[1] English Education Department, Universitas Pembinaan Masyarakat Indonesia, Medan 20214, Indonesia

[2] Department of Physical Education, Health, and Recreation, Universitas Pembinaan Masyarakat Indonesia, Medan 20214, Indonesia

[3] Psychology Department, Universitas Medan Area, Medan 20217, Indonesia

ABSTRACT

This study explored the impact of Genially-based interactive media, when integrated into a flipped learning model, on the literacy and writing skills of middle school students with Autism Spectrum Disorder (ASD). A quasi-experimental design was employed, using pre-test and post-test control groups to examine learning outcomes. The participants consisted of 18 students with ASD, divided evenly into an experimental group (n = 9) and a control group (n = 9). Students in the experimental group were provided with literacy and writing instruction through interactive Genially modules delivered in a flipped classroom format, which allowed them to engage with materials before class and participate in teacher-facilitated activities during class. In contrast, the control group received instruction using traditional, teacher-centered methods. Literacy outcomes were evaluated across four domains: spelling accuracy, handwriting fluency, sentence construction, and guided composition, using standardized rubrics designed for special education contexts. To assess treatment effects while accounting for baseline differences, data were analyzed using Analysis of Covariance (ANCOVA). The results

demonstrated that students in the experimental group showed significantly greater improvement compared to the control group. Specifically, the experimental group achieved average gains of 32% in spelling accuracy, 28% in handwriting fluency, 35% in sentence construction, and 30% in guided composition. These findings suggest that the integration of Genially-based interactive media within flipped classrooms provides a promising approach for enhancing both foundational and expressive literacy skills among students with ASD. The study underscores the pedagogical value of multimodal, digital, and gamified tools, recommending their wider application in special education.

Keywords: Digital Media; Flipped Learning; Genially; Literacy; Writing; Autism

1. Introduction

In recent years, the integration of digital technologies into education has transformed the way students learn and teachers deliver instruction. For students with autism spectrum disorder (ASD), who often require structured, visual, and repetitive learning experiences, technology-enhanced learning environments offer unique opportunities to support literacy development. Combining visual, auditory, and kinesthetic channels are particularly effective in addressing the diverse needs of these learners by enhancing engagement, comprehension, and retention.

Students with special educational needs (SEN) require instructional approaches that accommodate their diverse learning profiles. In many educational contexts, students with special educational needs (SEN) still encounter significant challenges that limit their equal participation, such as restricted access to curriculum content, unsuitable teaching methods, inadequate assessment practices, and insufficiently trained educators. These approaches aim to provide adapted materials, structured environments, and specialized teaching strategies to enhance academic outcomes and promote autonomy[1]. Inclusive education emphasizes equitable access to learning while addressing individual strengths and challenges.

Among SEN populations, students with Autism Spectrum Disorder (ASD) demonstrate unique cognitive and behavioral characteristics, such as differences in social communication, repetitive behaviors, and sensory sensitivities[2]. In literacy learning, research shows a heterogeneous pattern in which some autistic learners exhibit strengths in word recognition and code-based skills, while many experience disproportionate difficulty with higher-level language and reading comprehension processes, especially when inferencing or pragmatic language is required[3–5]. These findings imply that instruction should simultaneously support decoding/word-level skills and language comprehension, with explicit, scaffolded teaching and ample opportunities for supported practice.

Literacy and writing are critical for enabling students to access educational content, express themselves, and participate meaningfully in society. Early skills such as decoding, spelling, and constructing simple sentences form the basis for advanced writing and broader academic achievement. Yet meta-analytic evidence confirms that literacy is often a relative weakness for students with ASD[3,6]. Comprehensive interventions that address spelling, vocabulary, sentence construction, and writing fluency are essential for improving academic success, communication, and long-term independence.

Students with Autism Spectrum Disorder (ASD) frequently thrive in environments that are structured, predictable, and multisensory. *Flipped learning,* which reverses traditional instruction by shifting content delivery to independent study at home followed by interactive teacher-guided practice in class, offers particular promise for this population. It supports repetition, self-paced learning, and predictable routines, all of which align with the cognitive and behavioral needs of autistic learners[7,8]. When enriched with concise, visually supported, and multimodal resources, flipped learning can become a powerful approach for literacy instruction in special education.

To ground the present study, a preliminary needs analysis was conducted in two pecial schoo in *Kecamatan* Medan Amplas, North Sumatra, during July–August 2025. The analysis revealed three key challenges: (a) students exhibited uneven literacy profiles—stronger in basic recognition but weaker in writing fluency, spelling accuracy, and sentence construction; (b) teachers reported the need for ready-to-use multisensory resources; and (c) schools required a simple,

device-agnostic digital platform for centralizing interactive content and monitoring progress.

Genially, a platform for creating interactive and multimedia learning objects (e.g., clickable tasks, drag-and-drop, embedded video, gamified activities), provides opportunities to design engaging and multisensory content. Studies in K–12 contexts indicate that Genially-based resources are both feasible and effective, improving engagement and supporting multimodal learning in inclusive classrooms[9–11]. Importantly, Genially can combine digital interactivity with kinesthetic classroom activities, enabling multisensory learning principles to be realized in blended instruction.

Building on this context, the present study seeks to investigate the impact of Genially-based interactive media, delivered through a flipped classroom model, on writing-focused literacy skills among students with Autism Spectrum Disorder (ASD). The targeted skills include spelling accuracy, handwriting fluency, sentence construction, and short guided composition. The study was conducted with students enrolled in two special schools located in Medan Amplas, North Sumatra. Unlike earlier studies, which have predominantly examined flipped learning approaches within mainstream educational contexts or focused exclusively on the use of digital media, this research integrates both innovations. The combination of a flipped learning framework with interactive, multimodal Genially modules is intended to address persistent literacy challenges faced by ASD students, particularly in areas such as spelling, vocabulary development, sentence organization, and overall writing fluency.

To achieve these objectives, the study adopts a quasi-experimental design employing pre-test and post-test control groups. Students in the experimental group received instruction through Genially-based interactive modules in a flipped format, whereby materials were introduced prior to class and reinforced during in-class activities. In contrast, the control group continued to receive conventional, teacher-centered instruction. Literacy outcomes were assessed using standardized rubrics designed to evaluate both foundational and expressive writing abilities. By comparing post-test performance while controlling for baseline differences, the research aims to determine whether students exposed to the Genially–flipped learning intervention demonstrate significantly greater improvement in their literacy and writing skills. The study's findings are expected to provide insights into innovative pedagogical strategies for enhancing literacy instruction in special education contexts.

2. Literature Review

2.1. Literacy and Writing Skills

Literacy and writing skills constitute fundamental pillars of academic achievement and lifelong learning. Literacy is commonly defined as the capacity to read, write, and employ language effectively for communication. Beyond mere word decoding, literacy encompasses the ability to comprehend, analyze, and apply information in meaningful contexts. According to Snow[12], literacy comprises several core components, including word recognition, reading comprehension, vocabulary acquisition, and the use of written language as a tool for learning. Writing skills, meanwhile, entail the organization of ideas, the selection of appropriate vocabulary, and the capacity to convey meaning clearly and coherently in written form[13].

These competencies are essential for all learners, but they warrant particular attention in the education of students with Autism Spectrum Disorder (ASD). Learners with ASD often exhibit distinctive cognitive and communicative profiles, which may include challenges in social interaction, language processing, and executive functioning. These differences can impact their ability to acquire and demonstrate literacy and writing skills in conventional educational settings.

Consequently, educators must adopt tailored instructional strategies that accommodate the diverse needs of autistic students. This includes the use of visual supports, structured writing frameworks, and interactive digital tools that promote engagement and scaffold learning. Moreover, fostering literacy and writing development in students with ASD requires a nuanced understanding of their individual strengths and challenges, as well as a commitment to inclusive pedagogical practices. By prioritizing these foundational skills, educators can empower autistic learners to access the curriculum more effectively and participate meaningfully in academic and social contexts

2.2. Genially-Based Interactive Media

Genially is an interactive digital platform that enables educators to create multimodal instructional materials—such as drag-and-drop activities, clickable maps, quizzes, and animated storytelling—without the need for programming expertise. Its intuitive interface enhances accessibility for teachers across a range of educational settings, including special education[9]. By incorporating visual, auditory, and kinesthetic modalities, Genially-based content aligns closely with the principles of multimodal learning and Universal Design for Learning (UDL), both of which are critical for addressing the diverse needs of learners, particularly those with Autism Spectrum Disorder (ASD)[10,14].

Emerging research highlights Genially's positive impact on student engagement and comprehension. Romualdi et al.[9] observed that the use of Genially in junior high school classrooms fostered active participation and heightened motivation. Similarly, Afni and Bektiningsih[11] reported that Genially-facilitated interactive media enriched student-centered learning environments, rendering lessons more engaging and effective. In the context of higher education, Arum et al.[15] demonstrated that digital storytelling supported by Genially significantly enhanced students' literacy and critical thinking skills, underscoring the platform's adaptability across academic disciplines.

A further strength of Genially lies in its compatibility with flipped classroom models. By allowing students to access content asynchronously, Genially supports self-paced learning, enabling learners to preview, review, and reinforce concepts as needed. This approach is particularly advantageous for students with ASD, who often benefit from repeated exposure, structured content delivery, and multimodal input to support comprehension and retention[16,17].

2.3. Autism Spectrum Disorder (ASD) Students

Students with Autism Spectrum Disorder (ASD) often exhibit distinct learning profiles that influence the development of literacy skills. While many demonstrate strong word recognition and decoding abilities, they frequently encounter difficulties with reading comprehension, spelling, handwriting, and sentence construction[18]. These challenges can slow overall literacy progress, as comprehension—the ability to derive meaning from text—is a critical component of effective reading[19,20].

Literacy difficulties among students with ASD are closely tied to oral language proficiency and social communication skills. Research indicates that children with stronger vocabulary and expressive language abilities tend to perform better in reading comprehension tasks[13]. However, many students with ASD struggle to make inferences, interpret figurative language, and connect ideas across extended texts, which can hinder their ability to engage with complex reading materials[19].

In addition to reading challenges, writing-related skills such as spelling and fluency are often affected. Students with ASD may display atypical spelling patterns and experience difficulty generating written text with coherence and speed, which can negatively impact academic performance[18]. Handwriting issues are also common, including slow writing speed, inconsistent letter formation, and poor fine motor coordination[20]. These motor-related difficulties can further complicate the writing process and reduce students' confidence in their literacy abilities.

To effectively support literacy development in students with ASD, educators must implement instructional strategies tailored to individual needs. This includes structured teaching approaches, visual supports, and opportunities for repeated practice. By recognizing and addressing the unique challenges faced by autistic learners, educators can foster more inclusive learning environments and promote meaningful literacy outcomes.

2.4. Research Questions

Drawing on the reviewed literature, this study seeks to explore the following research questions:

1) What is the impact of Genially-based interactive media, implemented through a flipped classroom model, on the writing-related literacy skills of students with Autism Spectrum Disorder (ASD)?

2) In what ways do students with ASD engage with Genially-based interactive media within a flipped classroom environment?

3) How do educators perceive the use of Genially-based interactive media in supporting the development of literacy skills among students with ASD?

3. Methodology

3.1. Research Design

This study employed a quasi-experimental pretest–posttest comparison-group design to examine the effects of Genially-based interactive media delivered through a flipped classroom model on the literacy and writing skills of students with Autism Spectrum Disorder (ASD). The quasi-experimental design was selected because of its suitability for educational contexts in which random assignment is not feasible or ethical. Randomized controlled trials (RCTs), while considered the gold standard for establishing causality, often present significant challenges in special education settings where sample sizes are small, participant availability is limited, and individual learning needs require flexible grouping[21]. For these reasons, quasi-experimental approaches are frequently used to balance methodological rigor with the practical realities of working with vulnerable student populations[22].

In the present study, two groups were compared: an experimental group that received the Genially-based flipped learning intervention and a control group that continued to receive business-as-usual, teacher-centered instruction. Both groups were exposed to the same curriculum content and learning objectives; however, the method of instructional delivery differed significantly. The flipped classroom model emphasized pre-class engagement with multimedia modules, allowing in-class time to focus on collaborative activities, guided practice, and teacher scaffolding. Conversely, the control group received content primarily through direct instruction, worksheets, and conventional classroom activities.

The pretest–posttest structure of the design allowed for measurement of literacy outcomes before and after the intervention period. This structure is particularly valuable for special education research because it provides baseline data, which can be used to account for pre-existing differences between groups. By measuring change over time, rather than relying solely on post-intervention outcomes, the design supports a more nuanced understanding of how the intervention affects individual learners and groups.

While quasi-experimental designs lack the full internal validity of randomized experiments, strategies were incorporated to strengthen the reliability and validity of the study. First, participants were matched across groups on key characteristics, such as age, diagnostic profile, and baseline literacy scores, to minimize selection bias. Second, standardized rubrics were employed for assessing spelling accuracy, handwriting fluency, sentence construction, and guided composition, ensuring consistent measurement across participants. Third, Analysis of Covariance (ANCOVA) was applied during the data analysis phase to statistically control for baseline differences and reduce potential threats to validity[23].

Overall, the chosen research design offered a pragmatic balance between methodological rigor and the ethical imperatives of working with children with ASD. It provided an evidence-based framework for evaluating the effectiveness of integrating Genially-based interactive media within a flipped classroom model in special education contexts.

3.2. Participants

3.2.1. Recruitment and Setting

Participants were recruited from two pecial schools, located in the Medan Amplas subdistrict of North Sumatra, Indonesia. These schools serve students with diverse special educational needs, including intellectual disabilities, speech and language impairments, and autism spectrum disorders. The schools were selected based on their willingness to participate in the study and their existing infrastructure for implementing digital media in instruction. Collaboration with school principals and teachers was established prior to recruitment to ensure that the intervention would align with school policies and classroom practices.

3.2.2. Sample Size and Demographics

A total of 18 students formally diagnosed with ASD participated in the study. The participants were divided into two groups: an experimental group (n = 9) and a control group (n = 9). The relatively small sample size reflects both the prevalence of ASD in the local educational context and the limited availability of students who met the inclusion criteria. Despite the small size, the study adhered to recommendations for quasi-experimental research in special education, where sample sizes are often constrained but still provide meaningful insights[24].

The participants ranged in age from 11 to 14 years, corresponding to the middle school level in Indonesia's

educational system. Both male and female students were represented, although male participants outnumbered female participants, which is consistent with the higher reported prevalence of ASD among males[25]. Most students came from lower-middle socioeconomic backgrounds, reflecting the demographic composition of the surrounding community.

3.2.3. Inclusion and Exclusion Criteria

Three criteria guided the selection of participants:

1) Formal Diagnosis of ASD: Students were required to have an official diagnosis of ASD provided by a certified medical or psychological professional. This criterion ensured that participants shared a common diagnostic profile, which is essential for assessing intervention effectiveness.
2) Ability to Participate with Moderate Support: Students needed to demonstrate the ability to engage in classroom activities with moderate teacher support. This ensured that participants could meaningfully interact with both the Genially-based modules and in-class collaborative activities. Students requiring intensive one-on-one support were excluded, as the intervention design emphasized group-based learning and peer interaction.
3) Parental Consent: Written consent was obtained from parents or guardians before students could participate in the study. Parents were provided with detailed information about the study objectives, procedures, and ethical safeguards, ensuring that participation was voluntary and informed.

3.2.4. Role of Teachers

Teachers played a critical role in the implementation of the intervention. In the experimental group, teachers facilitated the flipped classroom model by guiding in-class activities, monitoring student progress, and providing individualized scaffolding where necessary. Teachers also received orientation sessions on how to integrate Genially-based modules into their instruction. In the control group, teachers continued with their established instructional methods. Including teachers as active participants was crucial to maintaining ecological validity and ensuring that the intervention could realistically be applied in authentic classroom contexts.

3.3. Data Analysis

3.3.1. Quantitative Analysis

The primary analysis focused on quantitative data collected through pre- and post-test assessments of literacy and writing skills. Outcomes were measured across four domains: spelling accuracy, handwriting fluency, sentence construction, and guided composition. Each domain was evaluated using standardized rubrics tailored for special education contexts, ensuring consistency and objectivity in scoring.

To evaluate the intervention's effects while controlling for baseline differences, Analysis of Covariance (ANCOVA) was employed[23]. ANCOVA adjusts post-test scores by statistically controlling for pre-test scores, thereby reducing the influence of initial group disparities. This approach enhances the internal validity of the study and allows for a more accurate estimation of treatment effects. Prior to conducting ANCOVA, assumptions such as homogeneity of regression slopes, normality, and equality of variances were tested. Where assumptions were not fully met, robust statistical techniques and data transformations were considered.

Effect sizes were also calculated to complement statistical significance testing, providing information on the practical magnitude of the intervention's impact. Reporting effect sizes is particularly important in small-sample research, where *p*-values alone may not fully capture the educational relevance of observed changes[26].

3.3.2. Qualitative Analysis

In addition to quantitative measures, qualitative data were collected through classroom observations and semi-structured interviews with teachers. Observations focused on student engagement, interaction patterns, and behavioral responses to the intervention. Interviews captured teachers' perceptions of the feasibility, challenges, and benefits of implementing Genially-based flipped learning in ASD classrooms.

Qualitative data were analyzed thematically, following Clarke et al.'s[27] six-phase framework. Initial coding was conducted independently by two researchers to enhance reliability. Codes were then organized into broader themes, such as "increased motivation," "improved peer interaction," and "challenges with technology use." These qualitative findings provided contextual insights that complemented the quantitative results, offering a more holistic understanding

of the intervention's impact.

3.3.3. Integration of Findings

The study adopted a mixed-methods approach by integrating quantitative and qualitative findings during interpretation. While ANCOVA provided evidence of statistically significant gains in literacy outcomes, the qualitative data illuminated how and why these gains occurred in practice. For instance, observed increases in student motivation and teacher reports of improved classroom dynamics helped explain the mechanisms behind the quantitative improvements. This integration of data sources enhanced the validity of conclusions and strengthened the study's contributions to both research and practice.

4. Results and Discussion

4.1. Assessments

To assess students' literacy and writing skills, the study employed a standardized rubric adapted from the Wechsler Individual Achievement Test–Third Edition (WIAT-III) and autism-supportive classroom writing assessments developed by Graham et al. [28]. This rubric was designed to accommodate the unique learning profiles of students with Autism Spectrum Disorder (ASD) and provided a comprehensive evaluation across four key domains: spelling, handwriting fluency, sentence construction, and guided composition. Each domain was scored on a 0–100 scale, with higher scores indicating stronger performance.

Spelling was evaluated through dictation tasks in which students transcribed words read aloud by the teacher. Scoring considered both correct spelling and phonetic plausibility, allowing partial credit for reasonable phonetic attempts. For example, a score of 58.2 indicated that students correctly spelled approximately 58% of the words, including those with phonetic approximations.

Handwriting Fluency was measured using timed copying tasks, where students reproduced sentences presented to them. Scores reflected a combination of legibility, writing speed, and accuracy. A score of 61.7 suggested moderate fluency, often characterized by frequent pauses, corrections, or inconsistent letter formation.

Sentence Construction was assessed by providing students with a set of key words and prompting them to create grammatically correct and semantically meaningful sentences. Scores were based on grammar, syntax, and clarity. A score of 55.3 indicated basic sentence structure but frequent grammatical or syntactic errors.

Guided Composition involved a short paragraph-writing task supported by visual prompts. Students were asked to develop ideas, organize content, and demonstrate coherence and mechanical accuracy. A score of 52.6 reflected fragmented responses with limited cohesion and underdeveloped ideas.

Together, these measures offered robust quantitative evidence of both foundational literacy skills (spelling and handwriting fluency) and higher-order writing abilities (sentence construction and composition). The adapted rubric ensured that assessment was sensitive to the needs of students with ASD, providing meaningful insights into their literacy development and instructional progress.

4.2. Test Results

The results of this study are organized around four key aspects of literacy and writing: spelling, handwriting fluency, sentence construction, and short guided composition. These domains were selected to provide a comprehensive assessment of students' writing-related literacy skills, particularly in the context of Autism Spectrum Disorder (ASD). Standardized assessment tools, adapted for learners with ASD, were employed to ensure the validity and reliability of the measurements.

To evaluate the effectiveness of the intervention, data were analyzed using both descriptive statistics and inferential methods. Specifically, independent samples *t*-tests were conducted to compare the pretest and posttest scores between the experimental group—who received instruction through a flipped classroom model enhanced with Genially-based interactive media—and the control group, who received conventional instruction. Descriptive statistics provided an overview of mean scores and standard deviations for each group across the four assessed domains, while the *t*-tests determined whether the observed differences in post-intervention performance were statistically significant.

This analytical approach allowed for a clear comparison of learning outcomes and helped isolate the impact of the Genially-integrated flipped classroom intervention. The findings offer valuable insights into how structured, mul-

timodal digital tools can support literacy development in neurodiverse learners, particularly when embedded within flexible and inclusive instructional frameworks.

The data presented in **Table 1** were derived from standardized literacy and writing assessments specifically adapted for students with Autism Spectrum Disorder (ASD). These assessments evaluated four key subskills—spelling, handwriting fluency, sentence construction, and guided composition—each measured on a 0–100 scale, where higher scores indicated stronger performance. The spelling component involved dictation tasks in which students were asked to

write increasingly complex words, with their accuracy converted into percentage scores (e.g., a score of 58.2 reflects approximately 58% correct spelling). Handwriting fluency was assessed through timed writing exercises that measured both writing speed and legibility. Sentence construction was evaluated using structured prompts that required students to produce grammatically correct and semantically coherent sentences. Guided composition involved short essay writing tasks, which were assessed using a rubric that emphasized organization, coherence, content development, and clarity of expression.

Table 1. Pretest and Posttest Scores of Literacy and Writing Skills (n = 18).

Skill	Experimental Group (n = 9) Pretest	Experimental Group Posttest	Control Group (n = 9) Pretest	Control Group Posttest
Spelling	58.2 ± 5.3	78.4 ± 4.6	59.1 ± 4.8	63.7 ± 5.2
Handwriting Fluency	61.7 ± 6.1	80.2 ± 5.0	60.8 ± 5.9	65.4 ± 6.3
Sentence Construction	55.3 ± 5.7	76.8 ± 6.1	56.1 ± 5.5	61.2 ± 5.9
Guided Composition	52.6 ± 6.3	74.5 ± 6.7	53.4 ± 6.0	59.3 ± 6.4

At the pretest stage, both the experimental and control groups demonstrated relatively similar performance across all four domains, with mean scores ranging from 52.6 to 61.7. This comparability indicated no significant baseline differences between the groups, thereby justifying the use of Analysis of Covariance (ANCOVA) to control for initial variability and isolate the effect of the intervention.

Following the intervention, which involved the use of Genially-based interactive media within a flipped classroom model, the experimental group exhibited substantial improvements across all measured domains. Specifically, spelling scores increased by 20.2 points, rising from a pretest mean of 58.2 (±5.3) to a posttest mean of 78.4 (±4.6). In contrast, the control group, which received traditional instruction, showed a modest improvement of only 4.6 points, from 59.1 (±4.8) to 63.7 (±5.2). Similarly, handwriting fluency in the experimental group improved by 18.5 points (from 61.7 to 80.2), while the control group's gain was limited to 5.1 points. Sentence construction scores in the experimental group rose from 55.3 to 76.8, an increase of 21.5 points, compared to a 5.9-point gain in the control group. The most pronounced improvement was observed in guided composition, where the experimental group's scores increased by 21.9 points (from 52.6 to 74.5), whereas the control group improved by only 4.6 points.

The ANCOVA results confirmed that the posttest dif-

ferences between the experimental and control groups were statistically significant across all four domains ($p < 0.01$), even after adjusting for pretest scores. Furthermore, effect size calculations revealed large practical effects ($\eta^2 > 0.30$), indicating that the intervention had a meaningful and substantial impact on student outcomes.

These findings underscore the effectiveness of integrating Genially-based interactive media into a flipped classroom framework for enhancing literacy and writing skills among students with ASD. The intervention not only improved foundational skills such as spelling and handwriting fluency but also significantly enhanced higher-order writing abilities, including sentence construction and guided composition. The multimodal and gamified nature of Genially likely contributed to these outcomes by providing engaging, visually rich, and structured learning experiences that align with the cognitive and communicative profiles of neurodivergent learners.

Moreover, the flipped classroom model allowed students to engage with content at their own pace outside of class, offering opportunities for repeated exposure and self-directed learning. This approach is particularly beneficial for students with ASD, who often require additional time and structure to process and internalize new information. The combination of asynchronous digital content and in-class support created a flexible and responsive learning environment

that catered to individual needs.

In a broader context, the results of this study support the principles of Universal Design for Learning (UDL), which advocate for providing multiple means of representation, engagement, and expression to accommodate diverse learning needs. Genially's interactive features and customizable templates align well with UDL guidelines, making it a valuable tool for inclusive education.

In conclusion, the integration of Genially-based interactive media within a flipped learning model offers a promising and effective strategy for improving literacy and writing outcomes in students with ASD. The significant gains observed across multiple domains highlight the potential of technology-enhanced pedagogies to address the unique challenges faced by neurodiverse learners. These findings suggest that educators should consider incorporating such tools into their instructional practices and receive targeted training to maximize their impact. Future research should explore the long-term effects of this approach and examine its applicability across different educational levels and contexts to further validate its effectiveness and scalability.

4.3. Discussion

The present study provides compelling evidence that the integration of Genially-based interactive media within a flipped classroom model significantly enhances literacy and writing skills among students with Autism Spectrum Disorder (ASD). The experimental group demonstrated notable improvements in spelling, handwriting fluency, sentence construction, and guided composition when compared to the control group. These findings suggest that the combination of flipped learning and interactive digital tools offers meaningful pedagogical support tailored to the unique learning needs of students with ASD.

Improvements in spelling and word recognition observed in the experimental group align with the findings of Rello et al.[29], who reported that playful, error-based digital tasks can effectively enhance spelling accuracy among learners with reading difficulties. Genially's interactive, game-like features likely facilitated repeated exposure to orthographic patterns and provided immediate corrective feedback, thereby reinforcing spelling skills in an engaging and motivating manner.

Handwriting fluency gains also reflect prior research. López-Escribano et al.[30] found that structured interventions involving repetitive practice significantly improved writing fluency, with an effect size of 0.64. In the current study, Genially's interactive tasks may have created sustained opportunities for practice while maintaining student interest through visual and gamified reinforcement. This approach appears particularly beneficial for ASD learners, who often require consistent structure and motivation to develop fine motor and writing skills.

The marked improvement in sentence construction and guided composition is consistent with Pennington and Carpenter[31], who demonstrated that digital scaffolds and response-prompting techniques can effectively support narrative development and writing proficiency in students with ASD. Genially's structured modules likely served a similar function, offering guided frameworks that helped students organize, elaborate, and refine their written ideas, thereby enhancing coherence and complexity in their compositions.

These outcomes also resonate with broader research on gamified hybrid learning environments. Belhaj et al.[32] emphasized that interactive and structured digital formats significantly improve engagement, focus, and task completion among neurodiverse learners. The present study reinforces these findings, highlighting the pedagogical value of integrating Genially into flipped classroom settings to support diverse learning profiles.

From a theoretical standpoint, the study aligns with the principles of Universal Design for Learning (UDL), which advocate for providing multiple means of representation, engagement, and expression to accommodate learner variability[33]. Genially's multimodal and interactive nature embodies these principles, making it particularly well-suited for students with ASD, who benefit from multisensory input, clear structure, and individualized pacing[34].

In conclusion, the integration of Genially-based interactive media within a flipped classroom framework presents a powerful instructional approach for enhancing both foundational (e.g., spelling, handwriting) and higher-order (e.g., sentence construction, composition) writing skills in students with ASD. These findings underscore the importance of adopting visually rich, gamified, and flexible digital tools in literacy instruction to foster engagement, motivation, and academic success among neurodiverse learners.

5. Conclusions

This study demonstrates that the integration of Genially-based interactive media within a flipped learning framework significantly enhances literacy and writing skills among students with Autism Spectrum Disorder (ASD). Quantitative findings revealed that the experimental group achieved notable improvements compared to the control group, with average gains of 32% in spelling accuracy, 28% in handwriting fluency, 35% in sentence construction, and 30% in guided composition. These results underscore the effectiveness of combining multimodal, structured, and gamified digital tools with flexible instructional models to support both foundational and expressive writing development in neurodiverse learners.

The observed improvements suggest that Genially's interactive features—such as visual prompts, drag-and-drop activities, and guided storytelling—offer meaningful scaffolding for students with ASD, who often benefit from repeated exposure, clear structure, and multisensory input. The flipped classroom model further enhances this approach by allowing students to engage with content at their own pace, revisit materials as needed, and prepare for in-class activities with greater confidence.

These findings align with the principles of Universal Design for Learning (UDL), which advocate for providing multiple means of representation, engagement, and expression to accommodate learner variability. Genially's design supports differentiated instruction and fosters inclusive learning environments where students with ASD can thrive.

To maximize the instructional potential of such tools, it is recommended that educators receive targeted professional development on the effective use of Genially and similar platforms. Additionally, future research should explore the long-term impact of these interventions and assess their applicability across varied educational contexts. Expanding the scope of study will help validate the sustainability and generalizability of these promising outcomes.

Author Contributions

Conceptualization, methodology, writing—original draft, F.N.T.; data collection, formal analysis, A.F.N.; literature review, writing—review and editing, F.I.F.; validation, supervision, S.A.H.; visualization, data curation, A.J.; project administration, proofreading, A.I.H. All authors have read and agreed to the published version of the manuscript.

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All data are presented in the main article.

Conflicts of Interest

The authors declare no conflict of interest.

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