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Master Course Templates in Online Education: Enhancing Aligned Learning, Accessibility, and Overall, Success for Students & Faculty

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Editor's Note

The Journal of ITC employs a rigorous peer-review process to uphold high academic standards and ensure the quality of published work. Each submission is carefully evaluated for originality, relevance, and scholarly contribution. Reviews are conducted by a panel of experienced faculty and researchers from New Jersey City University, whose expertise supports the journal's commitment to excellence in education.

This issue highlights innovative approaches and research in education that address critical transitions, accessibility, and engagement across diverse learning environments. Our first article explores a transitional program designed to support students with Autism Spectrum Disorder as they move from elementary to middle school, offering insights into inclusive practices. The second article examines the use of master course templates in online education, emphasizing their role in promoting alignment, accessibility, and success for both students and faculty. Finally, we feature a study on math engagement among girls in early childhood, shedding light on strategies to foster interest and confidence in STEM from a young age. Together, these contributions reflect the evolving landscape of education and the commitment to equity, innovation, and student-centered learning.

Dr. Brooke Litten, Ed.D

Editor-in-Chief

Journal of ITC

Elementary to Middle School:

A Transitional Program for Students with Autism Spectrum Disorder

By Victoria Perez

Introduction

The transition from elementary to middle school is a critical period in the academic and social development of all students, but it can be especially challenging for children with Autism Spectrum Disorder (ASD). Research has shown that students with autism face unique obstacles when adjusting to a more complex middle school setting, including difficulties with socialization, communication, and adapting to the expectations of a new environment (Broadstock, 2019). These challenges can lead to increased anxiety for both students and their families, as they face the unknowns of new routines, teachers, and expectations.

In many educational settings, the transition process for students with autism is underdeveloped, and there is a lack of comprehensive transitional programs to ease this shift. The purpose of this article is to propose a well-researched, structured transitional program designed to address these challenges, support families, and foster collaboration between educators to ensure a smooth transition to middle school. By providing a clear framework for collaboration, communication, and preparation, this program aims to reduce the stress and anxiety typically associated with the middle school transition, enhancing students' academic success and social integration.

The Problem

Several studies have addressed the challenges of transitioning students with autism to middle school. According to Vicker (2003), one of the primary barriers these students face is the shift in environment, which often involves a greater number of teachers, more demanding social interactions, and a lack of personalized support. Broadstock (2019) emphasizes the importance of creating individualized transition plans that focus on students' strengths and specific needs, particularly in the areas of socialization, communication, and behavior. This individualized approach is critical to helping students succeed during such a significant transition.

Research also points to the importance of parental involvement in easing transition-related stress. Harrington (2024) discusses the role of parents in preparing their children for the middle school transition, recommending that schools provide training and resources to help parents better support their child's readiness. Additionally, there is a lack of communication between students' previous and new teachers. Studies suggest that communication between the student's previous and future teachers plays a crucial role in establishing continuity and preventing potential setbacks or regressions (Vicker, 2003).

Program Overview

The solution is a structured transitional program designed to support students with Autism Spectrum Disorder (ASD) by assisting them, their families, and educators in managing the shift from elementary to middle school. Recognizing the unique challenges these students face in socialization, communication, and behavior, the program emphasizes preparation, collaboration, and additional supports. The approach also addresses parental anxiety and establishes continuity between educators, fostering a holistic support system that empowers students to thrive in their new middle school environments.

Below is a summary chart of the five key components of the transitional program:

Component	Description
Parental Involvement	Parent training, access to social stories and school tours
Communication Between Educators	Structured meetings, sharing of triggers/strategies
Preparation of the Student	School visits, mentor pairing, videos, visual schedules

Component	Description
Staff Preparation	Autism training for staff, behavioral strategies
Individualized Plans	Tailored supports developed collaboratively

The proposed transitional program consists of several key components:

1. **Parental Involvement**

Parental anxiety is a significant concern for families of students with autism. To address this, the program offers parent training sessions that provide information on middle school expectations and how to support their child over the summer in preparation for the transition. Additionally, parents will be given access to materials, such as social stories and video tours, to familiarize them with the new school's routines, spaces, and faculty.

2. **Communication Between Educators**

Successful transitions rely on effective communication between the student's elementary and middle school educators. The program facilitates structured communication between previous and future teachers to share information about the student's triggers, motivators, and successful strategies.

3. **Preparation of the Student**

The program emphasizes early and repeated exposure to the middle school setting. This includes school visits, route practice, and videos of the school environment, including the cafeteria, gym, and bathrooms. Social stories and sample schedules are also provided to help the student visualize the daily routines. Students may also meet with a mentor, or "big brother/sister," who can offer support and guidance during the transition.

Digital tools play a central role in preparing students with ASD for the new environment. These include video tours of the middle school (narrated by familiar staff or peers), interactive visual schedules available on tablets or phones, and personalized social stories created with apps like Pictello or Book Creator. These resources allow students to preview and rehearse routines at their own pace, helping to reduce anxiety and build predictability. Additionally, students can be introduced to educational platforms such as Google Classroom or Seesaw and calming apps like Breathe or Headspace as part of their sensory regulation strategies.

4. **Staff Preparation**

Preparation for middle school staff is a critical component of the program. Teachers and staff members will receive training on the specific needs of incoming students with autism, including how to recognize and address potential triggers and behavioral challenges. This training will also include strategies for enhancing social interactions and providing emotional support.

5. **Individualized Transition Plans**

Each student will have an individualized transition plan that outlines their strengths, interests, and specific support needs. These plans will be developed in collaboration with parents, teachers, and administrators. The transition plan will target the student's areas of challenge, particularly in socialization, communication, and behavior.

Example: Michael, a 5th-grade student with ASD, had a plan that included: weekly school visits during the summer, a video series showing his locker and new classrooms, a digital daily schedule, a peer mentor introduction in June, and an educator meeting to discuss his sensory sensitivities. His parents were given resources and one-on-one training with a school counselor. As a result, Michael's first semester attendance and engagement were strong.

Funding and Resources

While transitional programs require planning and coordination, many aspects—such as video creation, parent trainings, and staff meetings—can be implemented with minimal cost. Grants such as IDEA (Individuals with Disabilities Education Act), local Special Education budgets, or partnerships with autism foundations can provide funding. Districts can also apply for support through state education initiatives or use Title I funds where applicable.

Adaptability for Schools and Districts

This transitional framework is designed to be flexible and scalable. Schools can adapt it to their unique student populations and resources. For example, districts with fewer staff may leverage online modules for parent training or use virtual mentor meet-and-greets. Urban schools may offer weekend visits instead of summer programming. The core components remain the same, ensuring consistency while allowing for customization.

Conclusion

The transition from elementary to middle school is a pivotal moment in the educational journey of students with autism. A structured and individualized approach, as proposed in this article, can significantly reduce the stress and anxiety that often accompany this transition. By emphasizing parental involvement, teacher communication, and student-centered preparation, this program provides a comprehensive framework for ensuring that students with autism can successfully navigate the challenges of middle school.

In today’s evolving educational climate, where DEI policies and funding allocations are in flux, it is even more critical to advocate for evidence-based, inclusive support systems. Transition programs like this one affirm the importance of equitable access to education and can serve as a model for sustaining inclusive practices amid change.

The continued development and implementation of such programs are essential to supporting the educational and social success of students with autism.

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Master Course Templates in Online Education: Enhancing Aligned Learning, Accessibility, and Overall, Success for Students & Faculty

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Abstract

Ocean County College (OCC) implemented a revised master course model for Distance Learning (DL) and subsequently observed changes in student pass rates and satisfaction metrics. Analysis of this model provides insights into collaborative course design processes and their relationship to student outcomes. The model's emphasis on consistent design and alignment with institutional standards ensures a learning experience that supports student engagement and academic outcomes. By leveraging innovative design processes and research-based practices, OCC has increased pass rates for DL students by 3.77% from the 2022 academic year to the 2024 academic year and achieved high satisfaction ratings in areas such as course navigation and rubric clarity. This model represents one approach to scalable online education design for diverse student populations.

Introduction

OCC was recognized by OnlineU as among the top online programs for community colleges in New Jersey in 2023 (Londres, 2023). This recognition was based on factors including enrollment accessibility, affordability, and asynchronous course delivery.

OCC's leadership in online education reflects its commitment to innovation, accessibility, and student success. As higher education continues to evolve and grow, DL has become a top performing modality preferred by students. In the 2025 academic year, nationwide more students will be enrolled in entirely online programs than in fully face-to-face programs (Nadworny, 2025). As community colleges progressively turn to online programs to meet the demands of their diverse student populations, ensuring consistency, accessibility, and engagement is required to remain relevant (Weissman, 2023). OCC's approach to fielding these demands is the implementation of a master course model, carefully designed, universally applicable iterations of courses that can be pushed out to multiple instructors. This model pairs instructional designers (IDs) with subject matter experts (SMEs) to create courses that maintain approved curriculum alignment, accessibility, and a tenacious student experience.

This paper will explore the implementation of master courses, the collaborative course-building process, and the crucial role of facilitators in asynchronous online courses. It will highlight how this approach applies clear grading rubrics, interactive learning opportunities, and accessibility standards while supporting faculty to focus on connecting with their students without being bogged down with content creation and the regulations associated with DL. The importance of offering differentiated instruction to meet the needs of all students, including multi-language learners (MLL), a growing demographic served by this institution will also be explored. By adopting Universal Design for Learning (UDL) principles and emphasizing the unique contributions of IDs, the master course model represents an approach to online education design that aims to address scalability, equity, and effectiveness concerns.

Overview of Asynchronous Distance Learning

DL courses provide flexibility for students to complete coursework at their own pace, within a set timeframe. Asynchronous courses allow students to log into the course, participate in discussions, complete their work and assignments, and engage with learning materials whenever it fits into their personal schedule throughout each week. This modality accommodates community college students and non-traditional learners who must balance multiple responsibilities (Bracken & Buck, 2023).

OCC's student demographics for 2023-2024 reflect a diverse population. The student body is 57% female and 43% male. The majority of students (65%) are aged 18-24. The college serves students from various racial and ethnic backgrounds, including Asian, Black, White, and multiracial populations. Hispanic students represent the fastest-growing demographic group, comprising 20% of the student body over the past five years.

DL courses represent 30% of 2024 enrollment and offer a solution that accommodates potential challenges by removing the need to be online or in the classroom at specific times. This modality provides students with the flexibility to manage their academic commitments alongside personal responsibilities, allowing them to access course materials and complete assignments at their own pace, which can improve their learning experience and overall results (Leggins, 2021). This helps to reduce barriers to education, providing students with the opportunity to pursue academic goals that might otherwise be unattainable in more rigid, synchronous formats focused heavily on real-time attendance (Bracken & Buck, 2023).

It is important to acknowledge that online andragogy in asynchronous courses differs from traditional classroom teaching due to the absence of real-time interaction and the flexibility it offers students. Asynchronous environments require self-contained, accessible content with clear instructions, organized materials, mobile-friendly design, and engaging multimedia resources. (Lim & Richardson, 2021). Without the immediacy of face-to-face feedback, online education relies more on written communication, detailed feedback, and the design of interactive learning activities to maintain student engagement (Ahmadi et al., 2023; EHE Distance Education and Learning Design, n.d.; Lim & Richardson, 2021). Since students have more control over the pace of their learning they can take additional time with challenging material or accelerate through content they find easier to grasp or have prerequisite knowledge of. This autonomy may increase student motivation and promote more personalized learning experiences (Fiock et al., 2021; Wang et al., 2024). However, this modality also requires a carefully structured course design to guide students through the learning process and ensure they remain engaged and supported throughout their courses (Ahmadi et al., 2023; EHE Distance Education and Learning Design, n.d.; Li et al., 2022; Lim & Richardson, 2021).

While eliminating the constraints of real-time interaction allows students to study on their own terms, asynchronous learning opens the door to higher education for those who might otherwise be left behind. To maximize its potential, these courses must be designed thoughtfully, with consistent structure, clear expectations, and accessible resources.

Master Course Model

What is a Master Course?

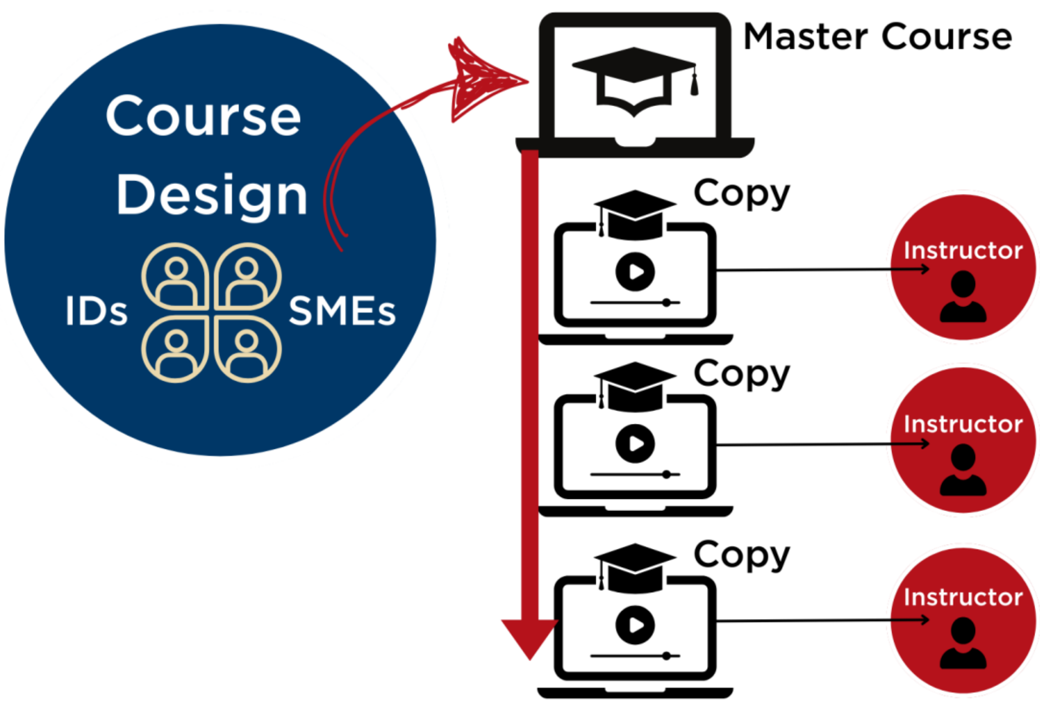
A master course at OCC is an intentionally designed iteration of a course that is carefully built to align with institutional curriculum standards, making it teachable by multiple faculty members across different terms and sections. Master courses, sometimes called standardized courses, templates, or course blueprints, enable educational institutions to efficiently scale their online learning offerings through a centralized design approach (Darr, 2018; Hill, 2012). Under this framework, content experts collaborate with instructional design professionals to develop a single course template that is then replicated for use across multiple sections (Bailey et al., 2018; Darr, 2018; Hill, 2012). This model allows institutions to serve larger student populations through multiple course offerings while maintaining consistency in curriculum alignment and learning outcomes without requiring instructors to rebuild course materials from scratch each semester (Bailey et al., 2018; Li et al., 2022).

The content in a master course aims to represent multiple voices and perspectives, with a focus on consistency in both the student's learning experience and learning outcomes, regardless of who is facilitating or teaching the course. A key benefit of a master course is that it promotes inclusivity by incorporating diverse voices and perspectives in its content, as they are designed with input from SMEs and IDs from a variety of backgrounds. This approach impacts the course by including multiple viewpoints and expertise, making the material more relevant to a broad student demographic. The result is a well-rounded learning experience that reflects various perspectives on the subject matter, ensuring students receive a balanced, bias-conscious, and comprehensive education.

In master course environments, individual teaching styles become less central to student experiences than in traditional settings. Instead of a course being shaped by one teaching style or preferences of a single faculty member, the master course is designed to meet high standards of learning outcomes, accessibility, and alignment to curriculum, which aims for more consistency for all students across courses and programs (Darr, 2018; Hill, 2012). This universality allows the course to focus more on content delivery, equitable access, and real-world applications rather than on the personal teaching philosophy of any one instructor.

Figure 1

Master Course Model



Note This figure illustrates the Master Course Model, where IDs and SMEs collaborate to design a centralized Master Course, which is then duplicated for multiple instructors to deliver consistently.

Why a Master Course Model?

Students in DL environments benefit from consistent, structured courses that clearly address learning outcomes and accessibility requirements (Wang et al., 2024). Research supports this standardized approach, with Gaddis (2022) and Hill (2012) demonstrating that consistent course design ensures students receive equivalent educational experiences regardless of instructor.

The master course model's consistent interface design may reduce cognitive load related to navigation, allowing students to focus on content rather than structural variability. Clear grading rubrics and well-defined structures are provided in each course, ensuring students understand how their work will be evaluated and what is expected of them (Gaddis, 2022; Li et al., 2022).

The appearance of each course remains consistent, with clearly labeled modules and assignments that align with the board approved curriculum, ensuring a cohesive learning experience. This clearly documented alignment also supports the transferability of credits, helping students seamlessly transition to other institutions and the ability to demonstrate evidence of their learning. Master shells also help prevent technical errors and maintain FERPA and accessibility compliance, offering a consistent experience that prioritizes student learning over managing course logistics (Darr, 2018).

Using effective strategies in online learning is critical to student success and preventing cognitive overload. Research suggests that duplicating in-person teaching strategies in online settings can be problematic, and instead, an evolving shift from didactic methods to constructivist approaches is recommended (Fiock et al., 2021; Willson et al., 2004). Online learning requires structured "direction-giving" and guided practice to help students stay accountable (Roskos et al., 2007). Culminating projects, discussions, and feedback-based questioning have shown to be particularly effective in fostering engagement (Fiock et al., 2021; Jones, 2011; Stienbonn & Merideth, 2007).

The master course model at OCC is designed with these andragogical principles in mind. Using a team-based development process addresses that content expertise is balanced with research-based best practices and technical implementation. A central component of this model is the strategic use of discussion boards, which serve multiple functions beyond traditional interaction: they provide a platform for students to share projects, engage in meaningful learner-to-learner exchanges, and facilitate peer and instructor feedback. Additionally, these teams develop rubrics that directly measure assignment objectives, ensuring clear alignment between learning outcomes and assessment criteria. By focusing on student interaction, collaboration, and active learning, the model not only addresses learning but aligns with proven strategies like "learning by doing" (Duncan & Barnett, 2010). Promoting social interaction through peer discussions and instructor feedback can be embedded within the course design so that students are engaged and supported in their learning journey (Ramos & Yudko, 2008). These methods reflect the demands of asynchronous DL while maintaining high standards for both student engagement and content delivery.

Differentiation and Accessibility

How Can a Master Course Model Improve Inclusivity?

Master courses incorporate differentiation strategies and multiple content formats. This design approach addresses varying student abilities, learning preferences, and language proficiencies through diverse access methods.

IDs are critical in ensuring that all learning systems and digital learning content meet accessibility standards. The AAAtraq report (2023) found that 97% of U.S. college websites fail to fully comply with the Americans with Disabilities Act (ADA), highlighting the importance of instructional designers in maintaining compliant digital learning environments. IDs manage course accessibility to help students with disabilities engage more effectively with course materials (Paykamian, 2023). Their role focuses on developing digital learning content that addresses both compliance and andragogical requirements.

Differentiation is a central feature of master courses. Content accommodates varying academic levels and learning styles through UDL framework implementation and multiple engagement options.

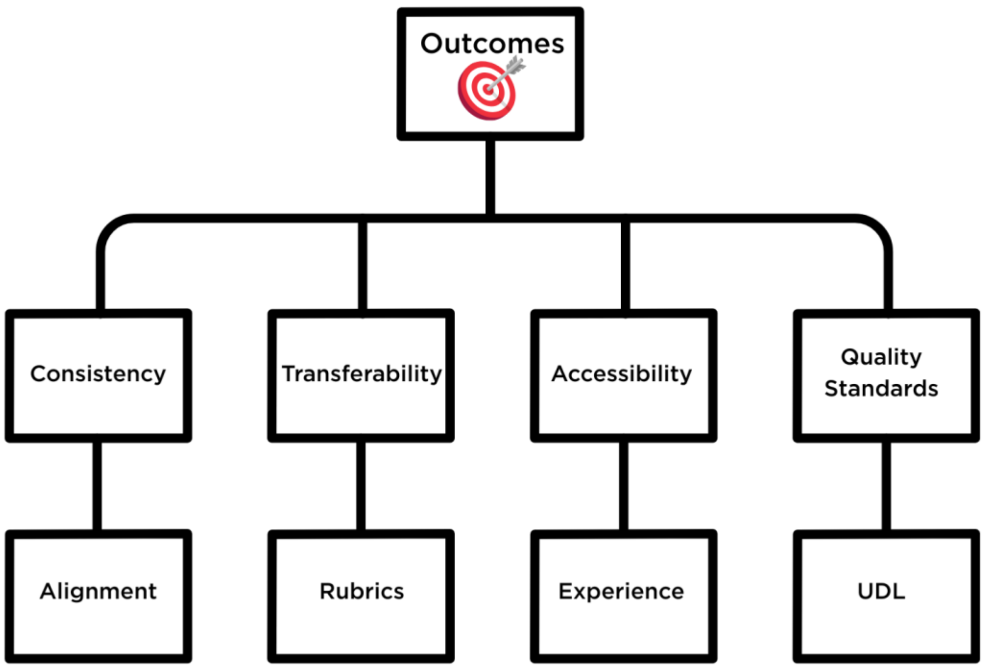
For example, instructional content may be presented through a combination of text, video, audio, and interactive elements, ensuring that students can choose the mode of learning that resonates with them most. Additionally, assignments often include options for students to demonstrate mastery in different ways, whether through writing, presentations, projects, or discussions, which allows them to engage based on their strengths.

For multi-language learners (MLLs) and students who may need additional support, master courses often include multiple versions of content tailored to different levels of language proficiency and understanding. This includes providing simplified versions of readings, translated materials, or annotated resources that break down complex concepts in more accessible ways. For example, visual aids, glossaries, and language support tools may be integrated to help MLLs follow along and grasp key ideas more effectively. Multiple content versions are designed to help students with varying language skills access course materials.

UDL principles are embedded into the master course structure, which promotes accessibility and inclusivity. By offering choices in how students access materials and demonstrate their knowledge, master courses enable students with disabilities, different cultural backgrounds, or varied academic preparedness to thrive. These courses are structured with high accessibility standards, with the goal that content is not only diverse but accessible to all students.

Figure 2

Outcomes Driven Design



Note This figure illustrates the concept of outcomes-driven design in course development, showing how outcomes are supported by pillars such as consistency, transferability, accessibility, and quality standards, each further reinforced by practices like alignment, rubrics, learner experience, and universal design for learning (UDL).

Facilitation vs Teaching in Asynchronous Distance Learning

Asynchronous DL environments emphasize facilitation over traditional teaching approaches. Facilitators guide students through structured course content while faculty concentrate on building relationships through personalized feedback and support. This student-centered approach aims to foster engagement and support learning outcomes (Garrison, 2022; Wang et al., 2024). This shift in pedagogical focus has direct implications for faculty workload. Nationally, the average workload for an instructor teaching online is estimated to be around 10-12 hours per week per course, which includes grading, providing feedback, answering questions, and facilitating discussions (Mandernach & Holbeck, 2016). In DL environments, instructors should ideally spend most of their time facilitating these courses, focusing on student interaction, assessment, and support, rather than on tasks related to course design or content development. To assist with continuous improvement and quality assurance, instructors are provided with a feedback form to suggest improvements and edits. Revisions are then managed through an approval process to preserve the integrity of the course iteration.

Why Separate Course Building from Facilitation?

The Burden of Dual Roles

Course building and facilitation require distinct skills and significant time investment. Development involves content creation, standards alignment, accessibility compliance, and interactive design, often requiring hundreds of hours. Facilitation, however, centers on student engagement, progress monitoring, and feedback provision. When instructors handle both roles, competing demands can lead to burnout and diminished student experiences. This separation of roles enables IDs to focus on learning environment development while faculty concentrate on facilitation, with the goal of improving the educational experience for both students and instructors (Martin et al., 2019).

Course design is a complex and time-intensive process that takes 4-6 months and requires deep attention to curriculum alignment, accessibility, interactivity, and the integration of technology. At the same time, facilitation requires regular student engagement, timely feedback, grading, and individualized support. Combining these two demanding roles can stretch faculty thin, reducing their ability to excel in either area. This dual burden may contribute to instructor burnout and potentially affect student engagement (Hogan & McKnight, 2007). The focus shifts away from providing meaningful interactions and high-quality feedback, compromising the overall learning experience.

By separating these roles, the course design can be done by a dedicated team of IDs and content experts who specialize in creating high quality, interactive, and accessible learning environments, while faculty facilitators can focus entirely on the teaching and mentoring process. This division of labor is intended to improve the experience for both students and instructors.

Collaborative Course Design Process

Prior to 2021, OCC faculty independently developed master courses in the LMS, with limited oversight from an ID. This approach often resulted in text-heavy courses that relied on external links and, in some cases, included copyrighted materials. In 2021, OCC adopted a revised master course model for all online courses. The model requires collaborative development involving two faculty SMEs and two IDs over a 4-6-month period. This process aims to align courses with quality standards, accessibility requirements, and research-based practices.

The model addresses student demands for interactive, mobile-friendly interfaces, integrated technology tools, and workplace-relevant projects and assessments. This approach relies more on internally created content with media options and bridges the gap between academic knowledge and practical skills, better preparing students for the workforce by enabling them to directly apply what they've learned to real-world situations. Additionally, the master course model supports vertical alignment across sequential courses within academic disciplines, ensuring that students experience consistent instructional design, navigation patterns, and assessment structures as they progress through prerequisite and advanced coursework. This continuity reduces cognitive load related to learning new interface designs and allows students to focus on advancing their subject matter knowledge rather than adapting to varying course formats.

Faculty Roles

SMEs include full-time faculty, adjunct faculty, and administrators, providing diverse academic and real-world perspectives beyond single-instructor viewpoints. One SME, known as the content developer, partners with an ID to outline the assessments for the course based on its board approved curriculum documents. Together they design the course structure, aligning course learning outcomes to assessments and create engaging learning activities that are relevant for students.

A second SME serves as the reviewer, working closely with the team to review content and assessments for accuracy and provide additional content support where needed. This reviewer often brings different strengths or experiences that can be added to enrich the course, helping ensure a well-rounded educational approach. Both SMEs provide continuous feedback throughout the course design process using a research-based rubric *(this is explained further in the Quality Standards section)*. This approach aims to blend academic rigor with practical relevance. By incorporating multiple SMEs, the course development process may benefit from diverse perspectives that reduce bias and foster a more inclusive curriculum.

Instructional Designer Role

IDs bring essential expertise to ensure that online courses meet curriculum alignment, legal, accessibility, and quality standards. Additionally, IDs also partner with librarians to ensure that all course materials are legally used and appropriately cited. IDs develop interactive, accessible content while balancing effectiveness, ensuring that courses align with both educational and legal requirements for quality and inclusivity.

IDs at OCC are required to have a master's degree in Education, Instructional Design, Curriculum Design, or a relevant education and technology discipline. The IDs work closely with SMEs to bring the courses to life, leveraging their knowledge of online andragogy and technology to create an engaging learning experience that also follows the curriculum. This includes customizing graphics, videos, and other media used for online instruction. They utilize the UDL framework to ensure that content is accessible through multiple means of representation and interaction, often using technology to further differentiate the content for different learning levels (CAST, 2024). Once the course is built, a second ID conducts a quality assurance review to catch any issues and ensure the course meets the institutional standards.

Quality Standards in the Master Course Model

The institution's approach to building master courses aligns with established quality frameworks in online education. The quality assurance process incorporates standards from Quality Matters (QM), the Open SUNY Course Quality Review (OSCQR) rubric, and internal benchmarks. It also includes checks for compliance with the Americans with Disabilities Act (ADA) and Web Content Accessibility Guidelines (WCAG) to ensure course design supports student learning while promoting accessibility and usability.

Throughout the design process, SMEs, IDs, and reviewers aim to meet established standards for alignment between learning objectives, instructional materials, and assessments. In the course, objectives are clearly stated and measurable, assessments align with learning outcomes, and content is designed to be accessible and engaging for all learners. The course development team maps out all objectives and alignment to ensure all learning objectives have been met. Once the course is complete, a second ID reviews the course using the rubrics to ensure quality, To support implementation of these standards, all full-time DL faculty members and IDs are QM certified, providing them with training in quality standards for both course development and facilitation. This certification supports the goal of continuous improvement and consistency across courses.

The structured evaluation process is designed to help ensure courses meet both academic standards and accessibility requirements while maintaining consistency across different instructors and course sections.

Table 1

Course Development Phases

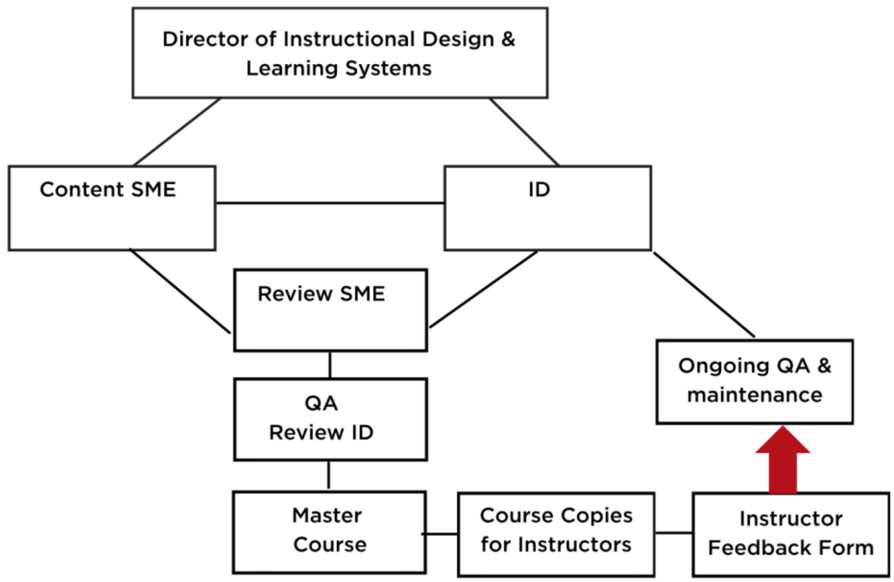
Development Phase	Month	Activities
1: Pre-development	1	● SMEs are hired and complete training ● IDs pull curriculum and create digital workspace folders ● IDs request librarian to search for Open Educational Resources (OER)
2: Kick-off	2	● ID sends a Welcome Letter and schedules a Kick-off meeting with Developer SME ● Kick-off meeting takes place ● SME and ID work on Course Outline/Blueprint of Assessments
3: Production Part 1	2-3	● Course Outline/Blueprint is Due and sent to Reviewer ● SME works on content for first half of course in digital workspace and it is reviewed by other SME ● ID builds content for first half of course in LMS
4: Production Part 2	4-5	● SMEs review first half of course in LMS

		• SME works on content for second half of course in digital workspace and it is reviewed by other SME • ID builds content for second half of course and SMEs review full course in the LMS with rubric
5: Quality Assurance	5	• Revisions take place from SME(s) feedback • Second ID does QA review and sends feedback notes • Design revisions take place (if needed)
6: Post-development	6	• Course is re-labeled as a Master Course in the LMS and ready to be copied • Payment is initiated for SMEs • ID reaches out after the first run to ensure smooth delivery

Note This table outlines the six-phase timeline and key activities involved in the course development process, from pre-development and kickoff to production, quality assurance, and post-development follow-up.

Figure 3

Master Course Process Flow Chart



Note This figure depicts the collaborative process used to develop and maintain a Master Course, from content creation and review to distribution and feedback, showing how team members contribute and how instructor feedback informs ongoing quality assurance.

Outcomes and Student Success

Following master course model implementation, institutional data shows changes in student performance and satisfaction that coincide with the revised approach. DL pass rates increased from 72.92% in 2021 to 75.66% in 2023, representing a 2.74% improvement that coincided with the separation of course design from facilitation roles (Ocean County College, 2024, Appendix A).

Student satisfaction surveys administered via Watermark provide additional outcome measures for this approach. Survey results indicate high levels of satisfaction across key areas of the master course model design. Student satisfaction surveys via Watermark indicate high satisfaction levels, with over

95% of respondents reporting positive experiences with course navigation, module organization, and rubric clarity. (Ocean County College, 2024, Appendix B). These findings suggest that the standardized interface design and consistent structure may contribute to improved user experience. Additionally, survey data indicates that students found multiple content access options, which aligns with the model's emphasis on accessibility and Universal Design for Learning principles. The high satisfaction rates across navigation, evaluation methods, and content accessibility suggest that the collaborative design process addresses key areas of student concern in online learning environments.

The data aligns with research from the North Carolina Community College System (2018) indicating that institutions employing master course designs may see improved student success rates. This finding supports the model's potential as a scalable solution for maintaining consistency and curriculum alignment in online education.

Conclusion

This analysis of the revised master course model reveals improved student outcomes and satisfaction metrics following implementation. The separation of course design from facilitation roles, combined with collaborative development processes, correlates with improved pass rates and student satisfaction scores. These findings contribute to the broader literature on online course design and suggest areas for future research in collaborative course development models.

Future adaptations may incorporate emerging technologies, such as AI-assisted tutoring tools and customized interactive learning experiences. Further research could also examine the long-term sustainability of this model and its applicability across different institutional contexts and student populations.

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Appendix A: Student Success Rates in DL Courses

Ocean County College. (2024). *Student success rates in distance learning courses*.

Student Success Rates in DL Courses

Year	**(All modality) Institution Success Rate %**	**DL Course Success Rate % (Grades of C or higher)**	**DL Pass Rate % (D or higher)**
2021	70.79%	68.29%	72.92%
2022	73.50%	68.87%	73.00%
2023	74.53%	71.31%	75.66%

Overall improvement: 2.74% increase from 2021 to 2023

*Years run Fall to Summer

Appendix B: Watermark Survey Data

Ocean County College. (2024) *Watermark Survey Data, 2023-2024 Academic Year.*

Course Navigation and Organization:

- 96.1% of respondents expressed satisfaction or very high satisfaction with module organization that aided their understanding of course material
- 98.1% of respondents felt they could navigate all course content with ease

Evaluation and Assessment:

- 96% of respondents felt that rubrics clearly explained how they were evaluated and graded
- 95% agreed that course content contributes to their mastery of learning objectives

Accessibility and Content Access:

- 96% of respondents found multiple options to access course content

Math Engagement in Girls in Early Childhood

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Abstract

The underrepresentation of women in STEM remains a significant issue in the 21st century. This qualitative study aimed to examine early interventions that could address this gender gap and spark an interest in math among young girls. It explored whether combining adult involvement with math kits would boost girls' enthusiasm for math activities. Over the course of four weeks, participants engaged in structured math activities with adults in their homes. By the end of the study, there was an increase in the students' willingness to engage in math. Additionally, their use of math-related language suggested that early, targeted interventions involving adult support positively influenced young girls' attitudes toward math and promote a career in STEM. Technological alternatives to tangible objects were identified to potentially increase math engagement in schools.

Keywords: Early Childhood Education, STEM, mathematics, gender, student engagement, parent support, technology

Abbreviations: Early Childhood (EC), Technology Enhanced Toys (TETs)

Introduction

In the 21st century, women still face underrepresentation in STEM careers worldwide. This is especially true for women of color. Decades of research show that gender stereotypes continue to influence disparities in girls' interest in math and other STEM fields, starting in early childhood (Eccles, 2015). This is concerning because, at the early childhood level, both boys and girls demonstrate similar levels of mathematical ability (Cimpian et al., 2016). Governments around the world have reported low numbers of women pursuing careers in STEM, with calls for action urging the development of quality STEM programs at the early childhood stage (Fleer, 2021).

Historically, ECE programs such as Montessori, Bank Street, Head Start, and High/Scope have emphasized child-centered, play-based, and hands-on learning, especially for children from underserved backgrounds (Isaacs & Isaacs, 2018; Kearney & Levine, 2019; Kohn, 2015). These philosophies promote developmentally appropriate learning, where children make sense of the world around them through exploration and guidance. These foundational approaches underscore the importance of aligning instruction with children's developmental stages and lived experiences. One such area where these principles are particularly evident is early math instruction, which benefits from hands-on, meaningful engagement.

Math in EC classrooms covers a wide range of early concepts, including spatial relations, measurement, quantity, and simple patterns (Harris & Petersen, 2017). Children develop math skills in a similar way to how they build literacy skills. These skills develop over time in a sequence as children learn vocabulary first and then progress to more complex ideas. These concepts are taught using various objects, such as manipulatives, puzzles, blocks, and everyday materials that help make abstract ideas more concrete (Clements & Sarama, 2019). These objects allow children to make predictions, conduct experiments, and observe outcomes, which helps strengthen their understanding. When included in play-based environments, these materials support active learning and align with developmentally appropriate practices in early childhood education (NAEYC, 2010).

Research indicates that being competent in early math skills is a strong predictor of later academic success both in reading and math (Harris & Petersen, 2017). However, by middle school, girls are already underperforming in mathematics. According to Levine et al. (1999), boys tend to excel in problem-solving and spatial reasoning, which are key skills for success in math and science. Girls, on the other hand, perform better on tasks related to verbal reasoning.

Research suggests that early experiences have a direct influence on this shift in performance, both inside and outside of school, in math and science (Levine et al., 1999).

This case study aimed to determine whether early at-home support for girls could boost their interest in math activities at school. Using objects like buttons, bear counters, beads, and other tangible items has always been important in developing early math skills, including one-to-one correspondence, pattern recognition, and prediction. While this research focused on physical tools to enhance students' math abilities, the role of developmentally appropriate technology might also be important. By the end of the study, girls' interest in math activities had increased slightly, suggesting that targeted support and hands-on activities could further improve their interest in math. However, the use of tablets, laptops, and other smart devices offers new opportunities for teaching math in EC classrooms (Papadakis et al., 2018).

Literature Review

The National Science Foundation (2020) reported that children who regularly participate in STEM-related activities are more likely to pursue STEM careers as adults. However, research shows that STEM is not integrated into early classrooms as often as it should be (McClure et al., 2017). Positive engagement with STEM during early childhood (EC) is crucial for future success in STEM-related fields (Stephenson et al., 2021). Harris and Petersen (2017) have suggested that educators in PreK classrooms tend to focus on early literacy skills, especially during direct, small-group instruction, rather than finding ways to combine both early literacy and early math skills. The practice of limiting math and other STEM-related skills has long-lasting implications and may be one of several reasons why girls avoid STEM careers later in life (Harris & Petersen, 2017).

Why do young girls tend to avoid math-related activities and later, STEM careers as adults? Fleer (2021) has noted that only 12% of engineers in Western countries are women, despite classrooms in these regions being equipped with tools designed to foster math skills. Even with limited access to digital devices, tangible items like blocks, magnets, twine, and other materials are available to help students develop STEM skills by allowing them to manipulate and explore through play. However, girls often hesitate to use these items for exploration in math and science. Instead, they tend to use these materials in gender-stereotyped ways (Halström et al., 2015). Gunderson et al. (2011) argue that boys receive more encouragement to develop science and math skills during play. This is evident when boys are prompted to explore and experiment with their surroundings. Conversely, girls often receive societal reinforcement to focus on social and verbal activities, with encouragement to be nurturing and cautious during play. These stereotypes become apparent as early as PreK and kindergarten, around ages three to five (McGuire et al., 2020). It is argued that young girls begin to internalize these stereotypes at various stages of development, with observations dating back to as early as three years of age (Gonzalez et al., 2021). This process continues throughout their academic careers, with some developing math anxiety. As a result, these girls often choose careers in social work or language arts.

DiStefano et al. (2023) argued that while young girls often avoided math and STEM- related activities at school, they also tended to avoid math activities at home. The authors further suggest that girls who achieved greater success in math later in their academic careers had parents who regularly engaged in math-related activities (2023). Parents who highly value math may show their children that success in math is possible, regardless of gender. These parents often buy math games, incorporate math language into conversations, and enroll their children in math-related activities. Conversely, parents who do not emphasize math might communicate that math is unimportant (DiStefano et al., 2023). Interestingly, many everyday activities involve math, such as making tea or coffee, baking, grocery shopping, doing laundry, and even online shopping, which can be simple yet effective ways for parents or guardians to promote math proficiency.

With greater access to digital tools inside and outside classrooms, technology-enhanced toys (TETs) are now used beyond just tablets, phones, and laptops to promote math skills. The use of TETs and other digital devices with young learners has sparked ongoing debates about whether technology is suitable for them at an early age, due to concerns about potential addiction and decreasing critical thinking skills (Jin et al., 2023). However, the number of educational apps designed for this age group and younger continues to grow. Apps like Splash Learn, ABC Mouse, Math Makers, and Code Monkey (Common Sense Education, n.d.) offer interactive and adaptive gamified learning experiences for students who struggle with traditional methods, thereby creating more opportunities for personalized learning in literacy, math, and other STEM-related areas.

Additionally, coding robots like Bee-Bot, Codepillar, and MTiny help students build computational thinking, pattern recognition, and problem-solving skills (Bers, 2022). These devices are designed to teach young children how to code in a simple and intuitive way. They are common in early childhood classrooms because they do not require a wireless connection to operate and need less scaffolding during use. As a result, students can independently control the robots through active learning, which encourages creativity and collaboration, skills that support math proficiency.

Although research suggests that early exposure to STEM in schools influences future career choices, the integration of STEM activities in EC classrooms remains inconsistent.

Research shows that EC educators often focus on literacy development during small-group instruction, unintentionally overlooking opportunities to incorporate early math and science learning. This imbalance has long-term effects, especially for girls, who are more likely to internalize societal stereotypes that depict STEM as a male-dominated field. These stereotypes start forming as early as age three and are reflected in how girls interact with materials in the classroom, often using them in socially expected ways rather than engaging in exploratory STEM play. Additionally, the reinforcement, or lack of reinforcement, of math at home influences children's early math identities, with parental involvement being crucial to building girls' confidence in math. As digital tools and educational technologies become more accessible, their developmentally appropriate integration has become a promising approach to support personalized, play-based math engagement and motivation.

Methodology Research Design

This qualitative case study (Merriam & Tisdell, 2009) was conducted to determine whether targeted math activities implemented at home could increase math engagement among girls in a PreK classroom. This included a desire to engage in sorting, counting, comparing and contrasting, creating patterns, and estimating. Math-related language, such as "You have more blocks than I do," "I have less," and "These are the same because they are all small but have different colors," or "This is/has a pattern," should also be evident. Using a case study approach allowed for a deep understanding of the participants' experiences. By examining the perceptions and behaviors of a small group of children and their parents/guardians in a controlled environment, the study aimed to investigate how informal, home-based interventions may influence early mathematical interest and participation.

Participants

The participants were selected from a school in an urban area of New Jersey where the researcher was based. The researcher used convenience sampling to recruit participants because the individuals at the researcher's workplace were easily accessible and met the study's criteria (Etikan et al., 2015) of being a girl enrolled in a PreK classroom and having at least one parent or guardian interested in participating.

The school served as an overflow facility, with nearly all children transported daily to and from their home schools. Students attended this school if: 1) the PreK classrooms at their home school were full, or 2) their home school lacked PreK classrooms. The participants ranged in age from four to five and a half years old and qualified for the free or reduced-price lunch program. All participants were assigned a letter to protect their identities and maintain confidentiality.

Procedures

For this qualitative case study, an IRB application was reviewed and approved. Consent forms detailing the study's goals, the participation process, and participants' rights were provided to the parents or guardians of potential participants.

Since the study required input from both children and their guardians, participation involved filling out a short consent form together. Eight girls were initially chosen for the study. All participants were informed they could withdraw at any time without any penalty. Out of the eight, six guardians completed and returned the consent form. One guardian-child pair withdrew before data collection started.

After obtaining the consent forms from the adults, a brief survey was administered to gather insights into their attitudes toward mathematics and math-related activities. The survey was designed to be non-intimidating and consisted of several reflective questions along with two basic math problems. Participants were instructed that they could skip any items they preferred not to answer. The responses were collected and analyzed to identify patterns in adult attitudes toward math.

Each week for four weeks, math activities were sent home to reinforce the concepts taught in class. These activities covered a wide range of math skills. Materials for each activity were included, along with a script for open-ended math questions and a notepad for the guardian to record responses. Each activity was to be returned by the end of the week, with responses noted in the notepad. Adults were allowed to add extra notes if they wished, but they were encouraged to use the provided questions. The math activities sent home included the following: bear counters for Week 1, tangrams for Week 2, measuring and estimating for Week 3, and graphing for Week 4.

Data Collection and Analysis

Data was collected using three primary sources:

1. **Anecdotal records** were collected in order to document students' engagement during math-related classroom activities before, during, and after the intervention.
2. **Observational notes** were recorded by the researcher three times a week, focusing on behaviors such as enthusiasm, participation, and persistence during math tasks.
3. **Parent/guardian reflections**, which consisted of written responses and informal journal entries submitted weekly, describing the home-based math activities that were completed, any reactions from the child, and any noticeable changes in attitude or confidence

The data were analyzed using Braun and Clarke's (2006) inductive thematic analysis. The anecdotes, observational notes, and parent/guardian reflection notes were read for familiarity.

The data was read a second time and then manually coded to identify recurring codes and themes.

Findings

This study explored how Pre-K girls interacted with math materials in both classroom and home environments, and how support from teachers and caregivers influenced their engagement over time. Figures 1, 2, and 3 provide an overview of the participants' demographic details, including age in months, ethnicity, and eligibility for the free or reduced-price lunch program.

Figure 1

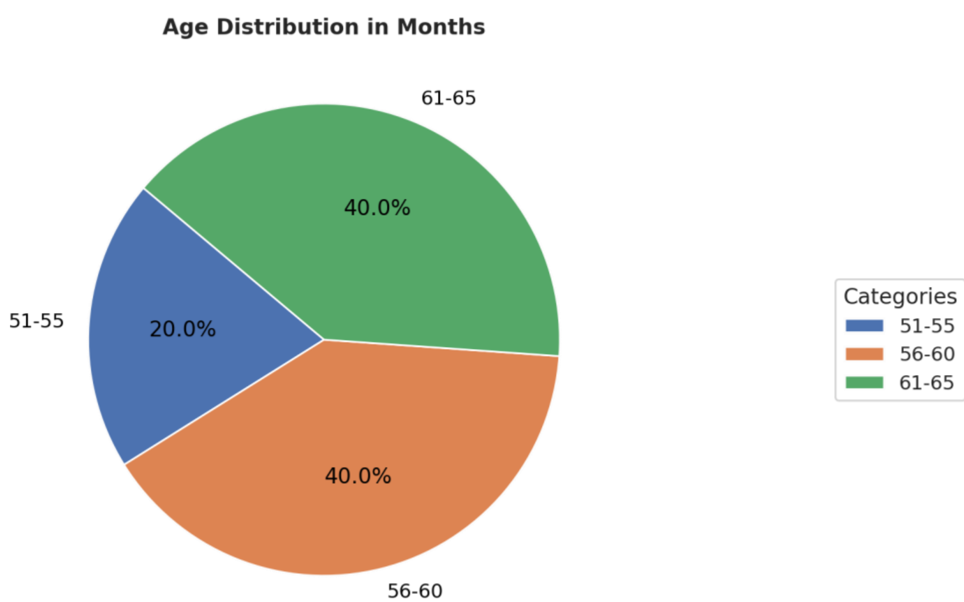


Figure 2

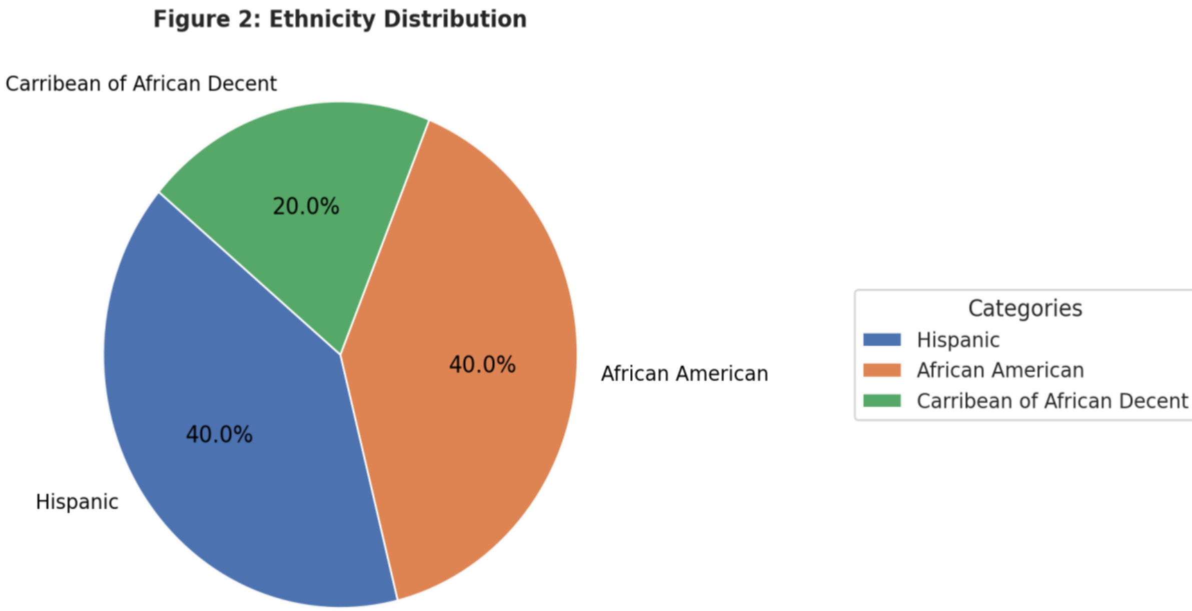
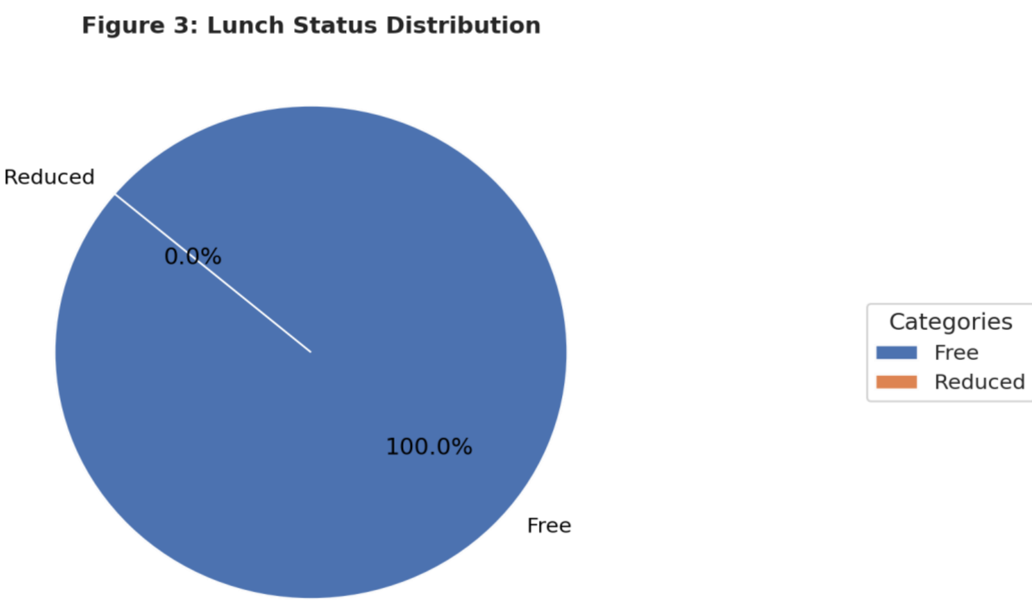


Figure 3



The pre-study survey highlighted parental attitudes toward schooling, particularly in math. Table 1 presents the survey questions and the accompanying math problems. Table 2 describes the results from the responses.

The survey aimed to gain a better understanding of the academic backgrounds, attitudes toward math, and math competency of the adult participants through two problem-solving questions. All five adults answered both math problems on the survey correctly.

The adult participants reported a variety of favorite high school subjects. Only one adult chose math as their favorite, while others preferred English or art/music. Despite this, four out of five guardians described math as "very important." One guardian, whose favorite subjects were art/music, rated math as only "somewhat important," showing the only moderate view among the adult participants.

Adult education levels ranged from high school to some college experience. Four participants had completed high school, and one reported "some college." Overall, the data suggests that while the guardians held diverse academic interests and came from different educational backgrounds, they demonstrated some regard for math and math competency.

Table 1

Parent/Guardian Math Survey

Question	Options
1. How important do you feel math is in relation to the grade your child is in?	☐ Very important ☐ Somewhat important ☐ Not important
2. What was your favorite subject in school?	☐ Art / Music ☐ English ☐ Math ☐ History ☐ None of the above
3a. Your grocery bill comes to $34.16. You give the cashier a $50 bill. How much change will you receive?	☐ $18.48 ☐ $15.84 ☐ $16.48
3b. What is the result of 1/4 × 4/8?	☐ 4/12 ☐ 1/8 ☐ 5/12
4. When solving the two problems above, how did you feel?	☐ Anxious / Nervous ☐ Neutral ☐ Excited

5. What is the highest level of education you have completed?	☐ Elementary school ☐ High school ☐ Some college ☐ College graduate ☐ Graduate work

Table 2

Survey Results

ID	Favorite Subject in High School	Both Math Answers Correct on Survey	Parent Education Level	Importance of Math
A	Math	Yes	High School	Very Important
B	Art/Music	Yes	High School	Somewhat Important
C	English	Yes	Some College	Very Important
D	English	Yes	High School	Very Important
E	Art/Music	Yes	High School	Very Important

Another survey was given to the adults at the end of the study. This survey aimed to find out if the instructions for the activities were unclear, if the tasks were too difficult, and how much time was spent on the activities. None of the adults reported difficulty with the instructions or the activities themselves. The bear counters and measuring activities were among the favorites. The least popular activities were the tangrams and graphing activities. Table 3 shows that most parents spent 20 to 30 minutes on each activity, except for Student C, whose adult reported spending 0 to 20 minutes on the two activities she completed. All the parents said they were willing to try the activities on their own. Table 3 presents the survey results.

Table 3

Post Study Surve

ID	Activities Difficult?	Instructions Understandable?	Favorite Activity	Least Favorite Activity	Time Spent (minutes)	Tried Activities Independently?

A	No	Yes	Bear Counters	Tangrams	20–30	Yes
B	No	Yes	Bear Counte rs	Tangrams	20–30	Yes
C	No	Yes	Tangrams	Bear Counter s	0–10	Yes
D	No	Yes	Measuremen t	Graphing	20–30	Yes
E	No	Yes	Measuremen t	Graphing	20–30	Yes

Using Braun and Clarke's (2006) inductive thematic analysis approach, the researcher identified three themes: Playful Engagement with Math Tools**,** Emerging Mathematical Thinking with Support**,** and Adult Scaffolding Promotes New Thinking. These themes were developed through an iterative coding process that included observational notes, anecdotal records, teacher prompts, and parent feedback collected over four weeks. Table 4 shows the codes and themes identified during analysis.

Table 4

Example of Codes and Themes Identified

Open Codes	Category	Themes
Built house with dominoes; cooked with balance scale; role-played with bears; made ladder with cubes; created rainbow instead of pattern	Imaginative and Non-Traditional Use	Playful Engagement with Math Tools
Matched domino dots after prompting; labeled bear sizes; estimated cube quantity; began color patterns	Emergent but Inconsistent Understanding	Emerging Mathematical Thinking with Support
Teacher modeled math vocabulary; parents completed home activities; student taught	Educator and Parental Scaffolding	Adult Scaffolding Promotes New Thinking

peers; lack of support hindered progress		

Theme 1: Playful Engagement with Math Tools

Before the study, all five students showed interest in the math materials, but they often used them creatively or unconventionally, deviating from their intended mathematical purposes. The math area was viewed more as an extension of the dramatic play area rather than a space for problem-solving or other mathematical reasoning.

For example, Student A, one of the oldest in the class, sat in the math area stacking dominos vertically until they toppled over. She then used them to build a structure. When asked what she was building, she responded, "I'm building a house for the bears." The teacher redirected her by introducing the concept of matching the dots. Student A responded with interest: "Like a matching game?" and then examined the dominoes more intentionally.

Similarly, Student C rarely visited the math center. She used the balance scale to mix seashells and rocks, stirring them with a stick and explaining, "I am cooking rice for the baby to eat." Even after the teacher prompted her to consider weighing as a possible use of the scale, she insisted on completing her imagined task of cooking for her baby before considering the alternative.

These examples show that although the students were actively engaging with the materials, their play focused on storytelling, building, and social interaction rather than on structured mathematical thinking. For the girls, these objects were more suited for creative expression rather than as tools for exploring relationships with math.

Theme 2: Emerging Mathematical Thinking with Support

Although initially unclear, several students showed early numeracy skills when prompted or given time to reflect on their play. **Student B,** who used bear counters to represent a family, pointed out: "This is the daddy (the large one), this is the mommy (the medium one), and this is the baby (the small one).” While she did not sort the bears or use formal terms like “biggest” or “smallest,” her understanding of size categories demonstrated natural comprehension of measurement.

Student D, another regular visitor to the math center, connected unifix cubes to her imaginative world by building a “ladder” to climb a slide. The teacher prompted her to count how many cubes she had used, and she replied, “A lot of cubes so I can reach the top.” This response showed an understanding of quantity, even though applying one-to-one correspondence still needed teacher support.

Student E, who demonstrated the strongest math skills, started a red-blue color pattern on her own but abandoned it for a different outcome: “Look, Ms. S, I made a rainbow.” Later in the study, she returned to patterning with beads and buttons, showing her growth in balancing creativity with repetition and structure. The behaviors of these students suggest they had hidden mathematical knowledge that was sometimes triggered during play but needed support to expand their play.

Theme 3: Adult Scaffolding Promotes New Thinking

The biggest increase in math engagement happened when adults, including teachers and parents, acted as facilitators of learning. In the classroom, well-timed questions and modeling helped students move from using materials creatively to working on conceptually solid math tasks.

Student A, after learning how to match domino dots, began modeling this activity for her peers who were not participants in the study. Likewise, Student B progressed from dramatic bear play to separating the bears by size and lining them up, most likely from internalizing the classification language introduced earlier by the teacher.

Parental involvement through the structured take-home math activities also helped change perceptions. Each student received a weekly tote bag with manipulatives, activity instructions, and a small notebook. According to the parent post survey, most families spent 20–30 minutes on these activities, and several expressed willingness to do them again independently. The most popular tools were teddy bear counters and measuring items, while the tangrams and graphing activity were seen as less engaging.

Student C's case emphasizes the importance of support. Her mother, the only parent in the study with reported college experience, said she "doesn't have time to do this with me." As a result, Student C failed to return many supplies and did not show notable changes in her classroom behavior, continuing to use math tools as props for pretend play.

These findings emphasize the importance of developmentally appropriate teaching methods that connect imaginative play with math learning. While young children often explore materials through creativity and storytelling, intentional adult guidance is crucial in helping them recognize the math potential of those materials. When properly scaffolded, both in the classroom and at home, students showed some improvement in mathematical language, problem-solving, and understanding other math concepts.

Discussion

The purpose of this study was to investigate how young girls interacted with mathematical materials in a school setting and to determine whether home-based math activities and adult support could promote more purposeful math engagement. The findings identified three themes: Playful Engagement with Math Tools, Emerging Mathematical Thinking with Support, and Adult Scaffolding Promotes New Thinking. These themes highlight the development of skills from an imaginative use of math materials to more intentional mathematical thinking, particularly when scaffolded by educators or caregivers.

At the beginning, the girls' interactions with math manipulatives were mainly imaginative and narrative-driven. This behavior is consistent with research suggesting that young children often use learning materials in fantasy play (Bodrova & Leong, 2024). Students built structures, enacted family stories, and "cooked meals," all while using tools intended for counting, measuring, or sorting. This form of play is developmentally appropriate; however, it was often devoid of mathematical focus.

An important finding in this study was that children showed emerging mathematical awareness when prompted by adults. For example, matching domino dots, identifying patterns, and sorting bear counters by color only appeared after direct intervention. This aligns with existing research, which emphasizes the importance of intentional instruction and scaffolding in early math education (Sarama & Clements, 2019). Without some support from the teacher or parent, the children's spontaneous use of mathematical concepts was limited, even with rich materials. These results reaffirm that math learning in early childhood does not happen in isolation. It must be built through meaningful interactions between adults and children.

The third most significant theme identified was the role of adult scaffolding in helping children transition from play to meaningful math engagement. Teacher prompts, modeling, and encouragement played a role in extending students' thinking. Additionally, most parents/guardians who participated in the study reported a willingness to continue math activities at home, with many stating that they spent 20 to 30 minutes per activity. One student had inconsistent support, showing that barriers such as time constraints can hinder children's opportunities to engage meaningfully with math activities.

One instructional approach that could potentially boost math engagement in students involves integrating digital tools. Technology integration has shown some promise in EC classrooms. Existing research indicates that well-designed math apps can promote number sense, pattern recognition, and other math-related skills in young learners (Papadakis et al., 2022). Apps such as Splash Learn, Math Maker, and Numberblocks provide interactive environments that allow children to practice multiple math skills while receiving immediate feedback (Neumann, 2018). These features can be especially helpful for children who prefer visual and tactile interaction. Additionally, families who use math apps might find them quite beneficial if they do not feel confident facilitating math instruction on their own.

Furthermore, coding robots such as Bee-Bot, KIBO, and M-Tiny give young children chances to practice mathematical reasoning through sequencing, estimation, and spatial thinking. Previous studies have shown that coding robots support other math skills, such as computational thinking and problem-solving, by encouraging teamwork and logical reasoning (Bers, 2018).

These tools allow for hands-on manipulation and can be included in many story-based activities. They may also connect with students who, like those in this study, prefer imaginative play over abstract tasks. Using coding robots in early childhood classrooms may help bridge the gap between playful engagement and understanding of math concepts.

The success of digital interventions heavily depends on adult guidance, especially in EC classrooms. As is well known, digital tools are not a replacement for teachers or parents. However, they serve as a complement to current instructional practices (Zilka, 2021). Teachers need to be trained not only to effectively integrate technology but also to recognize when to intervene or scaffold learning experiences based on student needs.

Conclusion

This study confirms the necessary role of the teacher, in addition to parental support, in developing early math skills. The study also suggests that intentionally integrating digital tools can enhance student engagement. Possible future research could investigate how combining traditional manipulatives with digital resources supports inclusive math learning environments, particularly for children who tend to avoid math areas in the classroom.

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