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ARTICLE

Professional Development and Changes in Teachers' Teaching Practices: A Pilot Study

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ABSTRACT

Current efforts to improve physical education programs involve providing teachers with quality preparation professional development opportunities, especially for elementary classroom teachers (ECTs) who deliver physical education without adequate preparation (DeCorby et al., 2005).[5] However, little is known about the role of continuous professional development (CPD) in changes in ECTs' practices regarding teaching physical education (Parker et al., 2022).[23] This study utilized visual methods to explore changes in ECTs' practices regarding physical education teaching throughout their participation in a state-funded, five-month-long CPD initiative. The participants were four elementary classroom teachers in rural California. The CPD initiative consisted of a three-day summer institute and two follow-up sessions. Participant-generated visual diaries and focus group interviews were used to capture teacher practice changes. Findings revealed three themes: a) A focus on standards-based instruction facilitated teacher's change; b) Involvement in a community of learners can be a powerful source of change; and c) Teacher change is a time-consuming process. This study highlights that ECTs who receive inadequate training in physical education teacher education are more likely to have a lack of competence and confidence in teaching physical education. The CPD activities can potentially enhance ECTs' skills in planning and teaching practice, thereby boosting their confidence.

Keywords: Continuous professional development; Teacher change; Elementary classroom teachers; Physical education; Visual methods

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1. Introduction

Elementary physical education is crucial in developing children's skills, knowledge, and dispositions, enabling them to embrace physically active lifestyles. As a result of a well-designed elementary physical education program, children can become more predisposed to participate in physical activities by gaining confidence in their abilities and discovering enjoyable forms of movement. However, international research has indicated that teacher qualification and preparation are one barrier to implementing quality elementary physical education programs (Lynch & Soukup, 2017;[15] Tsangaridou, 2012).[31] In various countries, including Australia, Britain, and the United States (U.S.), the responsibility for delivering physical education falls upon elementary classroom teachers (ECTs) at elementary schools (Carney & Armstrong, 1996;[2] Faulkner et al., 2008;[10] McKenzie et al., 1998).[17] In the U.S., ECTs are responsible for providing physical education instruction in numerous states, including but not limited to Alabama, California, Florida, New York, and Ohio (Society of Health and Physical Educators America, 2016).[30]

Unfortunately, ECTs frequently encounter insufficient professional training for teaching physical education due to constraints within their undergraduate curriculum (DeCorby et al., 2005).[5] In the best-case scenario, ECTs engage in a single course during their undergraduate studies, aimed at cultivating fundamental knowledge and skills requisite for delivering physical education lessons (Xiang et al., 2002).[32] Consequently, ECTs might find themselves deficient in both knowledge (such as content knowledge and pedagogical content knowledge) and skills due to the constraints of their limited training. This deficiency could impede the successful implementation of high-quality physical education programs (DeCorby et al., 2005;[5] Fletcher et al., 2013).[11] For instance, researchers have uncovered that insufficient training for ECTs can lead to various challenges, including the inappropriate utilization of equipment, a lack of task progression, limited task modifications and challenges, extended transition times, and inadequate provision of specific feedback on students' skill development (DeCorby et al., 2005;[5] Fletcher et al., 2013;[11] Jones & Green, 2015).[14]

Furthermore, inadequate preparation can adversely affect ECTs' confidence in teaching physical education (Faucette et al., 2002;[9] Morgan & Bourke, 2005).[20] Previous research has indicated that many ECTs are generally not confident when teaching physical education (Xiang et al., 2002).[32] In addition to this challenge, ECTs might have negative attitudes toward physical education due to their own discipline experiences as students, perceiving physical education as a break from classroom tasks rather than a vital curriculum component (Xiang et al., 2002).[32] For instance, Morgan and Bourke (2005)[20] reported that ECTs who recalled more negative experiences in physical education exhibited lower confidence in their teaching abilities.

Continuous professional development (CPD) programs present a viable avenue for augmenting the competence and confidence of classroom teachers in teaching physical education. Over the years, researchers have crafted and executed a range of CPD initiatives aimed at to enhance ECTs competence and confidence in teaching physical education (Faucette et al., 1992;[8] Faucette et al., 2002;[9] McKenzie et al., 1997;[18] Morgan & Hansen, 2007;[21] Morgan & Hansen, 2008;[22] Petrie, 2010).[27] Findings from those studies have underscored that the positive effects of collaborative opportunities, engaging experiences, and sustained support (Faucette et al., 2002;[9] Fletcher et al., 2013;[11] McKenzie et al., 1997)[18] are inherent in long-term CPD initiatives. These elements collectively contribute to enhancing ECTs' delivery of physical education lessons.

Professional development opportunities are frequently confined to brief timeframes, detached from the real-world contexts of teachers, and provide limited ongoing assistance (Patton & Parker, 2015).[26] Researchers argue that effective professional development should adopt a continuous approach and involve teachers as active participants rather than passive recipients of knowledge (Desimone,

2011;[6] Morgan & Hansen, 2007;[21] Patton & Parker, 2015).[26] Within a supportive and collaborative environment, teachers tend to show enthusiasm for acquiring new knowledge and are willing to apply it within their classrooms (Patton & Parker, 2015).[26] Effective CPD activities are tailored to address teachers' specific needs (Morgan & Hansen, 2007).[21] Furthermore, scholars suggest that engagement with facilitators and fellow teachers over an extended period contributes to teacher change (Morgan & Hansen, 2007).[21] Teacher change is both a process and the outcomes linked to modifications, adaptations, or transformations in a teacher's beliefs, attitudes, or practices. This dynamic and ongoing process aims to enhance the quality of education and improve student learning outcomes.

Contemporary endeavors to enhance elementary physical education programs encompass providing CPD opportunities for teachers, mainly focusing on classroom teachers entrusted with delivering physical education without sufficient preparation (DeCorby et al., 2005).[5] Nevertheless, there remains a gap in our understanding concerning the impact of CPD on the evolution of ECTs' practices in teaching physical education. In addition, while the majority of previous research has employed methods such as interviews, observations, document analysis, and surveys to examine CPD programs targeting ECTs in the field of physical education (Faucette et al., 1992;[8] Faucette et al., 2002;[9] Morgan & Hansen, 2007;[21] Morgan & Hansen, 2008;[22] Petrie, 2010),[27] to the authors' knowledge limited studies have utilized visual methods. Therefore, this study used visual methods to explore changes in ECTs' practices regarding physical education teaching throughout their participation in a state-funded, five-month-long CPD initiative. Visual methods allow participants to articulate their perceptions and ideas more clearly and help them recall their memories during interviews (McIntosh, 2010).[16] This approach also facilitates effective communication between researchers and participants, which contributes to the enrichment of this study.

Theoretical Framework

Guskey's model of teacher change (see Figure 1) served as the theoretical framework for this study (Guskey, 2002).[13] This model visually represents how changes in teachers' practices typically transpire. Specifically, the model of teacher change indicates that professional development activities directly lead to changes in teachers' classroom practices. This initial phase involves teachers engaging in professional development and acquiring specific and concrete knowledge, skills, and concepts, guiding modifications in their planning and instruction. This, in turn, precipitates changes in student learning outcomes due to more effective teaching practices. Ultimately, successful implementation and observable improvements in students' learning outcomes contribute to transforming teachers' beliefs and attitudes. When witnessing their students' success, teachers' newly adopted teaching strategies contribute to a positive classroom environment, further reinforcing teachers' perspectives and confidence in teaching. This study focused on the initial phase wherein CPD influenced changes in ECTs practices. More specifically, this study aimed to utilize visual methods to explore changes in ECTs' practices regarding physical education teaching throughout their participation in a state-funded, five-month-long CPD initiative.

The model of teacher change provides three foundational principles that hold essential significance in designing effective CPD programs. First, ongoing support is necessary for teacher change. This approach enables teachers to enhance their teaching practices and job satisfaction consistently. Absent such support, maintaining changes becomes challenging throughout the process. Second, the process of change is inherently gradual and intricate for teachers. This involves embracing novel approaches and striving to implement them successfully, demanding considerable time and effort. As a result, teachers are compelled to venture into a realm of uncertainty and take calculated risks, given that the effectiveness of these new ideas in fostering student learning outcomes remains uncertain. Last, teachers must

see the changes in student learning. The sense of accomplishment and success for teachers is deeply rooted in observing improvements in their students' learning journeys. This substantiation becomes a pivotal driver in confirming the efficacy of the newly adopted teaching methodologies within the classroom. Therefore, this study utilized visual methods to explore changes in ECTs' practices regarding physical education teaching throughout their participation in a state-funded, five-month-long CPD initiative.

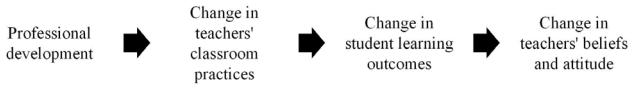

Figure 1. Guskey's model of teacher change (Guskey, 2002, p. 383)[13]

2. Methods

In this qualitative study, we employed a visual method (Pink, 2012).[28] Specifically, we used participant-generated visual diaries and focus group interviews to capture changes in teachers' decision-making as they engaged in a CPD initiative. Visual methods represent an innovative research approach that can encourage and empower participants to communicate their perspectives about specific issues and experiences in meaningful and creative ways (McIntosh, 2010).[16] In this study, photographs served as visual aids, assisting participants in recalling their memories during interviews and facilitating a more explicit articulation of their experiences and perceptions.

Professional Development Initiative

The CPD initiative (which we will call Teaching Institute) was provided by the California Physical Education-Health Project (CPE-HP), one of the nine California Subject Matter Projects authorized by the state legislature to provide CPD for K-12 health and physical education teachers. CPE-HP is funded at the state level to provide teachers with comprehensive and content-focused CPD by building teacher leadership and fostering collaboration with university faculty. CPE-HP is dedicated to increasing teachers' academic content knowledge and pedagogical content knowledge to improve K-12 student learning. CPE-HP builds communities of practice at regional sites, forms partnerships with school districts to support their work in physical education and health education, and supports teachers in their role as instructional leaders within these two disciplines.

Spanning five months, the Teaching Institute comprised a three-day workshop during the summer and two follow-up workshops in the Fall. All workshops lasted for eight hours and were delivered at a university campus. The Teaching Institute was planned and delivered by a group of veteran physical education teachers and a university faculty, who acted as the content expert. This institute focused on motor learning in the context of standards-based physical education. Workshop sessions involved various activities, including lectures, group work, individual tasks, and practical tasks.

Participants

Participants in this study were four ECTs serving public schools in rural California. All participants were White females with teaching experience between three and 25 years. Specifically, one participant had three years of teaching experience, another eight years, a third 15 years, and the fourth 25 years of experience. All participants taught grades four and five at their elementary school. Among these participants, the teacher with 15 years of teaching experience also served as a coach.

Data Sources

Data sources for this study comprised visual diaries and focus group interviews. Researchers provided clear instructions for the visual diaries, asking teachers to use photography to document changes that represent the changes in teaching physical education, such as a lesson plan, class setup, instructional moments, assessments, or students in action. Following this, teachers were requested to select 6 to 8 photos to include in their visual diaries,

which were to be submitted to researchers before the interviews. Furthermore, the interview guides included open-ended questions to capture teachers' experiences and perceptions. For example, "What is the impact of this institute on your teaching?", "How do you envision successful professional development for teaching physical education in the future?" and "Why did you pick that photo? Can you share a bit about the photo?"

Data Collection

Teachers were invited to participate in this study on the first day of the Teaching Institute's three-day program. Those who agreed completed informed consent and joined a meeting with the principal investigator. Within this meeting, the principal investigator provided detailed instructions on how to create a visual diary. Using a combination of photography and captions, visual diaries serve as personal records that capture daily life events, routines, and realities. This approach allows participants to provide authentic accounts of their experiences and engage in reflection (Azzarito, 2012).[1]

Teachers were instructed to create visual diaries by taking photographs of meaningful events, representations, and activities concerning their teaching practice within two one-week windows. At the end of each window, teachers were asked to select 6-8 photos representing changes in their teaching practices regarding physical education instruction. They then inserted the photographs in a Google Doc and wrote a brief caption describing their meaning. The two photograph windows were arranged according to the Institute schedule. Teachers participated in a focus group interview to discuss their visual diaries on the two designed follow-up days of the Teaching Institute (September and October). During these interviews, the visual diaries were provided in printed form, and teachers were prompted to discuss the photographs and their corresponding captions. Figure 2 displays the data collection process.

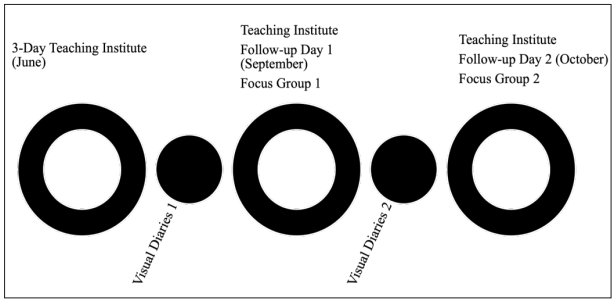

Figure 2. Data collection process

Data Analysis

The responses to interview questions and the visual diaries were analyzed inductively (Miles et al., 2019).[19] Initially, data generated through the interviews were transcribed verbatim. The analysis process followed an inductive approach using the three concurrent flows of activity suggested by Miles and colleagues (2019):[19] a) data reduction, b) data display, and c) conclusion drawing and verification. The constant comparative method (Glaser & Strauss, 1967)[12] was also employed throughout the analysis to ensure the consistency and appropriateness of the coded segments within their designated clusters of data. First, researchers extracted significant phrases or sentences in the interview data that pertained directly to ECTs' teaching practice changes. These extracted elements were then consolidated into a comprehensive list of codes.

Similarly, during the analysis of the visual diary, researchers identified all the features (e.g., objects, people, places) portrayed by the participants in their photographs and quotes. Next, the researchers comprehensively reviewed the compiled codes, encompassing the interview data and the visual diaries. The goal was to discern patterns among these codes by grouping those that shared analogous meanings into distinct categories (Glaser & Strauss, 1967).[12]

Researchers used three strategies to establish trustworthiness in the analysis: a) analytic memos, b) triangulation of data, and d) peer debriefing (Creswell, 2009;[3] Saldaña, 2013).[29] First, analytic memos involved researchers documenting their reflections, thoughts, and questions at various

stages of the study, including after interviews and during data analysis and interpretation. These notes augmented the study's foundation with supplementary insights. Second, data triangulation was applied, leveraging multiple sources of information to acquire diverse perspectives. This encompassed participants' diaries, photographs, and responses to interview questions. This comprehensive approach facilitated a richer understanding of the subject matter. Last, peer debriefing was conducted as a validation measure. The first author devised the codes and themes derived from the data, which the second author assessed and reviewed. This process ensured a rigorous evaluation and refinement of the codes and themes, enhancing the overall credibility of the study.

3. Findings

This paper utilized visual methods to explore changes in ECTs' practices regarding physical education teaching throughout their participation in a state-funded, five-month-long CPD initiative. Data analysis resulted in three themes: a) A focus on standards-based instruction facilitated teacher's change (i.e., standards-based curriculum design, applying multiple instructional strategies, conducting peer assessment); b) Involvement in a community of learners can be a powerful source of change, and c) Teacher change is a gradual process (i.e., Phase I and Phase II).

A Focus on Standards-Based Instruction: Facilitating Teacher's Change

The Teaching Institute focused on standards-based instruction, resulting in changes in participants' practices regarding implementing physical education lessons. More specifically, throughout the Teaching Institute, teachers started using the national physical education standards, applied new instructional strategies, and conducted peer assessments in physical education lessons.

Standards-Based Curriculum Design

During the Teaching Institute, ECTs learned that physical education, like any other curricular discipline, is guided by standards. Following the initial workshop, the teachers endeavored to incorporate the national physical education standards and grade level outcomes as guiding principles for designing their lessons instead of teaching the contents randomly. Understanding what should be included in elementary physical education and what needed to be achieved, they chose the contents and developed tasks to align with the standards. During the focus group interview, Katie shared, "I take it more seriously, it was like 'what do you want to play today?' Now it is 'we are going outside, and we are working on underhand rolling.' This is a third-grade standard." Simultaneously, these teachers understood how to unpack and translate the standards into the classrooms. During the interview, Mia presented photos (see Figure 3) that showcased students collaboratively identifying key elements regarding grade level outcome 4.5.4 (i.e., Students will respond to winning and losing with dignity and respect). Mia emphasized that this approach rendered the standard and grade level outcome meaningful for students by having them discuss the definitions of dignity and respect.

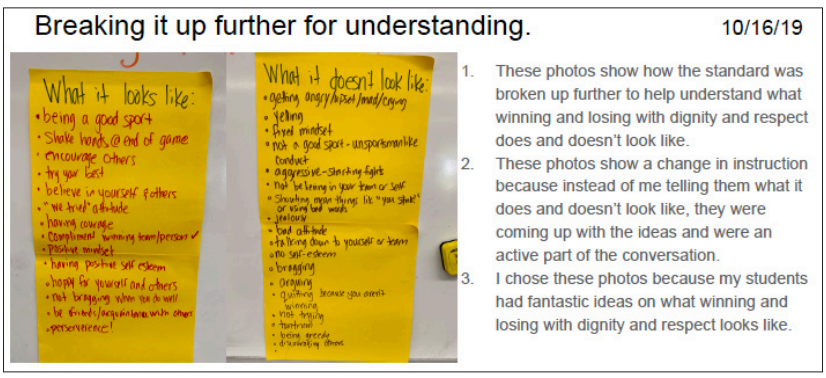

Figure 3. Mia's Diary on breaking down the standard

Throughout the Teaching Institute, participants learned that physical education standards also included learning in the affective domain. As a result, they commenced incorporating the national physical education standard five (i.e., the physically literate individual recognizes the value of physical activity for health, enjoyment, challenge, self-expression and/or social interaction) within their classrooms. As Bonnie reflected in her diary, "I never realized that PE (physical education) had Standard 5 in which the students demonstrate and utilize knowledge of psychological and sociological concepts, principles, and strategies that apply to the learning and performance of physical activity existed." Furthermore, teachers planned the lessons intentionally based on students' current skill levels. For example, Bonnie shared her experiences when teaching the soccer unit:

I just put them (students) in the standard for the grades that I'm teaching is being able to pass a soccer ball to a moving target. A lot of them don't even have the skills to dribble the ball which is a second-grade standard. So, I had to backtrack and do some drills. (Focus group 2)

Applying Multiple Instructional Strategies

Classroom teachers indicated they acquired various new ideas for teaching physical education that they applied in their classrooms. All teachers mentioned gaining a new approach to instructing fundamental skills: using performance cues. Mia reported during the interview:

We're not trained in the way PE specialists were, I don't know how to break down the critical elements for every standard. I don't even know if I could do a proper overhand throw because I have never played a sport that involves an overhand throw. So how can I effectively teach others to do an overhand throw if I don't know the proper form and if I can't break it down?

Classroom teachers highlighted that the Teaching Institute supplied them with valuable information and resources contributing to their professional learning and teaching. For instance, the details concerning critical elements of skills in the book aided their grasp of the skills (see Figure 4), which allowed them to teach the skills accurately and use these pictures as visual aids to demonstrate the skills effectively. With the key elements of the skills, teachers could provide students with specific feedback on their performance and guide them in proper forms to facilitate their learning.

Furthermore, ECTs designed the tasks sequentially, allowing students to learn and practice the skills progressively. These teachers reported that they developed various activities and games for students

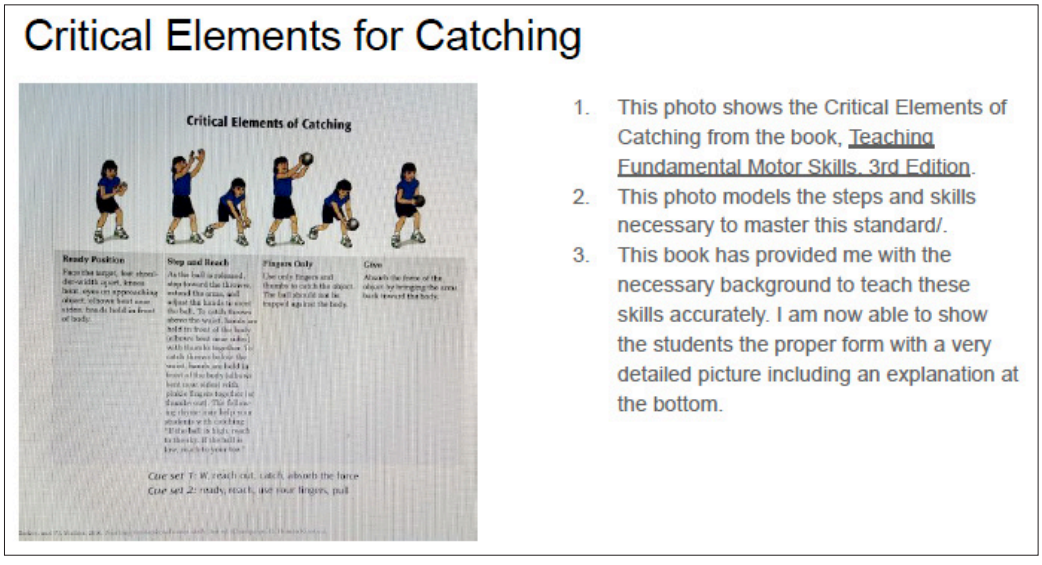

Figure 4. Bella's diary on using critical elements of catching to teach the skill

to practice the skills, and students were "enjoying the activity while they're learning that particular skill" (Bella, focus group 2). For instance, when teaching soccer dribbling, Bella started with "teaching dribbling skill, and then moved on to passing from 10 feet apart, and then 15 feet apart, and 20 feet apart" (Focus group 2). Similarly, Katie commented on the photos regarding chest passing in her visual diaries (see Figure 5):

This is just practicing passing with a partner, and for that, we use soft balls, because there were so many kids who were afraid of the ball. And in the second one, you can see how close they are together. And then the third one, the decision I made was to insist that they give each other more space in their past, I made sure that they stayed that distance away from the person that they were passing with. (Focus group 1)

Another notable change observed in teachers' practices was their newfound recognition of the diverse abilities of their students. They reported that they made some modifications to include students with varying skill levels. As Bella reported, "some of the kids are more advanced because they play Travel Ball or other sports and they know how to do it (throwing), and then some of the other kids that they are not being exposed to" (Focus group 2). Some teachers noted that the students with limited prior experience in sports faced more significant challenges when acquiring new skills. To facilitate these students' participation in class, teachers broke the skill into several sections and introduced peer teaching; for example, high-skilled students served as tutors to support their peers during skill learning.

Conducting Peer Assessment

The change in assessment the ECTs made was that they all started to employ peer assessment and developed rubrics to measure student learning. Katie reflected in her diary, "Students evaluated each other on the critical elements of the chest pass in our PE lesson. I have never done this before in teaching PE!" (September). These ECTs pointed out that students exhibited heightened engagement in class due to the awareness of being assessed. Figure 6 shows some rubric examples that those teachers used for peer assessment. Participants reported that students embraced peer assessment as students had the opportunities to collaborate with their peers, resulting in improving their skills and taking accountability for their learning. During the focus group interview, some teachers highlighted that they demonstrated the peer assessment procedure to

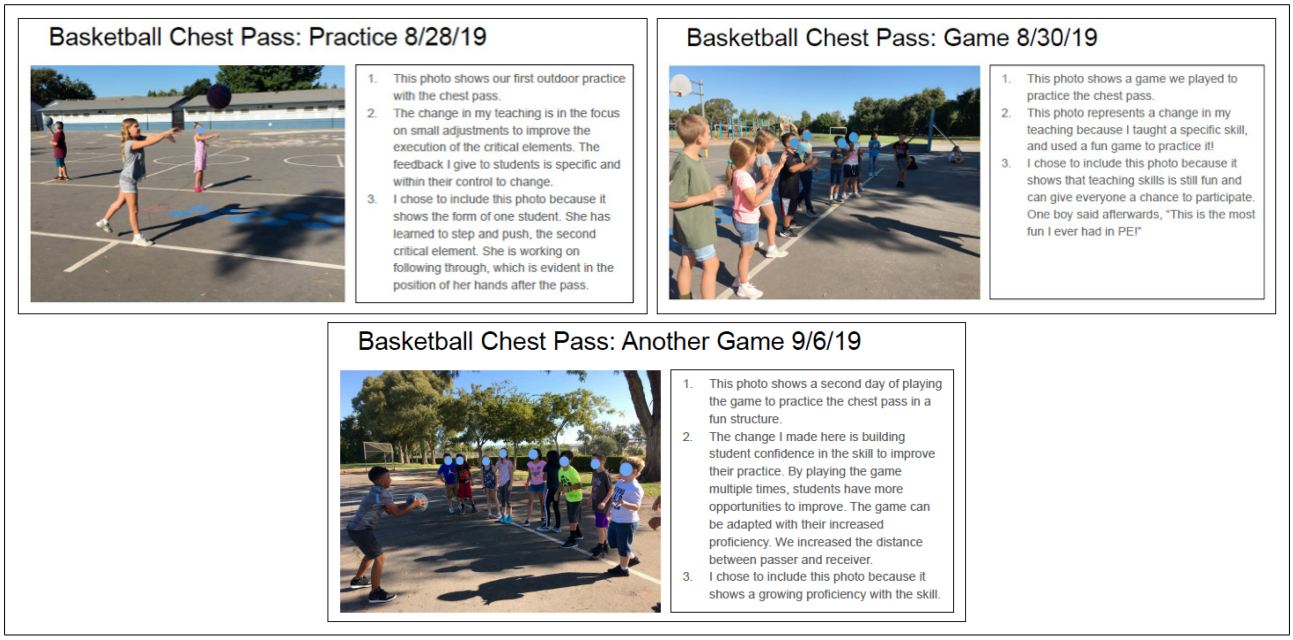

Figure 5. Katie's three lessons on basketball chest passing

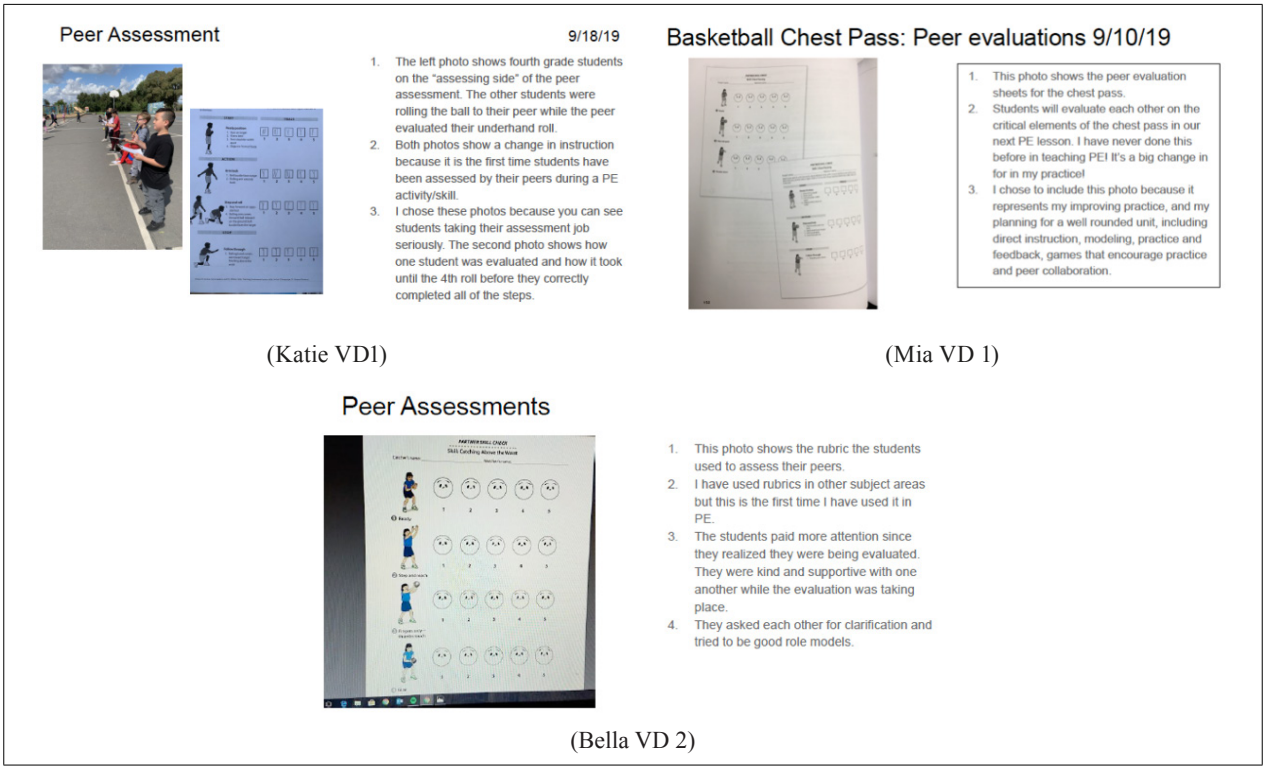

Figure 6. The diaries from multiple teachers regarding peer assessment

students and then had students practice it to ensure they understood how to measure their partners' performance. Besides, Bonnie added that having students provide specific feedback on their peers' performance can make peer assessment more effective:

I did a peer evaluation too but different from you (another teacher). I feel that I would have to give more explicit instructions on how to effectively evaluate the critical elements because I felt like the kids were just watching their friends pass and saying 'good job' rather than really identifying that one element. (Focus group 1)

Involvement in a Community of Learners: A Powerful Source of Change

Classroom teachers indicated that involving in the community of learners provided collaborative opportunities where they gained resources and ideas from facilitators, discussed their work within the learning community, and received support from one another. These ECTs emphasized that the ongoing and sustained support from facilitators and colleagues played an essential role in their changes in physical education teaching practices.

Teachers appreciated the learning opportunity in this CPD initiative because "we don't have support from our district" (Mia, focus group 1) and "when we go through the credential program, we learn a little bit" (Katie, focus group 1). The facilitators in this CPD initiative provided valuable resources and novel ideas for teachers concerning planning, instruction, and assessment in physical education. The book (Children Moving: A Reflective Approach to Teaching Physical Education) recommended by facilitators included lesson plan templates, teaching ideas, assessment tools, and grouping techniques, which helped to improve their teaching practices. Figures 4 and 6 represent their utilization of this book: Figure 4 shows critical elements of catching skills, and Figure 6 shows the rubrics for peer assessment. Katie reported that she gained various activity ideas and assessment techniques from that book while teaching new skills, "We're going to teach the skill. These are the activities we're going to

do to enforce the skill. This is something that we can use to assess it." (Focus group 1) Similarly, Bella added her insights on how the book is helpful:

It has really good lessons, and it has rubrics. And that helped me a lot because I don't have the background to create those rubrics. So that's been very helpful because he provides me with focus and I have some evidence for what to use tools (Focus group 1).

Teachers expressed a positive sentiment toward collaborating with their peers within the learning community where they received support. During these gatherings, the ECTs engaged in discussions about their teaching and student progress, addressing questions such as "How are your scores changing?" and "What's happening with that?" (Mia, focus group 1). Furthermore, some teachers indicated that they shared equipment with their peers who lacked sports equipment. For example, Bella said, "We share basketballs, soccer balls, and rubber balls." (Focus group 2) Teachers reported that they liked meeting together to work on unit and lesson plans to ensure the lessons were developed sequentially. As Katie said during the focus group interview:

For me, it was very helpful to have my peers with me because when I taught a few of the lessons and things were not working the way that I thought they should have been working I could brainstorm strategies on how to make it better and because we're all using the same book and the same ideas it was helpful, it was very helpful for our future lessons, that was very powerful for me to have somebody to work with.

Teacher Change: A Gradual Process

Teacher change is a gradual process; making changes takes time and is complex. Comparing the data collected during Phase I (between the initial workshop and the first follow-up workshop) and Phase II (between the first follow-up workshop and the second follow-up workshop), it is evident that changes in teachers' instructional approaches evolved distinctly during these two phases, with more pronounced shifts occurring over time. In Phase I, teachers primarily focused on adopting standards-based planning, teaching fundamental skills with critical elements, implementing peer assessment, and providing constructive feedback to enhance student learning. Transitioning to Phase II, teachers honed the techniques gained during Phase I and developed new teaching practices, including using peer teaching, creating progressive tasks, and incorporating equity in their classrooms.

Phase I: Between the Initial Workshop and the First Follow-up Workshop

The data analysis revealed that the initial CPD workshop helped teachers increase their knowledge, capabilities, and confidence regarding teaching physical education, as Mia reflected in her diary, "This photo shows my evolution from not knowing how to approach teaching PE at all to having a solid resource to use to help me learn, so I am, in turn, able to teach." The initial workshop delivered standard-based training, offering support, giving teaching resources, and developing a learning community for teachers. As a result, significant changes occurred between the initial workshop in the summer and the first follow-up workshop in the middle of the fall semester. These transformations took place in teachers' instructional practices, including the formulation of standards-aligned curricula, the integration of performance cues in skill instruction, the incorporation of peer assessment, and the proactive delivery of specific feedback to facilitate learning. For example, after the summer workshop, ECTs conducted peer assessments in their current classrooms when they used to "not have a skill assessment" (Mia, focus group 1) or "have an assessment that is not standards-based" (Katie, focus group 1). It should be noted that among these shifts, the most notable change in teachers' teaching during this phase was the adoption of standards-based planning as the Teaching Institute focused on motor learning in the context of standards-based physical education. Bonnie reported:

I have been doing PE for a very long time, but it's never been standards-based. I don't even know that I

knew that there were standards specific to each grade level. Because we didn't talk about that when I went through the credential program, even when I went through the PE class…never really talked about how and what skills they should be doing at each level. (Focus group 1)

Phase II: Between the First Follow-up Workshop and the Second Follow-up Workshop

In this phase, teachers strove to refine the teaching techniques obtained in Phase I, particularly emphasizing standard-based planning. Consequently, their planning with the national physical education standards was more authentic, leading them to incorporate lower grade level outcomes as many students required additional practice in fundamental skills. Furthermore, teachers incorporated standard five (i.e., the physically literate individual recognizes the value of physical activity for health, enjoyment, challenge, self-expression and/or social interaction) into their classrooms, exemplified by instilling dignity and respect. Some teachers delved more deeply into the standards and grade level outcomes during Phase II, fostering an in-depth understanding by unpacking these concepts alongside students. For example, Figure 7 shows two diaries from Mia: the left one was recorded in Phase I, and the right one was kept in Phase II. It is evident that in Phase I, Mia identified the grade level outcome to design the class, while in Phase II, she facilitated a student-led discussion about the meaning of this grade level outcome, aiming to help students comprehend the expectations surrounding dignity and respect.

Aside from refining the standards-based planning, new changes became evident between the first and second follow-up workshops, including conducting peer teaching to facilitate students' learning, designing tasks with progression, advocating for equity to include students with different skill levels, and having a lower level of anxiety. During the focus group interview conducted in Phase II, some teachers reported that their increased knowledge and skills reduced their anxiety levels in physical education. When asked what contributed to this decrease, Bella said, "Because I know more what to do. I have a structure that I didn't have before" (Focus group 2), and Katie added, "I agree, I think it's having the standards and knowing these are my goals. When you have that guide, I think that helps because you can focus on something." (Focus group 2)

4. Discussions

This study utilized visual methods to explore changes in ECTs' practices regarding physical education teaching throughout their participation in a state-funded, five-month-long CPD initiative. The results of this study indicated that there is a need for ECTs to receive additional specialist preparation in the field of physical education and more resources to support their teaching. Given the lack of knowledge and skills, most ECTs taught unstructured lessons with random content. Teachers in this study reported revealed feelings of incompetence and a lack of confidence in teaching physical education, which led to their anxiety about teaching this discipline. The state-funded CPD initiative provided initial

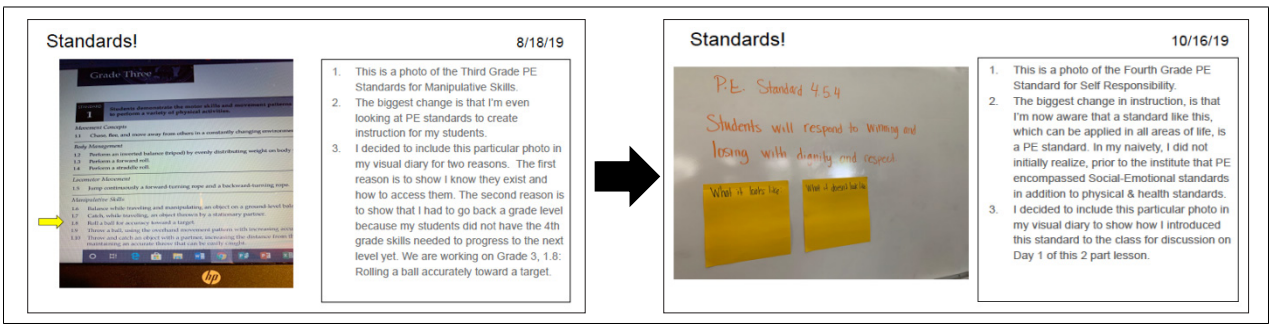

Figure 7. Comparing Mia's diaries in Phase I (left) and Phase II (right)

and follow-up workshops on standards-based physical education. These workshops employed a multifaceted approach, combining lectures, group work, individual tasks, and practical tasks. These learning opportunities increased teachers' knowledge and skills, aligning with the findings reported by McKenzie et al. (1997)[18] and Faucette et al. (2002).[9] Echoing previous studies (Faucette et al., 2002;[9] Morgan & Bourke, 2005;[20] Xiang et al., 2002),[32] the bolstering of teachers' knowledge and skills contributed to reducing their anxiety about teaching physical education. Thus, teacher CPD plays a critical role in developing ECTs' competence and confidence in teaching physical education (Lynch & Soukup, 2017;[15] Patton & Parker, 2015).[26] For ECTs who do not receive professional training in physical education during their undergraduate studies, pursuing standards-based and instruction-focused CPD can be a valuable strategy to address this gap.

Classroom teachers participating in this CPD initiative came to recognize the presence of national standards and grade-level outcomes within the subject of physical education, a central focus of this endeavor being standards-based physical education. By emphasizing the standards, teachers gained a clearer sense of purpose in designing the lessons, moving away from instructing based on personal preferences or student interests. Some teachers also started implementing standard five (i.e., the physically literate individual recognizes the value of physical activity for health, enjoyment, challenge, self-expression and/or social interaction) in their physical education classroom, aiming to foster holistic student development (Dyson, 2014).[7] Throughout the Teaching Institute, these teachers' approach to implementing standards evolved. Initially, they embarked on the process of unpacking standards independently. Over time, a shift occurred towards student empowerment, involving students in discussions about the standards and learning outcomes. Their alignment with the standards also prompted endeavors to offer developmentally appropriate activities and structured assessments within an organized framework. Thus, the impact of practical CPD workshops reverberated through teachers' instructional practices, inducing transformative shifts in lesson planning, delivery, and assessment. This impact proved especially pronounced for ECTs who faced initial inadequacies in physical education preparation (Darling-Hammond & McLaughlin, 1995).[4]

It should be noted that the focus of this CPD initiative was on standards-based instruction, given the ECTs' limited expertise in physical education. This highlights the significance of tailoring effective CPD programs to the specific needs of participants rather than adopting a one-size-fits-all approach. Effective CPD should position teachers as active learners instead of passive recipients of knowledge. This involves the creation of dynamic and interactive learning experiences that encourage engagement and social interaction, accompanied by sustained support for teachers (Desimone, 2011;[6] Faucette et al., 2002;[9] Morgan & Hansen, 2007;[21] Patton & Parker, 2015).[25] When designing CPD, trainers can seek teachers' input and understand their unique requirements to create personalized learning experiences (Morgan & Hansen, 2007).[21] For example, facilitators can utilize tools like questionnaires or classroom observations to discern the specific needs of ECTs, thereby informing the design of targeted CPD programs. These tailored CPD experiences are intricately linked to teacher engagement, teaching practice, and student learning, transcending the introduction of new concepts or equipment (Desimone, 2011).[6]

Additionally, providing resources is essential for ECTs to facilitate the transition of their teaching practices. While participants in this study recognized the significance of physical education in fostering students' physically active lifestyles, they encountered challenges in effectively implementing physical education instruction. This CPD initiative addressed this by furnishing valuable resources such as samples of lesson plans and adaptable templates for games. The Teaching Institute thoughtfully equipped participants with beneficial resources and reference materials, fostering a willingness among ECTs to

experiment with innovative concepts. This outcome resonates with Morgan and Hansen's (2007)[21] findings, which highlighted teachers' inclination towards using templates and examples over devising their own. Given these insights, CPD trainers can enhance their programs by offering practical resources such as lesson plan templates, creative physical activity ideas, effective classroom management strategies, and comprehensive assessment tools. By making such resources readily available, teachers can seamlessly integrate them into their teaching practices, driving impactful change within their classrooms.

Adhering to the model of teacher change, ongoing support leads to sustaining changes in ECTs' teaching. With guidance from facilitators and the collaboration of peers, these teachers not only refined strategies acquired during the initial workshop but ventured into new techniques over time. The learning community created by the CPD initiative served as a powerful platform in which teachers engaged in informal collaboration, fueling the change process (Parker et al., 2010).[24] This collaborative environment provided a safe space for teachers to experiment with novel classroom approaches and engage in open dialogues within the community. Notably, facilitators played a pivotal role by offering continual support, acting as consultants, and furnishing valuable resources. This collective effort ensured that teachers' professional growth remained an ongoing endeavor. Effective CPD goes beyond mere one-time training, emphasizing sustained support to facilitate continuous improvement in teaching practices. The amalgamation of structured CPD workshops and informal learning communities presents a robust framework, affording teachers ongoing support throughout their transformative journey.

Making changes is a time-consuming and challenging process, demanding a significant investment of time and effort (Parker et al., 2016).[25] The teachers in this study embarked on their journey by initiating alterations between the initial workshop and the first follow-up session. Subsequently, they engaged in a process of refining their novel teaching practices and acquiring additional strategies after the initial follow-up. The transformative process in teaching evolves gradually and is characterized by incremental steps. Teachers embark on this journey by taking modest strides, often experimenting with a few fresh ideas, implementing them in their classrooms, seeking peer input, refining their strategies, and then iterating. This iterative process underscores teacher change as a continuous growth and adaptation journey. For example, Bella learned about national physical education standards in the initial workshop and utilized the standards to design the lessons afterward. However, upon recognizing that her third-grade students were not yet prepared for the skills aligned with the grade-level outcomes, she opted to revert to the grade two outcomes, allowing her students ample practice time to attain readiness.

Implications

The following are the key implications of this study for designing CPD programs tailored to ECTs teaching physical education. These implications include addressing the knowledge gap, the importance of resources, tailoring CPD to needs, sustained support, and a gradual change process. These insights can also be extended to the design of CPD initiatives in various areas of education. By integrating these implications into CPD, teachers can be better equipped to enhance their teaching practices, thereby contributing to improved student learning outcomes.

Address Knowledge Gap. Classroom teachers without formal training in physical education can benefit from standards-based and instruction-focused CPD training. This approach provides ECTs with the essential knowledge, skills, and confidence to teach physical education effectively, thus addressing the shortcomings resulting from inadequate initial preparation during their undergraduate preparation. Closing this knowledge gap is a foundational step for individuals to acquire basic information for the field.

Importance of Resources. Providing ECTs with valuable resources, such as lesson plan templates, assessment tools, and instructional techniques,

significantly facilitates the implementation of new teaching practices. These resources enable ECTs to integrate innovative ideas into their classrooms and enhance student learning. Ensuring the availability of practical resources can be immediately applied is crucial.

Tailoring CPD to Needs. The study reinforces the importance of customizing CPD to address specific needs and challenges ECTs face. Acknowledging individuals as active learners and involving them in the design of CPD programs ensures a more personalized and practical learning experience.

Sustained Support. The role of ongoing support from facilitators and peers must be considered. A collaborative learning community allowed ECTs to continue improving their practices and seeking advice beyond the initial workshops. This enduring support is essential for maintaining and embedding changes in teaching practices over an extended period. Therefore, sustained support can enhance the potency and longevity of CPD impact on individuals.

Gradual Process of Change. This study highlights that teacher change is a gradual and iterative process. Teachers often begin with small changes and continuously refine their strategies based on feedback and experiences. This emphasizes the need for patience and perseverance to pursue effective teaching practices. In essence, the process of making changes unfolds gradually.

5. Conclusion and Limitations

This study indicates that ECTs who need more training in physical education teaching often experience deficits in their competence and confidence to teach this subject effectively. The CPD activities can potentially enhance ECTs' skills in planning and teaching practice, consequently boosting their confidence in teaching physical education. The CPD activities should tailor the contents and activities for ECTs and provide ongoing support throughout the process. One limitation of this study is that no data was collected to inform the influence of teacher CPD on students' learning outcomes. Future research can examine the impact of long-term CPD programs on changes in student learning performance and ECTs' attitudes and beliefs toward teaching physical education at elementary schools. Overall, the transformative journey in teachers' teaching is a gradual process that teachers should continue to seed CPD opportunities for their professional growth and student learning.

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ARTICLE

The Effect of Using Repair Strategies on Seventh-Grade Students' Writing Performance

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ABSTRACT

This study examined the potential effect of using Repair strategies on Jordanian EFL seventh-grade students' writing performance. A quasi-experimental design and two groups were employed. For this study, two full sections of grade seven from Al-Rashedia Secondary School for Girls were selected randomly. Thirty students were assigned as the control group and thirty students as the experimental group. The pre-/post-writing test was designed in order to fulfill the study's objectives. Furthermore, the experimental group received instruction using Repair strategies, whereas the control group received instruction using conventional methods of instruction suggested in the Teacher's Book. Results demonstrated that Repair strategies improved students' writing performance. The researchers recommended utilizing Repair strategies on different writing genres instead of traditional instructional writing strategies.

Keywords: EF; Jordanian Students; Repair strategies; Writing performance.

1. Introduction

People must acquire English as a second language in order to excel in the classroom and at work, as well as to comprehend and interact with other cultures. Building communication skills is crucial for students to succeed in an EFL environment and become fluent in the target language. This requires them to be proficient in both productive and receptive skills (Ivancic & Mandic, 2014).[17] Accurate language practice and acquisition are greatly aided by the integration of writing skills (Ibnian, 2010;[15] Omaggio, 2001).[31] Writing fluently is a fundamental communication skill that is valued as a distinctive benefit to the process of learning a foreign language in the classroom (MOE, 2006).[26]

Writing is described as the art of communicating

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ideas and feelings (Camahalan & Ruly, 2014).[8] Connecting and exchanging thoughts, viewpoints, remarks, and blogs is crucial for international communication (Bello, 1997).[6] Composing is necessary for everyday living as well as for the development of other language sub-skills like spelling, vocabulary acquisition, punctuation, idea communication, and the use of accurate grammar (Liu, 2013;[24] Olango & Geta, 2016).[29]

Both academic success and a wide range of career prospects need writing (Richards, Platt, & Weber, 1985).[35] Writing is an important cognitive exercise since it assesses memory, language proficiency, and critical thinking skills all at once. It improves the personality and sense of worth of learners while also serving as a means of evaluating their knowledge (Kellogg & Raulerson, 2007).[20] Writing effectively tests the ability to analyze, recall, and apply words, which makes it a significant intellectual task. It necessitates quickly retrieving topic-specific domain information from long-term mental storage. The act of writing allows one to synthesize fresh information with existing knowledge into a cognitive framework (Kellogg, 2001).[19]

Byrne (1988)[7] examines the several purposes of writing in education. Writing encompasses a wide range of learning strategies and criteria. It also gives instructional activities more variation. Depending on the circumstances, writing is usually needed for both official and informal assessments.

According to Starkey (2004),[40] an effective piece of writing should contain the following components. First, organization is crucial since it guides the reader and writer from the opening to the last sentence. The second quality is clarity, which can be attained by doing away with ambiguity, employing strong, specific adjectives and adverbs, using modifiers, and being brief by doing away with unnecessary words and duplication of material. Third, the selection of words: Writers should take into account two things when choosing words: connotation (writers should pay attention to positive or negative connection that most words naturally bring with them) and denotation (writers should be mindful of the words' exact meanings).

According to Fareed, Ashraf, and Bilal (2016),[12] EFL students struggle with word choice and producing grammatically correct, pertinent, cohesive, and coherent sentences. EFL teachers avoid writing assignments because they don't have enough writing experience, but if they put in the necessary effort with their students, they may conquer any obstacles (Rajesh, 2017).[33] In reality, writing is the final assignment that teachers assign; they mark errors in students' work with red marks. Writing calls on the integration and control of numerous processes, including memory, handwriting, thinking, organization, language, spatial skills, and even emotions (Singer & Bashir, 2004).[39] According to Erkan and Saban (2011),[11] writing proficiency is a prerequisite for academic success. However, writing in a foreign language presents a number of challenges for students as it is an active and practical skill.

One of the communication strategies used to resolve learners' writing problems is the Repair strategies. Repair is the process of addressing issues that arise during interactive language use (Seedhouse, 1999).[38] It improves one's capacity for critical thought and problem solving. The two most popular strategies in the realm of repair for second language learners are self-initiated language and repetition. Self-initiated writing, as defined by Ramos (2000),[34] is any writing that young people choose to produce for themselves, outside of what they are required to do for school, out of intrinsic interest and motivation. Self-initiated writing is a reflection of learners' experiences, abilities, perceptions, and motivations. Repetition can be described as the act of repeating or reproducing verbal or non-verbal actions created by oneself or another in communicative contexts. Repetition is the process of using words or sentences more than once in order to make a stronger impression on the reader. It is an important literary device that allows a writer or speaker to highlight specific aspects that they feel are important (Haniah, Sasongko, & Fauziati, 2020).[13]

Repair strategy is a broad concept or phenomenon. For all levels of EFL learners, it is the more generic

domain of occurrence that may be applied in a variety of educational contexts with an emphasis on communication as the primary learning objective (Schegloff, Jefferson, & Sacks 1977).[37] It is a crucial exercise for EFL learning and communication in both formal and informal settings (Kasper, 1985).[18] It helps students become aware of their writing mistakes and equips them with critical thinking and self-directed learning skills (Saadi, 2021).[36]

The Repair in language learning contexts has a significant impact on resolving speaking, listening, and hearing problems (Abusahyon, Singh, & Alzubi, 2022).[1] Furthermore, Repair is present at a variety of sequential positions, including the turn that follows the trouble source, the transition space that comes after the turn that contains the issue source, and the turn that precedes the trouble source (Lee, 2018).[22]

A lack of interest in writing is observed in Jordanian EFL classes, although the stakeholders have offered needed support (Bani-Hani, Al-Sobh, & Abu-Melhim, 2014).[5] Traditional techniques and summative, timed exams are still the norm, which might be to blame for the complaints of students' subpar writing abilities throughout elementary and secondary education (Obeiah & Bataineh, 2016).[28] Teachers, who teach English as a foreign language, are provided with textbooks and flashcards to assist them with their teaching duties. However, Jordanian students continue to struggle with weak writing abilities and other issues (Al- Abed Al-Haq & Sobh, 2010;[2] Al-Sawalha & Chow, 2012;[3] Toubat, 2003).[41]

2. Statement of the Problem

In light of the researcher's experience in teaching foreign languages in Jordanian schools, some seventh-grade students are unable to write English in a way that is coherent and properly formed. Furthermore, students' difficulties in academic writing are not just about structure and vocabulary, but also about how to convey and organize their ideas in a second language which leads to students' low motivation toward writing tasks. Listyani and Budjalemba (2020)[23] stated that many students in an academic writing class feel nervous and worried about their writing because students have various difficulties in the world of writing such as proficiency level, lack of motivation, and lack of knowledge.

In EFL context, writing is consistently regarded as one of the most challenging competencies. Writing is a difficult activity for most people who learn a second language because of particular psychological, linguistic, and cognitive factors (Byrne,1988).[7] Another problem encountered by students is the absence of the teacher's role in applying modern and innovative teaching strategies due to teachers' incompetence in teaching writing which causes students boredom in writing class and unwilling completion of their writing tasks. The teacher is very essential for students during their writing process and they are required to teach writing to the students effectively (Astrini & Ratminingsih & Utami 2020).[4] Regarding all of the problems mentioned above, it is significant to minimize students' deficiencies in writing and look at effective and practical strategies such as Repair strategies. The main purpose of this method is to overcome learners' writing challenges and arouse their interest and motivation during their writing tasks.

Purpose of the Study

The purpose of the current study is to investigate the potential effect of using Repair strategies (self-initiated language & repetition) on seventh-grade students' writing performance.

Question of the Study

The current study attempted to answer the following research question:

- Are there any statistically significant differences at ($\alpha = 0.05$) in the seventh-grade students' mean scores on the writing performance post-test that can be attributed to the teaching strategy (Repair vs conventional)?

Significance of the Study

This research significantly contributes to

improving Jordanian EFL seventh-grade students' performance in writing lessons by utilizing the Repair Strategies. Furthermore, the significance of this study derives from the need to train students in efficient instructional strategies that make it possible for them to deal independently with the problems they face in learning academic skills, specifically writing. Also, the findings of the study encourage teachers to implement such of these strategies due to their positive impact on students' writing performance.

Operational Definition of Terms

Repair Strategy: It is as a correction that applies the proper linguistic form in place of incorrect sentences. Also, the person who wrote the trouble source starts the repair process when errors are found (Schegloff et al. 1977).[37] In this study, the repair strategy is a path or technique in which seventh-grade students try to resolve writing problems during their writing tasks. Further to this, repair is one strategy that has been taught by the teacher to ignore writing errors and develop the effectiveness of their writing.

Writing Performance: "It is the ability to define an individual's thoughts effectively in writing is based on the individual's feeling of efficacy towards the skill which he/she acquires in his/her learning" (Nobahar, Tabrizi & Shaghaghi 2013, p.2117).[27] In this study, writing performance is measured by the writing post-test, based on the outcomes of some chosen units under the study in Action Pack 7.

Limitations of the Study

The following factors limit the outcomes of the current study:

1. The study's sample is restricted to female seventh-grade students learning English at Al-Rashidiya Secondary School during the first semester of 2023–2024. The study's findings may therefore be applicable to comparable samples or circumstances.

2. The examination lasted eight weeks. There might be differences in outcomes over various time periods.

3. In Jordanian public schools, the textbook is Action Pack 7 (modules 1, 2, and 3). Different texts and resources may provide various outcomes.

Review of the Related Literature

Following a review of educational literature, the researcher gathered the following studies that were instructive and pertinent to the investigation of Repair strategies.

Seedhouse (1999)[38] investigated the relationship between context and the organization of repair in the L2 classroom. The participants were EFL learners. The results showed that the repair strategy would have been more appropriate to interaction in a form and accuracy context than in a task-oriented context.

De Cock (2000)[9] investigated repetitive phrasal chunkiness in native speakers and advanced EFL learners' spontaneous speech and formal essay writing. The results showed that there are more frequently used sequences in speech than in writing but only up to a certain combination length because of the repetitive nature of unplanned speech.

Ramos (2000)[34] examined self-initiated writing practices of young urban adolescents to describe their conceptions and judgments of their self-initiated writing and the kind of writing they are asked to do for school. The participants were volunteers from the high school. The instrument was a survey. The results showed that the majority of the participants do write at their own initiative and they keep diaries, journals, stories, poems, songs, rhymes (or raps) and letters.

Perin (2002)[32] investigated the effects of task repetition on writing skills. The participants were upper-level developmental students. The results showed that the simple repetition of meaningful literacy tasks has the potential to facilitate learning in developmental education classrooms.

Indrarathne (2013)[16] examined the Effects of task repetition on written language production in Task-Based Language Teaching. Narrative tasks (picture stories) were used as the instrument of this study. The findings revealed that learners are likely to transfer their knowledge of discourse features related to a task when it is performed repeatedly.

Hidalgo and Ibarrola (2020)[14] analyzed the

effects of task repetition on collaborative writing EFL learners. The participants were learners who attended a Content and Language Integrated Learning program at a state school in the north of Spain. The instrument was a test. The results showed that less proficient native and non-native writers employ more repetition because less proficient writers lack the linguistic abilities and/or rhetorical strategies for developing supporting information.

Lu and Li (2023)[25] examined the effect of task repetition on linguistic complexity and accuracy in young second language (L2) learners' writing. The participants were Chinese teenager L2 writers of English. The instruments were pre-posttests. The results showed that task repetition was found to have differential influences on writers with different working memory and language aptitude capacities.

Elsayed (2023)[10] investigated the types of divergent repair strategies that a teacher uses at the tertiary level classroom to correct students' productions in academic writing online lectures. The participants were EFL learners. The instrument was classroom observation. The data revealed that the types of Repair strategies have a positive impact on students' production in academic writing. In addition, the most frequent strategy used is the other-initiation other-repair strategy.

Laila et. al (2023)[21] compared repair strategy variations in online learning in the university classroom during the COVID-19 pandemic in Indonesia, Algeria, and Iran. The participants were EFL learners. The results show that four different variations of repair strategies were used by lecturers and students in EFL university classrooms in Indonesia, Algeria, and Iran: self-initiated self-repair, other-initiated self-repair, self-initiated other-repair, and other-initiated other-repair, except the EFL university classroom in Indonesia, where other initiated other-repair was not used, and the most prominent variation was self-initiated self-repair.

Olatunji, Salihu and Iorhemen (2023)[30] examined the effect of Feedback and Repair Mechanisms in Selected English Essay Writing Classroom Discourse in Ilorin, Nigeria. The participants were Six Senior Secondary Classes II in Ilorin. The instrument was observation. The findings showed that student-self-made and fellow-learner-made repairs were outweighed by teacher-made repairs.

Concluding Remarks

Repair strategies have been shown to be important and effective as a teaching strategy by a number of studies (e.g., Seedhouse, 1999;[38] De Cock, 2000;[9] Ramos, 2000;[34] Perin, 2002;[32] Indrarathne, 2013;[16] Hidalgo & Ibarrola, 2020;[14] Lu & Li, 2023;[25] Elsayed, 2023;[10] Laila et al, 2023).[21] It was also revealed a limited number of research studies have been conducted on how Repair strategies affected college and high school students' writing skills. However, prior research demonstrated that Repair strategies significantly improved EFL students' general writing skills. In contrast to earlier studies, this one looked at how Repair strategies affected the writing skills of female students attending a public seventh-grade school. The goal of this study is to fill a gap in the literature on this topic.

3. Method and Procedures

Design and Variables of the Study

In this study, a quasi-experimental design was employed. The variable that was independent was Repair strategies. The dependent variable was the outcome of the students' post-test on their writing skills. Furthermore, the control group was taught using the teacher's suggested conventional teaching strategies, while the experimental group was taught using Repair strategies.

Participants of the Study

The study's participants are female EFL seventh-graders from Al-Rashedia Secondary School for Girls in Jordan. They were chosen purposefully. The first semester of the school year (2023/2024) saw the completion of this study. The researcher chose two of the four seventh-grade sections at random. Thirty students each are assigned at random

to an experimental group and a control group in the two sections. While the control group received instruction using the conventional methods of instruction recommended in the Teacher's Book, the experimental group was taught utilizing Repair strategies.

Repair Strategies-Based Instructional Program

This study's instructional materials are based on the writing exercises included in Action Pack 7's Student's Book and Activity Book (modules 1, 2, and 3). In order to give the participants in the experimental group writing instruction, the researchers redesigned these exercises using Repair strategies.

Procedures for Designing and Implementing the Instructional Program

The current program is implemented using the following procedures:

1. Recognizing the writing activities found in Action Pack 7's modules 1, 2, and 3.
2. Determining whether the writing activities in Action Pack 7's Student's Book and Activity Book allow the Repair strategies to be used.
3. Making these adjustments in accordance with the Repair strategies.
4. Determining the procedures that will be used in every lesson.
5. Setting aside enough time for every task.
6. Before delivering the targeted Repair strategies, give a pre-writing test to the control and experimental groups.
7. Presenting the experimental group with the focused Repair strategies.
8. After training them in it, teach students in the targeted tasks in accordance with the Repair strategies.
9. Using a post-test to gauge the students' writing proficiency following the implementation of the lesson plan.

Validity of the Instructional Program

To ensure the program's validity, the researchers showed it to a panel of experts in English curriculum and instruction. The jury was asked to review the program and let the researchers know if they had any thoughts or suggestions for the disseminated program.

Research Instrument

The pre-/post-writing test was designed with the study's objectives in mind. The following is the instrument's description:

The Writing Pre/Post-Test

Following a review of Action Pack 7's modules (1, 2, and 3) content analysis to ascertain the best ways to teach and assess writing skills, the researchers designed a pre-/post-writing test in which students were required to write an email, a brochure, and a short paragraph. The teacher then administered the test. The purpose of the pre-test was to gauge the students' writing proficiency and determine whether the control and experimental groups were equivalent. The post-test, which measured the efficacy of Repair strategies, was given at the end of the instructional program after the pre-test results had been adjusted for. The overall test score was 60, and it was scored according to five sub-skills in writing: ideas and development, organization, vocabulary, sentence structure, and mechanics (spelling, capitalization, and punctuation).

Correlation analysis was utilized to assess the test's construct validity. The Pearson Correlation Coefficients between the item score and the test's overall score fall between (0.55-0.93), according to the results. In addition, the test's test-retest and Cronbach's alpha coefficients were extracted. The findings showed that the test's test-retest coefficient was 0.91 and the test's Cronbach's alpha coefficient was 0.87. The reliability coefficients of the test surpass the threshold value of 0.70, indicating its validity and suitability for evaluating students' writing performance.

4. Results

The means and standard deviations of the pre/post test scores in the five writing subskills were computed in order to respond to the study question, as Table 1 illustrates.

Table 1 demonstrates that in each of the five writing sub-skills (ideas and development, organization, vocabulary, sentence structure, and mechanics (spelling, capitalization, and punctuation)), the experimental groups' post-performance is greater than the control group's mean post-performance.

To investigate the effect of the instructional strategy (Repair vs. conventional) on the linear combination of the five writing sub-skills after controlling the effects of pre-test scores, a one-way multivariate analysis of covariance (one-way MANCOVA) using a multivariate test (Hoteling's' Trace) was used, as shown in Table 2.

Table 2 demonstrates that there was statistical significance in the primary effect of the teaching strategy in a linear combination of five writing sub-skills. With a partial eta square value of.890, the instructional strategy was responsible for 89.0% of the variance in the linear combination of the five writing sub-skills. Table 3 displays the results of a follow-up univariate study (Follow-up ANCOVAs: Tests of between-subject effects) that was carried out because the instructional strategy's effect is statistically significant.

In all five writing sub-skills, Table 3 demonstrates that the experimental group's post-performance is statistically considerably greater than the control group's post-performance. The teaching strategy explained 68.2%, 65.9%, 78.2%, 74.2%, and 67.8% of the variance in ideas and development, organization, vocabulary, sentence structure, and mechanics, according to the partial eta squared values of .682, .659, .782, .742, and .678. Therefore, the vocabulary sub-skill saw the largest effect size from the instructional strategy, which was then followed by the sentence structure sub-skill, ideas and development sub-skill, mechanics sub-skill, and organization sub-skill.

Furthermore, Table 4 displays the means, standard deviations, and standard errors of the two groups in five writing sub-skills both before and after the pre-test scores were controlled.

Table 1: Descriptive Statistics of the Pre-Test and Post-Test Per-test of Five Writing Sub-Skills (per sub-skill)

Writing Sub-Skill	Group	Maximum score	Pre-test		Post-test	
			Mean	S.D	Mean	S.D
Ideas and Development	Experimental	12	4.50	.86	9.93	1.36
	Control		4.57	.77	6.37	1.13
Organization	Experimental	12	4.50	.90	9.80	1.35
	Control		4.63	.67	6.57	1.04
Vocabulary	Experimental	12	4.57	1.01	9.97	1.00
	Control		4.47	.57	6.60	.89
Sentence Structure	Experimental	12	4.73	1.17	9.70	1.12
	Control		4.77	.94	6.47	.90
Mechanics	Experimental	12	4.60	.93	9.77	1.22
	Control		4.60	1.00	6.70	.92

Table 2: Results of Multivariate Test (Hoteling's' Trace) for the Effect of Teaching Strategy on Five Writing Sub-Skills

Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Teaching Strategy	8.065	79.041	5.000	49.000	.000	.890

Table 3: The Effect of the Teaching Strategy on Five Writing Sub-Skills after Controlling the Effect of Pre-Test Scores

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Covariate- S1	Ideas and Development	1.505	1	1.505	.925	.341	.017
Covariate- S2	Organization	.502	1	.502	.343	.561	.006
Covariate- S3	Vocabulary	.488	1	.488	.548	.463	.010
Covariate- S4	Sentence Structure	.826	1	.826	.806	.373	.015
Covariate-S5	Mechanics	.306	1	.306	.243	.624	.005
Instructional Strategy	Ideas and Development	184.673	1	184.673	113.425	.000	.682
	Organization	150.012	1	150.012	102.418	.000	.659
	Vocabulary	169.250	1	169.250	190.064	.000	.782
	Sentence Structure	156.062	1	156.062	152.316	.000	.742
	Mechanics	140.150	1	140.150	111.376	.000	.678
Error	Ideas and Development	86.292	53	1.628			
	Organization	77.630	53	1.465			
	Vocabulary	47.196	53	.890			
	Sentence Structure	54.303	53	1.025			
	Mechanics	66.692	53	1.258			
Corrected Total	Ideas and Development	281.650	59				
	Organization	240.983	59				
	Vocabulary	222.183	59				
	Sentence Structure	216.583	59				
	Mechanics	208.733	59				

Table 4: Adjusted and Unadjusted Means of the Five Writing Sub-Skills

A Paragraph Writing Sub-Skills	Group	Unadjusted mean		Adjusted mean	
		Mean	S.D	Mean	S.E
Ideas and Development	Experimental	9.93	1.36	9.91	.234
	Control	6.37	1.13	6.39	.234
Organization	Experimental	9.80	1.35	9.77	.222
	Control	6.57	1.04	6.59	.222
Vocabulary	Experimental	9.97	1.00	9.97	.173
	Control	6.60	.89	6.60	.173
Sentence Structure	Experimental	9.70	1.12	9.71	.185
	Control	6.47	.90	6.46	.185
Mechanics	Experimental	9.77	1.22	9.77	.205
	Control	6.70	.92	6.70	.205

After controlling for differences in pre-test results, Table 4 demonstrates that there are still discernible disparities between the post-performance of the two groups on five writing sub-skills. Therefore, applying the Repair strategies improved the experimental group's post-performance in each of the five writing sub-skills: organization, vocabulary, ideas and development, sentence structure, and mechanics (spelling, capitalization, and punctuation).

5. Discussion

The results showed that the mean post-test scores of the experimental and control groups were statistically significantly different at (α=0.05), with the experimental group's students performing better

overall in writing than the control group. Repair strategies were used to improve writing performance in the five sub-skills (ideas and development, organization, vocabulary, sentence structure, and mechanics) as well as the overall writing performance.

For a variety of factors, Repair strategies may have enhanced the experimental group of students' post-test writing performance both overall and in the five writing subskills. One of the deciding factors may be the design of the instructional program based on Repair strategies. The instructional program was carefully created and given the go-ahead to be used in order to accomplish this aim. The writing assignments were thoughtfully set up by the researchers; the subjects were drawn from the curriculum, there was enough time allotted, and the exercises were brief and efficiently structured to generate more interesting subjects.

Another factor that may have helped students improve their writing performance is the way Repair strategies promoted teamwork. By highlighting individual differences, Repair strategies increased students' collaboration to accomplish assignments. To help students become more interested in the content they write, writing exercises that are suitable for both independent and group work were incorporated into the instructional program. By actively engaging in Repair strategies instead than merely listening to the teacher instruction, students were able to learn more.

Students' writing performance may have also benefited from Repair strategies' ability to place the teacher in close communication with each student as they work through the writing process step by step in the classroom. In other words, the teacher-student connection is mutually beneficial. Many students are attracted in this strategy of learning English since the teacher acts as a motivator, a leader, and an instructor. This is especially true when it comes to writing sessions.

6. Conclusion

Based on the discussion of the findings of this study, the following conclusions were made:

1. Participants' writing skills and participation in class activities were enhanced by an instructional program that focused on Repair strategies.

2. When Repair strategies were used in the classroom, particularly in writing skills classes, students' attention levels increased.

3. Students who took part in an instructional program focused on Repair strategies outperformed their peers on the post-test, indicating that Repair strategies enhance instruction and learning while expanding on the material covered in the MOE textbook.

Recommendations

Based on the findings of this study, some recommendations are presented as follow:

1. To assist students become better writers and to encourage engagement, communication, and peer and teacher feedback, EFL teachers are advised to utilize the current program.

2. It is advised that the MoE conduct seminars and workshops to provide teachers with the tools and knowledge they need to use Repair strategies in the classroom.

3. EFL textbook designs should incorporate exercises utilizing Repair strategies, especially for English language curricula for grade seven. Lessons on EFL writing skills are more engaging and fun with this feature.

4. Researchers are encouraged to carry out a variety of studies to look into how Repair strategies affect different grade levels.

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ARTICLE

The Impact of the Risk Perception of the COVID-19 Pandemic on College Students' Loneliness: The Mediating Role of Psychological Resilience

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ABSTRACT

In order to explore how universities provide psychological counseling work for college students, we investigated the relationships between and mechanisms behind risk perception, psychological resilience, social support, and loneliness. The study found that (1) The risk perception of the COVID-19 pandemic had a significant positive predictive effect on college students' loneliness. (2) Psychological resilience played a mediating role between the risk perception of the COVID-19 pandemic and loneliness. (3) Social support played a moderating role between the risk perception of the COVID-19 pandemic and loneliness. The results show that the risk perception of the COVID-19 pandemic both directly and indirectly affected college students' loneliness, the latter through psychological resilience, and that social support can regulate risk perception and loneliness; in other words, social support can reduce the negative impact of risk perception on loneliness. The research conclusions have practical guiding significance for preventing, intervening in, and alleviating college students' loneliness.

Keywords: COVID-19 Pandemic; Risk perception; Loneliness; Psychological resilience; Social support; College student

1. Introduction

In December 2019, COVID-19 began to spread rapidly around the world (Lima et al., 2020).[9] The World Health Organization designated the COVID-19 pandemic as a public health emergency of international concern (Liu et al., 2021).[12] This pandemic was the most serious public health emergency since the founding of the People's Republic of China. Its wide range and rapid infection rate and the difficulties in preventing and controlling the virus were unprecedented (Husky et al., 2020).[8]

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The COVID-19 pandemic not only seriously affected people's normal production and life, but research shows that it also led to psychological issues such as anxiety, depression, and loneliness (Zhao et al., 2021).[30] The strong infectivity of COVID-19 increased people's psychological stress levels, producing negative emotions such as anxiety, fear, and depression. In addition, new adaptability problems caused by the pandemic, such as factory shutdowns, student suspensions, university closures, urban management and control measures, the ability to detect nucleic acids, and so on, caused inconvenience, anxiety, and other psychological problems for everyone (Tang & Yang, 2023).[21] Some people stayed at home. With the passage of time, loneliness deepened, leading to negative emotions. Some people could not bear the pressure of life because they could not work to earn money, leading to self-injury and suicide. Others wanted to extricate themselves from the pain through excessive drinking, smoking, profligacy, playing games, and other behaviors, leading to a muddled life and even more emotional collapse, and possibly to serious criminal behavior. These psychological problems caused by the COVID-19 pandemic were encountered in various groups to varying degrees, and such problems were more prominent for college students.

According to survey data from the 2022 blue book on national depression, the number of people suffering from depression in China reached 95 million, among whom 50% were students in school (Zhu & Zhang, 2023).[33] On the one hand, the psychological problems of college students are more prominent (Sylvia et al., 2021).[20] The current group of college students is coming of age during a time of rapid change. Most of them are only children. The growing loneliness, a large amount of false information, serious complexity, the temptation of electronic entertainment, and so on lead to increasingly serious psychological problems among college students. On the other hand, college students' psychological state is not yet fully mature, and they lack experience in dealing with major emergencies. When emergencies occur, they will inevitably be afraid and anxious. The sudden pandemic situation forced college students to shift to close management and online teaching, which abruptly changed the pace of their life and learning and increased the pressure regarding their employment and postgraduate entrance examinations. This made it difficult for college students to adapt, and they experienced problems such as tension, anxiety, sleep problems, and fear of the coronavirus. These long-term psychological problems among college students will affect their physical health and the efficiency of their education and life, make interpersonal communication difficult, and lead to suspensions, withdrawals, and even suicide. College students are the future of the motherland and the hope of the society. The COVID-19 pandemic seriously affected their mental health. Therefore, it is necessary to explore the impact of pandemic risk cognition on college students' mental health and its internal mechanism to provide an empirical basis for managing their negative emotions and maintaining mental balance. In the past, scholars conducted a great deal of research on the overall mental health of college students, with less research being on the impact of the COVID-19 pandemic on negative emotions (Wang,C et al., 2022).[22] In view of this, this paper provides some theoretical guidance for the prevention, intervention, and mitigation of loneliness among college students and provides theoretical guidance for colleges and relevant education departments on mental health education by studying the impact of the risk perception of COVID-19 on college students' loneliness, along with the mediating role of psychological resilience and the regulatory role of social support.

2. Research Assumptions

Loneliness refers to an unpleasant feeling caused by the lack of some important quantitative or qualitative factors in personal social relations (Zhang, 2023).[31] In recent years, the development of the Internet and the pressure of life have led to the weakening of relationships between people.

People feel lonely, which has become a common phenomenon in society, especially among college students. College is a key period of life growth. Ensuring a healthy mental state helps to improve the enthusiasm of college students towards learning and life. Previous studies have shown that loneliness is closely related to autism, inferiority complex, depression, self-injury, and other issues. Loneliness can seriously affect an individual's mental health, leading to depression, and can affect learning and work efficiency. At the same time, loneliness can also have a negative impact on physical health. Long-term loneliness can lead to adverse reactions such as anxiety, insomnia, and palpitations, which affect people's health. The COVID-19 pandemic not only threatened people's lives, but also brought serious psychological problems. Loneliness is a problem worthy of attention. The psychological problems experienced by college students caused by the COVID-19 pandemic have been of significant concern to the state. The leading group of the Ministry of Education tasked with how to cope with the new coronavirus indicated that psychological researchers had to make judgments on the mental health of students so that schools at all levels could prepare a targeted response. Therefore, it was very important to explore the influencing factors and mechanisms of college students' loneliness in order to help prevent, intervene in, and alleviate loneliness.

Risk perception is an individual's subjective understanding of the risk of an emergency. The risk perception of the COVID-19 pandemic refers to the subjective judgment of the possibility of being affected by the pandemic (Ye et al., 2021).[28] Studies have shown that risk perception is an important factor influencing negative emotions. The COVID-19 pandemic elevated the risk perception of citizens. The perception that the COVID-19 pandemic could lead to unemployment and physical injury had a certain negative impact on people's emotions, especially regarding the measures taken to prevent and control the pandemic, such as sealing, isolation, and online teaching, which made college students unable to live and socialize normally, causing them to feel lonely. According to the hierarchy of needs theory, when individual social needs are not met, this causes emotional and social loneliness (Liu et al., 2023).[15] In addition, from the perspective of quality stress theory, the pressure brought by the COVID-19 pandemic may have activated a certain quality or susceptibility. The effect of this quality or susceptibility is psychopathological symptoms. The COVID-19 pandemic led to an increase in stress among college students, resulting in mental symptoms such as loneliness and depression. Therefore, the risk perception of the COVID-19 pandemic may be closely related to enhanced loneliness, so this study proposes hypothesis 1: The risk perception of the COVID-19 pandemic is significantly positively correlated with loneliness.

Resilience is a way of coping with stress. It is an individual's ability to recover from negativity and cope with sudden changes in the environment. Resilience is a protective factor that can effectively reduce the psychological and physical damage caused by loneliness. Most research on psychological resilience has been related to adversity. Natural disasters, wars, diseases, and other circumstances affect psychological resilience. As a major public health event, the COVID-19 pandemic also affected people's psychological resilience (Xu et al., 2021).[26] When dealing with loneliness caused by various factors, psychological resilience can play a positive role in maintaining stable mental health, allowing individuals to seek harmony. College students are in a critical period of academic, professional, and personal development, facing a variety of choices and decisions, so factors such as employment anxiety, risk awareness, and passive home anxiety caused by the pandemic were likely to affect their psychological resilience, and psychological resilience is significantly related to loneliness. Psychological resilience refers to the ability to adapt to adverse environments. The lower an individual's psychological resilience, the more their mental health was affected by the pandemic, and the lonelier they felt (Gu, 2015).[4] It can be seen that the risk perception of the COVID-19 pandemic reduced people's psychological resilience, and this reduced

psychological resilience led to enhanced loneliness. Based on the above, this study proposes hypothesis 2: Psychological resilience played a mediating role between the risk perception of the COVID-19 pandemic and loneliness.

Social support is material and spiritual help and care given by others when individuals encounter difficulties or emergencies. Relevant studies have shown that social support is an important factor affecting mental health, and the more social support an individual receives, the more conducive it is to promoting mental health (Hu et al., 2023).[7] During the COVID-19 pandemic, social support was an important indicator of college students' mental health. During the pandemic, the social relationships among individuals in a social support system, especially positive or negative relationships with parents and friends, interacted with the negative effects caused by other difficulties, which had beneficial or harmful effects on college students' ability to adapt. For example, college students without close friends were more sensitive, depressed, and lonely than classmates with close friends during the pandemic. In all intimate relationships, reduced support and concern from parents is the main factor causing overall psychological problems among college students. Relevant studies have shown that social support, an important factor in predicting loneliness, is negatively correlated with loneliness. The less social support an individual has, the higher the degree of depression and anxiety, resulting in a more profound experience of loneliness (Luo et al., 2016).[16] Therefore, social support could effectively adjust the relationship between the risk perception of the COVID-19 pandemic and loneliness; that is, social support could reduce loneliness by reducing people's panic and anxiety about the pandemic. Therefore, more social support could also reduce the impact of the risk perception of the pandemic on loneliness. Accordingly, this study proposes hypothesis 3: Social support may have regulated the impact of the risk perception of the COVID-19 pandemic on loneliness.

To sum up, there is a correlation between risk perception, resilience, and loneliness, but there is a lack of research on the relationship between the three and the role of social support. At the same time, there are few studies on the relationship between the risk perception of the COVID-19 pandemic and college students' loneliness in China and a lack of research on the impact mechanism of the risk perception of the COVID-19 pandemic on loneliness.

3. Method

3.1. Research Data Collection Instrument

This study used a survey to measure the social and emotional impact of the COVID-19 pandemic on college students.

3.2. Research Population Description

This study tested students at several undergraduate colleges in Hebei Province through a network questionnaire platform. A total of 650 questionnaires were distributed, and 582 valid questionnaires were collected, accounting for 89.54% of the total. Among them, 295 respondents (50.69%) were female and 287 (49.31%) were male, 139 (23.88%) were freshmen, 161 (27.66%) were sophomores, 148 (25.43%) were juniors, and 134 (23.03%) were seniors. The subjects' ages ranged from 18 to 24 years old, with an average age of 21.06 years old.

3.3. Research Tools

3.3.1. COVID-19 Pandemic Risk Perception Scale

The COVID-19 pandemic risk perception scale mainly refers to the research of Lin & Lagoe (2013) [10] and Yan & Wen (2020).[27] This scale has two dimensions and eight topics to investigate risk perception at the individual and social levels; examples include "The COVID-19 pandemic is closely related to me/the whole country", "I/ordinary people have the chance to be infected", "I/ordinary people will be very worried about being infected", and "I/the public think the pandemic is very serious." A 5-point Likert scale is used, in which 1 =

strongly disagree and 5 = strongly agree. The higher the score, the higher the awareness of the risk of COVID-19.

3.3.2 Loneliness Scale for College Students

This paper uses the third edition of the loneliness scale (UCLA) to measure college students' loneliness (Linda et al., 2023).[11] This edition of the scale has 20 items, including 11 forward scoring questions and 9 reverse scoring questions; examples include "Do you often feel harmonious with people around you?", "Do you often feel that no one knows you very well?", and "Do you often feel shy?" . A 4-point Likert scale is used for these items, where 1 = very little and 4 = frequently. The score represents the level of individual loneliness.

3.3.3 Chinese Version of Resilience Scale

The Chinese version of the resilience scale was revised and compiled by Xing et al. (2016) [25] according to the Connor–Davidson Resilience Scale , and has a total of 25 items in 3 dimensions: resilience (13 items), self-improvement/strength (8 items), and optimism (4 items); examples include "I can adapt to change", "I like challenges", and "I know where to ask for help". A 5-point Likert scale is used, where 1 = never and 5 = always. The higher the score, the higher the psychological resilience.

3.3.4 Social Support Scale

The social support rating scale compiled by Liu & Xiao (2002)[14] was used in this study. The scale consists of 10 items in 3 dimensions: objective support (3 items), subjective support (4 items), and utilization of social support (3 items); examples include "How many close friends do you have that can be supported and helped?", "In the past, when you were in an emergency, what did you use to get comfort and care?", and "When you were in trouble, how did you ask for help". The higher the score, the higher the level of social support.

3.4 Statistical Processing

In this study, SPSS software was used to carry out common method deviation test and correlation analysis on the collected data, and Stata software was used to carry out descriptive statistics and regression analysis on the data, and the mediation effect test and regulation effect test were carried out.

4. Results

4.1 Common Method Deviation Inspection

This study used the Harman single factor test method to test the common method variance of all items in the questionnaire (Bolin & Hayes, 2014).[1] As a result, three common factors with eigenvalues greater than 1 were extracted from the seven items, and the first common factor explained 20.03% of the total variation, which is less than the standard critical value of 40.00%. Therefore, there was no serious common method variance in the data of this study.

4.2 Descriptive Statistics and Correlation Analysis Among Variables

The results of variable descriptive statistics and correlation analysis are shown in Table 1. The average age and grade are 21.06 years and 2.48, respectively, indicating a relatively uniform distribution of age and grade among college students in the sample. The average score of pandemic risk perception is 23.88, and the standard deviation is 3.95. The results show that the level of risk perception among college students in the sample is relatively low, and the distribution of scores is relatively concentrated. The mean scores for loneliness, resilience, and social support are 49.98, 75.49, and 39.24, with standard deviations of 5.32, 6.77, and 6.48, respectively. These standard deviations are high, indicating that the data are relatively scattered. In addition, in terms of correlation, the relationship between the main research variables (gender, age, and grade as control variables) generally conforms to the assumptions of this study. Among them, the correlation coefficient between the risk perception of the COVID-19 pandemic and loneliness is 0.11, indicating a significant positive correlation. The correlation coefficient between risk perception and resilience is -0.21, indicating a

significant negative correlation, and the correlation coefficient between resilience and loneliness is -0.13, indicating a significant negative correlation.

4.3 Mediation Effect Test

The mediating effect of psychological resilience between the risk perception of the COVID-19 pandemic and loneliness controlled by gender, age, and grade was tested, and the results are shown in Table 2. The results of the t-test show that the risk perception of the COVID-19 pandemic significantly positively predicted loneliness, with t = 2.65 (β = 15, t > 2.576), and negatively predicted psychological resilience, with t = -5.07 (β = -34, t < -2.576). When both the risk perception of the COVID-19 pandemic and psychological resilience predict loneliness, t = -2.68 and the negative predictive effect of psychological resilience on loneliness is significant (β = -0.07, t < -2.576). The positive predictive effect of risk perception on loneliness is still significant, t=2.05 (β= 12, t>1.96). The mediating effect test shows that psychological resilience plays a mediating role in the prediction of loneliness by the risk perception of the COVID-19 pandemic.

Table 1. Descriptive Statistics and Correlation Analysis of Variables

	M	SD	1	2	3	4	5	6
1 Gender	-	-	-					
2 Age	21.06	2.02	0.00					
3 Grade	2.48	1.09	-0.03	-0.00				
4 Risk perception of COVID-19 pandemic	23.88	3.95	0.04	-0.06	-0.06			
5 Loneliness	49.98	5.32	-0.02	0.02	-.083*	0.11**		
6 Psychological resilience	75.49	6.77	-0.12**	0.00	0.03	-0.21**	-0.13*	
7 Social support	39.24	6.48	-0.03	0.05	0.01	-0.12**	-0.07	0.04

Note: Gender is a dummy variable (1 = male, 0 = female). ** Correlation significant at 0.01 level (two tailed); * correlation significant at 0.05 level (two tailed).

Table 2. Regression Analysis of Mediating Effect of Resilience

Regression equation		**Overall fitting index**			**Significance of regression coefficient**			
Result variable	*Predictive variable*	*R*	*R2*	*F*	*β*	*CI lower limit*	*CI upper limit*	*T*
Loneliness	*Gender*	0.13	0.02	2.90	-0.27	-1.13	0.60	-0.61
	Age				0.08	-0.14	0.29	0.70
	Grade				-0.38	-0.77	0.02	-1.87**
	Risk perception of COVID-19 pandemic				0.15	0.04	0.26	2.65***
Psychological resilience	*Gender*	0.24	0.06	8.72	-1.52	-2.59	-0.44	-2.77***
	Age				-0.03	-0.30	0.24	-0.22
	Grade				0.08	-0.41	0.58	0.32
	Risk perception of COVID-19 pandemic				-0.35	-0.49	-0.22	-5.07***
Loneliness	*Gender*	0.18	0.03	3.78	-0.40	-1.26	0.46	-0.91
	Age				0.07	-0.14	0.29	0.68
	Grade				-0.37	-0.76	0.02	-1.84**
	Psychological resilience				-0.09	-0.15	-0.02	-2.68***
	Risk perception of COVID-19 pandemic				0.12	0.01	0.23	2.05**

Note: * 1.645 ≤ t<1.96; **1.96 ≤ t < 2.576; *** 2.576 ≤ t.

4.4 Regulation Effect Test

The moderating effect of social support controlled by gender, age, and grade was tested, and the results are shown in Table 3. Together, the risk perception of the COVID-19 pandemic and social support significantly negatively predicted loneliness, with $t = -2.00$ ($\beta = -02$, $t < -1.96$), indicating that the predictive effect of risk perception on loneliness is regulated by social support. The test results show that social support plays a moderating role in the prediction of loneliness by the risk perception of the COVID-19 pandemic.

5. Discussion

5.1 Relationship Between the Risk Perception of the COVID-19 Pandemic and Loneliness of College Students

The results of this study show that there is a significant positive correlation between the risk perception of the COVID-19 pandemic and college students' loneliness; that is, the higher the level of risk perception, the stronger loneliness will be. Research shows that college students, who are in their late adolescence and early adulthood, are vulnerable to the external environment (Brandy et al., 2015).[2] Having interpersonal relationships is an important factor that affects loneliness. The main purpose of individual growth in adulthood is to establish relationships through social activities to avoid loneliness. According to the theory of personality time development, college students are in their infancy. If they do not have satisfactory social activities, they will lack a sense of security, resulting in loneliness. The outbreak of the COVID-19 pandemic led to college students' inability to socialize normally face-to-face, as they experienced a period of physical isolation from teachers, classmates, family members, and so on. If college students' social needs are not met in the critical period of growth, they will feel lonely (Ma et al., 2021).[17]

In the field of psychology, risk represents uncertainty, which means that individuals may feel hurt and threatened. College students worried that they or their relatives would be infected by the virus and experience its sequelae. They worried that elders with underlying diseases would have difficulty surviving. They worried that the pandemic would affect their employment and postgraduate entrance examinations and other opportunities related to their future. They worried that their families would not be able to work normally, and their income would be reduced. As a result, college students had a higher level of risk perception of the COVID-19 pandemic and thus had anxiety and experienced loneliness. At the same time, college students were often exposed to negative information about the pandemic released by the media and anxious information on the Internet, which was more likely to lead to loneliness. In addition, college students have high expectations for their own lives (Wang & Zhang, 2022).[24] Today's college students are experiencing a time of fast development, with rich leisure activities, entertainment projects, and relaxation

Table 3. Regression Analysis of Regulating Effect of Social Support

Regression equation		**Overall fitting index**			**Significance of regression coefficient**			
Result variable	*Predictive variable*	*R*	*R2*	*F*	*β*	*CI lower limit*	*CI upper limit*	*T*
Loneliness	*Gender*	0.17	0.03	3.29	-0.26	-1.12	0.60	-0.59
	Age				0.08	-0.13	0.29	0.72
	Grade				-0.37	-0.76	0.03	-1.83*
	Risk perception of COVID-19 pandemic ×				0.78	0.14	1.43	2.38**
	social support				0.32	-0.07	0.71	1.63
	Risk perception of COVID-19 pandemic × social support				-0.02	-0.03	-0.00	-2.00**

Note: * $1.645 \leq t < 1.96$; ** $1.96 \leq t < 2.576$; *** $2.576 \leq t$.

activities. Therefore, the pandemic not only had an uncertain impact on their work and life, but also did not allow them to relieve pressure through leisure and entertainment activities, resulting in excessive accumulation of pressure and loneliness. To sum up, college students' subjective risk perception of the COVID-19 pandemic led to a strong sense of loneliness, and the risk perception positively predicted the loneliness.

Loneliness will affect college students' mental and physical health. The long-term negative emotions caused by loneliness can lead to depression, autism, and even self-injury and suicide. Therefore, it is very important to reduce the impact of major public health emergencies. First of all, the education department and management department should implement targeted psychological intervention measures for different types of students to help them build a stress defense system and guide them to find useful resources when they are aware of the high risk and emotional changes, such as seeking help from relatives, friends, teachers, and organizations, so as to reduce their loneliness and prevent extreme behaviors. Secondly, when a public emergency occurs, colleges and students' parents should guide students to correctly understand the event and obtain relevant information from authoritative channels (Sun et al., 2022).[19] Colleges should provide students with official websites to obtain relevant information. Relevant social departments should strengthen their supervision of the network environment, severely punish publishers of false statements, prevent students from spreading false rumors, inflammatory statements, and other negative information, and provide true information (Mao & Jiang, 2023).[18] Finally, as independent individuals, college students should learn to adjust themselves, find their own adjustment methods in the face of pressure, find their own relaxation methods, improve their ability to deal with emergencies calmly and actively, and improve their ability to adapt to various changes in life (Zhang, et al., 2022).[32]

5.2 Mediating Role of Psychological Resilience

The analysis showed that psychological resilience played a mediating role in the risk perception of the coronavirus pandemic and the loneliness of college students. First, the risk perception of the pandemic negatively predicted psychological resilience. At the beginning of the outbreak of COVID-19, people all over the country were in a tense mood. College students' fear of contracting the virus rose sharply. Later, the prevention and isolation measures taken by the state to prevent the spread of the disease affected the normal lives of college students. In addition, the post-pandemic era may also involve employment pressure for college students, making their lives more difficult than expected. These perceptions of the high risk of the COVID-19 pandemic led to reduced psychological resilience (Gu et al., 2021).[5]

This study also found that psychological resilience negatively predicted college students' loneliness. On the one hand, the positive attitude inherent in psychological resilience, to a certain extent, allows individuals to deal with setbacks and improve their psychological energy, making them more capable of coping with emergencies, which promotes the development of mental health. After experiencing the negative impact of the pandemic, students with strong psychological resilience could more actively adjust their emotions and find ways to solve problems. They could use their positive attitude and the social support in their environment to deal with adversity and frustration to reduce the negative impact of the pandemic and reduce loneliness (Ye et al., 2017).[29] On the other hand, as an excellent quality, psychological resilience can directly reduce loneliness (Gu, 2015).[4] Therefore, psychological resilience is an important factor that enables college students to better adapt to a new environment (Liu & Wang, 2017).[13] Enhancing psychological resilience is very important to reduce loneliness. When facing loneliness, college students can effectively use "self-efficacy" to avoid the adverse effects and can enhance their psychological resilience so as to better maintain their mental health. This intermediary

model suggests that college students should reduce their loneliness by enhancing their psychological resilience and improving their ability to deal with setbacks.

The level of college students' psychological resilience is closely related to their mental health, environment, quality of will, and social support (Ding & Su, 2023).[3] First of all, college students can improve their psychological resilience through sports such as long-distance jogging. The physical and the psychological are interrelated. Sports can effectively exercise the body and make college students happy. Secondly, college students should strive to change their negative environment, stay away from those who often express negative emotions, and put themselves in a positive environment. In addition, schools should cultivate students' willpower, have the goal of cultivating their noble qualities in the whole educational process, and strive to play a positive role in classroom and extracurricular activities, school competitions, and so on. Schools should create a positive campus environment and improve students' willpower (Zhou, 2021).[34] College students should also try to look at problems from a positive perspective, be optimistic about difficulties and setbacks, and cultivate a positive attitude. Having a positive attitude is conducive to having an optimistic attitude toward environmental changes and sudden crises, which can improve their psychological toughness. Finally, psychological resilience can also be improved through social support. College students have little social experience, and they will inevitably be unable to cope with emergencies alone. If they get help from their families, friends, and society in terms of material or spiritual needs, they will find a certain direction to follow, and can gradually improve their psychological resilience.

5.3 Regulating Role of Social Support

This study also found that social support can play a moderating role in the relationship between risk perception and loneliness. There is a negative correlation between social support and loneliness; that is, compared with college students who receive more social support, among those who receive less social support, the risk perception of the COVID-19 pandemic had a more significant positive predictive effect on loneliness. When families, friends, schools, and society saw the negative impact of the pandemic on college students, they could fully understand their needs and provide help, alleviating their negative emotions. Especially in the worst period of the pandemic, students suddenly experienced isolation, school closures, and other prevention and control measures. At this time, social support buffered the negative impact of the fear of infection on their mental health, and they could obtain material support such as masks and disinfection supplies. Specific suggestions and guidance, psychological and physical care, and other social support can reduce loneliness. Social support can also help college students be optimistic and positive when dealing with emergencies, strive to adapt to sudden changes in their learning and living environment, and reduce the negative impact of emergencies, so as to reduce loneliness.

Social support refers to material and spiritual support from family, friends, and society. When surrounded by others, college students' loneliness will naturally decrease. This study further shows that social support can buffer the negative impact of emergencies on physical and mental health and can help maintain and improve physical and mental health, and the social support received by college students buffered the impact of the risk perception of the COVID-19 pandemic on their loneliness. Strengthening social support may be an effective way to help college students reduce their loneliness after experiencing a major public health emergency and can reduce the impact of emergencies on their mental health (He et al., 2014).[6] Therefore, universities, families, and society at large should pay attention to the mental health of college students, especially in the face of major public health emergencies or other sudden changes in the environment, strengthen the correct guidance for them, provide material and emotional help, and make them feel supported and not alone.

Strengthening social support means building a strong social support system. First, in the family aspect, it is necessary to create a healthy and happy family atmosphere for college students, maintain good communication, pay attention to giving them enough respect and care, and provide a sufficient sense of security and happiness, which is the basis for building a social support system. When individuals have a sense of security and happiness, their sense of loneliness will be reduced (Wang, D et al., 2022).[23] Secondly, in the school aspect, schools should create an upward and positive learning environment for students, strengthen communication between teachers and students, and set up peer counseling rooms to provide free psychological counseling services in order to prevent and intervene in loneliness. Schools should also provide more extracurricular activities to reduce students' loneliness by enriching their lives. Finally, in the social aspect, society should create a good and positive social atmosphere for students. Society can provide jobs for college students, guide them to correctly understand a pandemic, and provide subsidies for students with difficulties to reduce their risk perception, so as to mediate the effect of pandemic risk on loneliness.

6. Conclusion

This study explored the impact of risk perception on loneliness and the mechanisms of psychological resilience and social support. As a result of the research, we can draw the following conclusions: (1) The risk perception of the COVID-19 pandemic had a significant positive predictive effect on college students' loneliness; it had a significant negative predictive effect on psychological resilience, and psychological resilience had a significant negative predictive effect on loneliness. (2) Psychological resilience played a mediating role between the risk perception of the COVID-19 pandemic and loneliness. (3) Social support played a moderating role between the risk perception of the COVID-19 pandemic and loneliness. This study confirms that the risk perception of the COVID-19 pandemic not only directly affected college students' loneliness, but also indirectly affected loneliness through psychological resilience, and that social support can regulate the relationship between risk perception and loneliness; that is, social support reduces the negative impact of the risk perception of COVID-19 on college students' loneliness.

This study systematically investigated the mechanism of COVID-19 pandemic risk perception affecting college students' loneliness through psychological resilience, deepening the research on the impact of pandemic risk perception on loneliness and providing an empirical basis for the assertion that risk perception induces negative emotions. From the perspective of psychological resilience, this study revealed the mediating role of the impact of the risk perception of the COVID-19 pandemic on loneliness and verified the moderating role of social support in it. This provides a different way to address the mental health problems of college students clinically, that is, to pay attention to their psychological resilience, implement early intervention, and reduce their loneliness. The results of this study suggest that educators should pay attention to college students' mental health and provide social support as much as possible to reduce their loneliness and other negative emotions. In the process of reducing the loneliness of college students caused by public health emergencies, we can simultaneously improve the levels of social support (including material and spiritual support) and psychological resilience. Colleges should pay attention to students with weak psychological resilience relative to their peers and regularly provide in-class and extracurricular practical activities, and in the process gain as much recognition as possible, guide college students to improve their self-awareness and ability to adapt to environmental changes and cultivate a tough character in the face of difficulties to improve their overall psychological resilience in case of the occurrence of major emergencies.

This study still has some limitations. First, a self-assessment scale was used to measure risk perception, loneliness, psychological resilience, and social support

related to the COVID-19 pandemic. This self-reporting method is easily affected by subjective factors, and we cannot ensure that the results completely objectively and accurately reflect the real situation of the subjects. In future research, we can combine it with another rating scale as well as a projection test and use an implicit experiment to carry out a more comprehensive and accurate assessment of variables such as risk perception, loneliness, psychological resilience, and social support. Second, it is difficult to determine a causal relationship between variables by cross-sectional study. Future studies should use longitudinal research or an experimental design to verify the relationship between risk perception, loneliness, psychological resilience, and social support. Third, the conclusion of this study shows that there is a significant correlation between the risk perception of the COVID-19 pandemic and loneliness and that psychological resilience plays a mediating role, but how does psychological resilience affect loneliness? Does the risk perception of the COVID-19 pandemic affect loneliness through other mediators? These are questions worthy of further study.

Author Contributions

Conceptualization, Jinhui Ning; methodology, Le Han and Jinhui Ning; software, Le Han; validation, Shi Yin and Jinhui Ning; formal analysis, Shi Yin; investigation, Jinhui Ning; resources, Le Han; data curation, Le Han; writing—original draft preparation, Le Han and Jinhui Ning; writing—review and editing, Jinhui Ning; supervision, Shi Yin and Jinhui Ning; project administration, Jinhui Ning; funding acquisition, Jinhui Ning. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

The data presented in this study are available on request from the corresponding author.

Conflicts of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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ARTICLE

Drivers of Higher Education Rankings: A Case Study of Uzbekistan

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ABSTRACT

Uzbekistan is strategically focused on enhancing its international academic stature by exploring the determinants influencing higher education institution rankings. This study delves into the myriad factors shaping these rankings through qualitative interviews conducted with university authorities, local expert consultants, and the QS Consulting Team. Key determinants identified include the academic reputation of the university, research output, internationalization efforts, faculty development initiatives, and industrial collaborations. The findings underscore the significance universities place on robust research infrastructure, fostering international relations, and ensuring student success. While there is a shared vision among institutions, disparities exist in resource allocation and engagement in international collaborations. This comprehensive review of higher education in Uzbekistan not only contributes to rankings research but also holds potential to inform policymakers and educational administrators in enhancing the national education landscape. Recommendations stemming from this study include the development of a comprehensive government framework for internationalization, increased financial investment in education, fostering industry-academic partnerships, and promoting acceptance and diversity within universities. This paper offers specific policy and practice recommendations tailored to assist Uzbek institutions in enhancing, sustaining, and attaining global recognition. Its detailed analysis of how rankings influence institutional policies and strategic decisions serves as a valuable resource for stakeholders within and beyond Uzbekistan, facilitating a deeper understanding of how higher education rankings shape global academic benchmarks.

Keywords: Higher Education; International Rankings; QS Rankings; Thematic Analysis; Internationalization; Uzbekistan

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1. Introduction

The significance of higher education rankings transcends national borders, playing a pivotal role in shaping global perceptions of academic excellence and institutional quality. In an increasingly interconnected world, where students and scholars seek institutions with robust academic reputations and research capabilities, the relevance of higher education rankings cannot be overstated (Altbach & Hazelkorn, 2021).[2] These rankings serve as crucial decision-making tools for prospective students, educators, policymakers, and employers, influencing choices regarding academic pursuits, collaborations, and investments (Marginson, 2020).[23] Furthermore, they contribute to the competitiveness of nations in the global knowledge economy, driving innovation, talent attraction, and international collaboration (Marginson & van der Wende, 2021).[24] Thus, understanding the determinants and implications of higher education rankings in specific contexts, such as Uzbekistan, holds broader significance in the broader discourse on global educational excellence and competitiveness.

Since gaining independence in 1991, Uzbekistan has witnessed a notable improvement in the quality of higher education, particularly in vocational training (Ruziev, 2016).[32] However, the efficacy of the teaching staff responsible for delivering globally competitive education may be hindered by structural barriers such as administrative challenges and institutional constraints (Umarov, 2020).[33] Within this context, the nation's regulatory framework places significant emphasis on the global impact of higher education rankings, recognizing their role in driving university advancement and enhancing local competitiveness.

The education sector in Uzbekistan is undergoing a phase of globalization, evidenced by the growing influx of international students, the increasing recognition of educational institutions, and the proliferation of university rankings. Yet, like many other education systems, Uzbekistan faces the challenge of balancing modern advancements with the demands of the labor market (Khasanova et al, 2021).[15] Government funding for higher education, despite its magnitude, has raised concerns regarding the practical application of graduates' skills, and the effects of governmental adjustments aimed at improving post-secondary education remain mixed (Ruziev, 2016).[36]

Moreover, tourism and the introduction of new international educational systems have emerged as transformative agents (Umarov, 2020).[33] Yet, a critical gap persists in understanding the criteria considered in evaluating higher education in Uzbekistan and the role of the education system or business schools in this evaluation. Thus, this study aims to bridge this gap by establishing a nexus between the ranking system and educational performance in Uzbekistan.

In the quest to investigate the components of Uzbekistan's higher education rankings, this study addresses a significant research void, shedding light on the unique educational landscape of the country, which has often been overlooked in global higher education literature. Given Uzbekistan's increasing integration into the global arena and ongoing educational reforms, comprehending these components is imperative for enhancing the global academic standing of its higher education institutions.

As higher education rankings in Uzbekistan continue to evolve, this study examines various aspects, including ranking methodologies, the influence of institutional and financial resources, and the impact of student outcomes on institutional status. Higher education rankings in Uzbekistan are changing, hence this study examines their aspects. The study evaluates ranking officers' practices, financial and institutional capacities, and student performance metrics' impact on institutional status.

To ascertain the drivers that impact the rankings of higher education institutions in Uzbekistan, this study is guided by the following specific research questions:

a) What methods and criteria are used to determine higher education rankings?

b) How do institutional and financial resources influence higher education rankings?

c) How do student outcomes like graduation and employment rates influence university rankings?

d) What kind of challenges are faced by Uzbek universities that hinder their institution's progress?

Guided by specific research questions, this study aims to uncover the drivers shaping the rankings of higher education institutions in Uzbekistan and the challenges they face in progressing institutionally through qualitative research, specifically interviews. Beyond merely elucidating the factors underpinning the rankings of Uzbek higher education, this research endeavours to promote strategic development within the system. By examining Uzbekistan's role in the global education market, the study seeks to propose policies and practices that enhance educational quality and competitiveness, thereby contributing to scholarly discourse and advancing the global knowledge economy.

Nevertheless, the study is pivotal in unravelling the intricate web of factors influencing Uzbek higher education rankings. Therefore, illuminating relevant elements aims to empower policymakers and educational leaders to make informed decisions, fostering systemic improvements and bolstering the country's educational standing on the international stage.

2. Literature Review

The higher education rating question is complex and multi-faceted because several factors are involved in the determination of institution quality. The complexity of the mentioned factors lies in the conception of worthiness and quality in the context of higher education, whereby this issue can be subdivided into three parts (Abdurakhmanov, 2019):[1] The new role of higher education; The confinement of innovation by the requirements of learners and stakeholders; or The temptation to adopt the rankings as a tool for accelerating reforms. Improvements nevertheless may be related to several destructive consequences as well (Lugovskoy, 2020)[21] and marks a change in the university's reputation (Delgado-Márquez, 2012).[8] Global university rankings significantly influence higher education in Europe and possess the potential to profoundly alter the landscape (Erkkila, 2013).[9] Ultimately, Hrynkevych and Sorochak (2021)[12]emphasises the significance of enhancing the competitiveness of higher education to effectively oversee regional expansion, prioritising excellence, societal accountability, and economic efficacy.

2.1 Approaches (Methodologies) of Higher Education Rankings

Higher education ranking systems employed globally vary significantly, utilizing diverse assessment methodologies. Prominent examples include the Quacquarelli Symonds (QS) World University Rankings, the Times Higher Education (THE) World University Rankings, and the Academic Ranking of World Universities (ARWU).

The Times Higher Education World University Rankings utilize 13 performance metrics, categorized into teaching, research, citations, international outlook, and industry revenues. The aim of these metrics is to provide a comprehensive assessment of university excellence across various domains.

The ARWU, known as the Shanghai Ranking, evaluates research performance through six key parameters, categorized into academic achievements, research output, and citation impact. This ranking emphasizes scholarly contributions and global recognition.

Similarly, the QS World University Rankings utilize six indicators categorized into academic and employer reputation, faculty-student ratio, research citations, and international diversity. This approach offers a multi-dimensional evaluation reflecting diverse perspectives on university excellence (Bridgestock, 2021).[6]

2.1.1 Academic Reputation and Research Output

Multiple studies have been initiated to understand the correlation between the status of the academic institution in terms of prestige, research output, and rankings. Kuzhabekova (2018)[19] points out the role of research publishing in the world competition of universities, with the most concentrated focus on promotion-linked publication. Ghabban (2019),[10]

mentions that information and communication technology and international collaboration among organisations are the most crucial factors in being efficient for high research productivity and reputation. Walle (2015)[39] raises important questions in the operations of public credo rating; how to accurately rate article output and if it is at all possible to rate on the subject of public administration. Li (2022)[20] considers the academic reputation and the role of publications in university ranking. These studies confirm the principal importance of research, based on reputation and rankings, as well as a multi-faceted approach to university prestige.

2.1.2 Engagement with Industry and Alumni

The involvement of different stakeholders, which is mainly in the context of industry and alumni, has a massive effect on university rankings and graduate employment (Kinash, 2016).[17] Through this participation, students can give feedback and access to collaboration which leads to strengthening the quality of education (Crammond, 2019).[7] However, some feasible plans created by stakeholder groups could be a little different from the others (Kinash, 2016).[17] Through the diverse stakeholder expectations, the quality assurance system (Beerkens, 2017)[4] can metamorphose to become highly sophisticated, however, there is still a need for proper communication and being in unison (Whelan, 2010).[41]

2.1.3 Interiorization and Global Engagement

Through the involvement of intellect, expatriate staff, international students and faculty, the major force behind educating internationalization (Nyangau, 2018)[27] is assimilating internationalisation. There is a range of ways which give evidence for the existence of the institution which may include curricula internationalisation, exchanges, and recruitment of foreign staff and students among others. A defining characteristic of this trend can be found in the building of graduate skills, and global citizenship (Moir, 2018).[25] Internationalisation of higher education is commonly seen as a priority part of the development of higher education universities, and that is with a focus on mobility, scientific collaboration and remote learning (Vitenko et al., 2017).[37] This development is an intrinsic part of the process of preparing graduates for the requirements of the labour market and the information economy (Jeptoo, 2012;[13] Wit, 2020).[42]

2.1.4 Funding and Institutional Resources

Research often shows that financial and institutional resources have a very important influence on the position of education systems. Benito (2019)[5] gives attention to the role of public financing in university rankings and additionally, shows the extent to which the rankings affect many groups in the higher education industry. Jin (2007)[14] signifies the positive relationship between status and funding, both from subsidizing and government allocations. However, Kim (2018)[16] remarks that it may reduce resource allocation and the institution may put more privileges on non-educational activities. Platis (2017)[29] introduces the concept of rankings as a factor of resource problems requiring strategic decision-making and uncovering a correlation with institutions' reputation and prestige.

2.1.5 Inclusivity, Diversity and Sustainability

While Vught (2012)[38] and Barnett (2020)[3] underline the fact that these components are essential to identify with institutional values and to become responsible citizens, both scholars emphasize the necessity to consider such variables. Varga (2021)[36] and Moreu (2021)[26] attribute having the "inclusive" environment and "sustainability" of the diversity programmes, which depend on the behaviour change and assessment of the intervention by the stakeholders. Figure 1, signifies that only three of the universities from Uzbekistan have earned a place in the Sustainability Rankings 2024 made by Quacquarelli Symonds for the first time (QS Sustainability Rankings, 2024).[30]

2.2 The Context of Higher Education in Uzbekistan

One of the main goals of Uzbekistan's development has been the internationalisation of higher

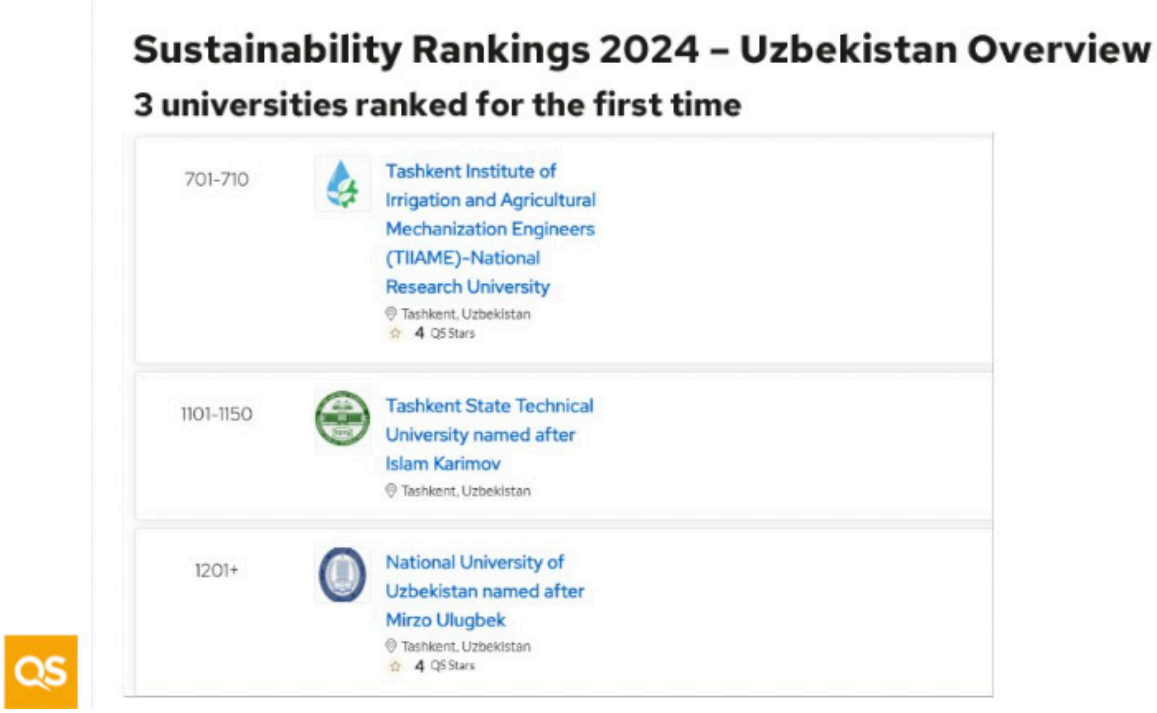

Figure 1. QS Sustainability Rankings 2024 – Uzbekistan Overview

Source: QS Sustainability Rankings, 2024

education (Uralov, 2020).[35] However, neither access nor quality have significantly improved because of the nation's top-down reform strategy. Major developments in this area include the growth of online and remote learning, as well as cross-border cooperation. There has been discussion about how university rankings support educational reform and competitiveness (Kurbatov 2012).[18] It has been noted that a trustworthy national university rating system is essential (Lugovyi, 2019).[22]

Therefore, the purpose of this research is to illustrate the method employed by the Uzbek universities that have achieved a place in the QS Asia Rankings. This paper identifies the major factors that influence higher education ranking in Uzbekistan by interviewing the QS consulting team and different university representatives. The objective is to identify the major aspects that contribute to the research ranking.

Although we manage to have 14 national universities featured in the QS Asia Rankings (QS, 2024),[31] there exists a large gap to fill when it comes to the global ranking of these universities. Internationally recognized ranking still proves to be elusive for Uzbek universities, which demonstrates bigotry between one region and the whole world. The objective of this research is to get rid of the existing gap by studying the techniques adopted by the universities that have already ranked internationally and analysing the role they could play in improving the worldwide rankings.

3. Research Methodology

3.1 Research Design

The research design for this study involved a qualitative method with a case study. Through this approach, we coped with numerous aspects that are specific to higher education rankings in the Uzbekistan context. The study was thus purposefully designed to capture specialists, professors, ranking bodies, and university administrators' points of view, attitudes and experiences. The research pursued an objective to elaborate upon the key factors that rank a university using qualitative content analysis and interviews and to unveil the strategies deployed by institutions to modify their position in ranking systems.

3.2 Participant Selection

Purposive sampling was employed to choose participants, ensuring that those with the required skills and experience could provide in-depth analysis (Wan, 2019).[40] The selection criteria included representatives from universities known for working hard to improve their rankings, as well as specialists with extensive understanding of Uzbekistan's higher education system and ranking systems. Six universities were interviewed in total: representatives from Tashkent State University of Economics (TSUE); Tashkent State Technical University named after Islam Karimov (TSTU); Tashkent Institute of Irrigation and Agricultural Mechanization Engineers (TIIAME)-National Research University (TIIAME NRU), expert`s view on Tashkent State Pedagogical University (TDPU), National University of Uzbekistan (NUUz), Jizzakh Polytechnical Institute (JizPI) and interview from the QS Consulting Team.

3.3 Data Collection Methods and Analysis

This study adopted a qualitative approach, specifically, interview to provide a comprehensive and coherent synthesis of all the impactful rankings on institutional policy, strategy development and Uzbek universities` accreditation and recognition in the world.

Thematic analysis was employed in the data analysis process (Herzog et. al, 2017)[11] which involved meticulously reading interview transcripts to seek trends and themes related to the study's goals. The analysis process included a manual case-by-case classification, and synthesis of the data to build a cohesive story about the factors driving Uzbekistan's higher education rankings. The data highlighted key themes on institutional methods, challenges, and the perceived impact of rankings on institutional actions and policy decisions.

3.4 Ethical Considerations

Following the ethical code, all participants were given a note that included the study aims, their role in the study, and their right to freely choose their participation in the study. Before the interviews were conducted, the testimonies gave their approval. The assurance was given that their responses would be personal and anonymous to openly participate, and they would be informed that they could withdraw from the study at any point if they wanted. To protect privacy, personal and institutional identifiers were either deleted or anonymized before revealing the results.

4. Results

4.1 Overview of Findings

The combination of interviews of the QS Consulting Team, University Representatives, and a Local Consultant give us an idea of how the various institutions in the higher education sector in Uzbekistan work using initiatives to improve institution rankings.

The analysis of Central Asian universities performed by QS Consulting Team experts determined that internationalization, research quality, and academic reputation are among the most significant variables to be considered. This process is not excluded for Uzbekistan's universities. Lifting a particular country's position in the rankings may lead to a better awareness and reputation, however, the problem of having to deliver courses in English and hiring both international students and faculty persists.

The QS Consulting team observes that Uzbek universities are now absent from global university rankings, with a score of zero. QS foresees potential future adjustments considering the significant worldwide growth observed among higher education institutions in Uzbekistan. Notwithstanding the present circumstances, there has been evident advancement in the Asia rankings, with a growing participation of Uzbek universities.

They observed that eight universities from Uzbekistan were included in the Asia rankings in 2023. In 2024, the Figure 1 has increased to fourteen, suggesting notable progress within the higher education sector of Uzbekistan. Furthermore, the fact that all of Uzbek universities have not yet made it to any international rankings calls into question the untapped potential of

this country which currently has 14 universities accentuated in the QS Asia rankings (Figure 2).

The growing representation of Uzbek universities in these rankings, along with the observed enhancements from the previous year to the present, is a promising indication. While not all universities that were previously listed have made significant progress, a considerable number have, and there are recently added institutions. Tashkent State University of Economics (TSUE) achieved the notable feat of being included in the top 500 rankings, as recognised by QS (Figure 2).

Figure 2. QS Asia Rankings 2024

Source: QS Consulting Team, 2024

Figure 3. Subject Rankings 2023- Uzbekistan Overview

Source: QS Consulting Team, 2024

In addition, QS (Figure 3) has noted the inclusion of new universities from regional areas, such as Karakalpak State University, as well as universities from Fergana and Jizzakh. This indicates a more extensive geographical presence in the rankings. Samarkand State University, being a well-established and long-standing university, is renowned for its steady academic achievements. In general, QS acknowledges and praises the advancements witnessed in the higher education sector in Uzbekistan according to the interview with QS Consulting Team.

The relative importance allocated to various criteria like the academic reputation, research production, student-faculty ratio, employability index and the participation of local and foreign students are factors that drive university rankings. Such plans are not merely 'wish lists' which include details such as quality research, building international relationships, working towards a better learning environment, and upholding inclusivity and diversity on campus. This demonstrates a complex balance between meeting immediate ranking demands and planning for long-term academic achievement.

According to the local expert, the existing ranking landscape does not always reflect the genuine level of higher education in Uzbekistan, with numerous projects seeking solely to improve their rankings. The local consultant emphasises the mismatch between theoretical objectives and practical implementations in higher education institutions, arguing for a more comprehensive approach that includes policy formulation, pedagogical excellence, and research integration.

NB: All other filed interviews on University Representatives; Expert`s Views on Other Uzbek Universities, and Interviews with QS Representatives are shown in the Appendices (see appendix case 1, 2, & 3)

5. Discussion

The path of HE excellence in Uzbekistan as expressed in the international rankings is a rather complicated issue since it depends on the country's overall socio-economic development. The results of interviews with university officials as well as the QS Consulting Team represent the pronounced strategy of all universities in the transformation to the internationally accepted standards and rules. This is achieved by recognizing the worldwide influence of HE ratings that function as a thermometer of academic quality and institutional reputation.

The literature emphasizes the complexity of HE rankings which depend on a wide range of influential factors including academic reputation, research output, dedication to the expansion of internationalistic education, and university-industry-alumni cooperation (Vught, 2012;[38] Kurbatov, 2012).[18] These components correlate with the remarks made by the university representatives, who stress the key aspects, namely, the presence of scientific potential, participation in research activities and faculty development, as well as international collaborations, that may determine the position of HE institutions in Uzbekistan in the given ranking.

5.1 Thematic Analysis - Similarities and Differences

Similarities Between University Groups

Integration of Global Standards

The interviews of the university representatives from the Uzbek universities depict a similar opinion about the application of global standards and internationalization issues which is highlighted in the literature review that identifies the importance of academic mobility and global involvement (Nyangau, 2018;[27] Moir, 2018).[25] In the context of TSUE and TIIAME NRU, there is an evident effort to raise the quality of education by inviting more foreign teachers to participate in international Olympiads, which indicates a strategic adoption of global educational practices.

Emphasis on Research and Academic Reputation

As illustrated by research (Kuzhabekova, 2018;[19] Ghabban, 2019)[10] all universities claim that the research output and academic reputation are the most important criteria to measure university performance. The approach of universities such as TSTU which

involves funding of research infrastructure and interactions with high-performing international institutes, is consistent with the thought that enhanced research capabilities and networks increase the university's global reputation and rankings.

Stakeholder Engagement and Graduate Employability

The practical measures TSTU and TSUE have been making to enhance the contacts with industry and boost the employment of university graduates indicate an agreement with the literature on the topic of stakeholder involvement effect on university performance (Kinash, 2016;[17] Perkmann, 2010).[28] This is further supported by the fact that a university being able to build up its ranking and popularity because of alumni networks and industry partnerships is an important measure of credibility.

Differences Between University Groups

Resource Allocation and Strategic Planning

Institutional commitment to increase their ranking position is a shared goal, while the approaches to resource allocation and strategic planning differ among these institutions. The strategic planning of TSTU is holistic, and the resources are well-targeted on specific issues, as proposed by Platis (2017),[29] to discuss the factors that can help in the improvement of rankings. On the other side, several institutions are still facing problems with the allocation of resources, which in turn can relate to one of the remarks by the local consultant - the government money is not always used properly. The local rivalry and lack of internal academic cooperation reflect the opposite of the global academic communion efforts.

Transparency and Data Utilization

An important difference in how higher institutions operate is visibly revealed in the way they employ and present the performance data on student outcomes. TSTU and TIIAME NRU illustrate open tracing of graduation and employment rates through the method that follows the requests for improvement of data management in higher education ratings (Bridgestock, 2021).[6] Nevertheless, the absence of systematic data generation and reporting from other institutions implies an unwillingness to be transparent and show that this system is not developed there.

Addressing Research Challenges

An important difference in how higher institutions operate is visibly revealed in the way it employs and present the performance data on student outcomes. TSTU and TIIAME NRU illustrate open tracing of graduation and employment rates through the method which is by the requests for improvement of data management in higher education ratings (Bridgestock, 2021).[6] Based on the data of alumni feedback, the use of TIIAME NRU can have an impact on rankings too since it follows the idea applied in best practices for continual program enhancement (Crammond,2019).[7] Nevertheless, the absence of systematic data generation and reporting from other institutions implies an unwillingness to be transparent.

5.3 Practical Implications for Policymakers and Higher Education Institutions

Strategic Internationalization

Uzbekistan's higher education internationalization strategy should encompass multidimensional initiatives beyond student mobility. It should prioritize curriculum development, research partnerships, and faculty exchange programs. Building a global mindset among students and staff is imperative, integrating international education standards and fostering an academic culture valuing diversity and global citizenship. Establishing international offices to handle collaborations with foreign institutes, research projects abroad, and cultural events is essential. Creating joint degree programs with foreign institutions enhances graduate employability and elevates Uzbekistan's global academic reputation (Jeptoo, 2012).[13]

Enhanced Research Culture

Developing a robust research culture in Uzbek universities requires innovation support, interdisciplinary collaboration, and recognition for outstanding student performance. Establishing research teams

and centers of excellence addressing critical national and global issues amplifies research significance and scope. Providing researchers with modern equipment, financial support, global networking opportunities, and mentorship fosters competitive abilities. Workshops on academic writing and grant applications further enhance researchers' global competitiveness. Exploring open-access publications increases research visibility and impact, crucial for global university performance assessment (Li, 2022).[20]

Industry-Academia Synergy

Close collaboration between academia and industry aligns education with evolving labour market demands. Uzbek universities should engage industry partners in curriculum development, emphasizing practical skills and problem-solving. Establishing industry advisory boards and internship programs enhances students' real-world experience. Encouraging lecturers to conduct industry-supported research fosters innovation and economic growth. Strengthened industry ties ensure graduates possess in-demand skills, enhancing employability and university reputation (Kinash, 2016).[17]

Inclusivity and Diversity

Uzbek universities must move beyond mere policy statements to enact concrete projects fostering community among diverse members. This entails recruiting students and staff from varied backgrounds, providing financial aid to marginalized groups, and organizing cultural events showcasing institutional diversity. Mandatory cultural responsiveness and anti-discrimination training for all staff create a supportive environment. Diverse student demographics enhance the teaching-learning process, preparing students for a globalized world (Moreu, 2021).[26]

Transparent Quality Assurance

Uzbek universities must prioritize transparency in quality assurance to build trust in educational offerings. Timely dissemination of student performance, teacher competencies, and research outcomes fosters accountability. External accreditation serves as a quality benchmark, supplemented by student and alumni feedback for continuous improvement. Implementing self-assessment and accountability mechanisms enhances teaching, research, and governance practices, elevating institutions' quality, and rankings (Beerkens, 2017).[4]

Enhancing Sustainability in Higher Education

Sustainability should guide Uzbekistan's higher education development. Universities should integrate sustainability into curriculum, research, and campus operations. This includes developing academic programs in environmental studies, conducting sustainability-focused research projects, and adopting green campus practices like energy conservation and waste reduction. Engaging with neighbouring communities spreads the message of sustainable development. Aligning with UN Sustainable Development Goals and sustainability rankings enhances institutional environmental features and global recognition (United Nations, 2023).[34]

6. Conclusion

The exploratory study delved into the factors shaping higher education institution rankings in Uzbekistan. Interviews with university representatives, local experts, and insights from the QS consulting team revealed the multifaceted nature of rankings. Key factors include academic reputation, research output, internationalization, faculty development, and industry collaboration. These areas serve as competitive advantages for Uzbek universities globally.

This study enhances understanding of higher education rankings in Uzbekistan, contributing a nuanced perspective to the academic literature. By examining strategies employed by Uzbek universities, it elucidates the complexities of global ranking systems. Providing detailed insights and solutions aids in achieving international recognition and excellence.

6.1 Limitations and Suggestions for Future Research

Though this research represents an initial step in understanding and enhancing Uzbekistan's global

academic reputation, it aims to inform policymakers and university leaders, contributing to the nation's academic and economic advancement.

While the report offers new perspectives, it relies heavily on qualitative data from a limited number of institutions and expert consultants. Future research could adopt a mixed methods approach to provide a more comprehensive understanding. Quantitative data can complement qualitative insights, enhancing the study's validity.

Exploring the influence of cultural elements on ranking strategies and conducting longitudinal research to track institutional progress over time are potential avenues for further investigation. These approaches offer a more nuanced understanding of Uzbekistan's higher education landscape.

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Appendices

Appendix 1 – Analysis of Case 1: University Representatives

Question 1: In your opinion, what are the main factors that impact the rating of higher educational institutions in Uzbekistan?

TSUE:

"The main factors influencing the rating are scientific potential, scientific research works, projects, professional development of professors and teachers abroad, involvement of foreign teachers in classes, the level of satisfaction of employers and quality of personnel, and participation of students in international Olympiads."

TSTU:

"Government Rankings:

National Ranking by the Ministry of Higher and Secondary Specialized Education: This ranking considers factors like:

- *Educational Quality: Faculty qualifications, student performance, graduation rates, and curriculum relevance.*
- *Research Activity: Research funding, publications, patents, research collaborations.*
- *Infrastructure and Facilities: Modernization of buildings, libraries, laboratories, and technology resources.*
- *Internationalization: Exchange programs, collaborations with foreign universities, and student mobility.*
- *Social Impact: University's contribution to the community, and social responsibility initiatives.*
- *International Rankings:*
- *QS World University Rankings: Considers factors like academic reputation, employer reputation, faculty-student ratio, research citations per faculty, and international-student ratio.*
- *THE World University Rankings: Like QS, but also includes research income, teaching reputation, and international outlook.*

Additional Factors:

- *Accreditation: Accreditation by national and international bodies ensures quality standards.*
- *Alumni Network: Successful alumni can boost their reputation and attract talent.*
- *Industry Partnerships: Collaboration with businesses enhances the employability of graduates.*
- *Student Satisfaction: Positive student experiences and feedback can influence rankings."*

TIIAME NRU:

"Improving the quality of education in HEIs.

- *Inclusive education, improvement of conditions created for students with disabilities, allocation of various scholarships.*
- *Increasing the quality and weight of the work carried out in harmony with the goals of sustainable development of the UN.*
- *Creation of necessary infrastructure for carrying out scientific research, provision of scientific laboratories and centers with modern equipment and facilities.*
- *Increasing the quality, number, and effectiveness of scientific research.*
- *Increasing the scientific potential.*
- *Expansion and strengthening of international cooperative relations.*
- *Increasing the number of foreign students.*
- *Increasing the number of foreign professors and teachers.*
- *Increasing international grants, projects and investments.*
- *Increasing international exchange and joint programs.*
- *Emergence of leaders and personalities in the field of science from the university.*
- *Expansion and strengthening of cooperative relations with industry, stakeholders and employers.*
- *Increasing employment rate of graduates.*
- *Development of infrastructure related to modern educational buildings, library, sports complexes, health care, dormitories and catering.*
- *Greening the university.*
- *Creation of conditions for the use of clean energy, and a friendly attitude toward the environment on the territory of the university.*
- *Implementation of active social events, etc."*

Question 2: What strategies does your institution employ to allocate resources and enhance its ranking?

TSUE:

"The level of training of teachers abroad has been increased."

TSTU:

"Prioritization:

- Strategic Planning: Tashkent State Technical University likely has a strategic plan outlining its vision and goals, including improvement in rankings. This plan would prioritize key areas based on their potential impact on rankings and alignment with the university's overall mission.
- Data Analysis: The university likely analyzes data from various sources, including government rankings, international rankings, student surveys, and alumni feedback, to identify areas needing improvement.
- Strengths and Weaknesses: Based on the data analysis, the university identifies its strengths and weaknesses compared to competitor universities. Resources are then prioritized towards addressing weaknesses with the highest potential for improvement in rankings.
- External Benchmarking: The university might benchmark itself against other leading universities in Uzbekistan and internationally to identify best practices and areas for improvement.

Resource Allocation:

- Faculty Development: Investing in faculty training, research opportunities, and international collaborations can improve academic reputation and research output, contributing to rankings.
- Infrastructure and Facilities: Upgrading laboratories, libraries, and technology resources can create a more attractive learning environment, potentially improving student satisfaction and employability.
- Internationalization: Increasing international student exchange programs and faculty collaborations can boost the university's international outlook, reflected in rankings.
- Student Support Services: Investing in career counseling, scholarships, and mental health resources can improve student satisfaction and graduation rates, both factors considered in rankings.
- *Marketing and Communication: Effectively communicating the university's achievements and strengths to relevant stakeholders can raise its profile and attract talented students, potentially impacting rankings."*

TIIAME NRU:

"Our university is focusing on almost all the criteria mentioned above. This includes improving conditions for scientific activities and research by modernizing existing laboratories, establishing modern labs, purchasing necessary equipment, and recruiting top researchers, professors, and teaching staff. We also aim to create favorable conditions for them and reward the most active researchers. Other efforts include upgrading the library, improving conditions for inclusive education, strengthening international cooperation, attracting large investments, and promoting environmental sustainability within the university etc."

Question 3: Do you think the current ranking system in Uzbekistan effectively reflects the quality of higher education?

TSUE:

"No response was provided."

TSTU:

"Strengths of the ranking system:

- Provides a framework for comparison: Rankings offer a standardized way to compare universities based on specific criteria, which can be helpful for students, parents, and policymakers.
- Highlights areas for improvement: By identifying strengths and weaknesses, rankings can encourage universities to focus on areas needing improvement.
- Promotes competition and innovation: Ranking systems can incentivize universities to strive for excellence and adopt innovative practices.

Weaknesses of the ranking system:

- Oversimplification: Rankings often use a limited set of metrics, which can fail to capture the full picture of the university's quality, such as teaching quality, student support, and community engagement.
- Methodological biases: Different ranking systems have different methodologies and weightings, which can lead to biased results depending on the chosen criteria.
- *Focus on prestige: Rankings can create an unhealthy obsession with prestige and attract students based on reputation rather than individual needs and fit."*

TIIAME NRU:

"Yes, indeed. In my opinion, the QS and THE rating systems are not exclusive to Uzbekistan but rather encompass rating systems that incorporate the requirements of all countries for their higher education institutions and consolidate them into a unified system."

Question 4: How does your institution track and measure student outcomes, such as graduation and employment rates?

TSUE:

"Monitoring is carried out according to directions."

TSTU:

"Measuring and Tracking Student Outcomes:

Employment Rates:

- Graduate Surveys: TSTU likely conducts surveys of graduating students after a specific period (e.g., 6 months, 1 year) to track their employment status, job titles, and salaries.
- Employer Partnerships: Collaboration with companies hiring TSTU graduates can provide data on employment rates in specific industries and fields.
- Government Data: National statistics might track graduate employment rates across different universities, offering a broader comparison.

Graduation Rates:

- Internal Records: TSTU likely maintains records of student enrollment, progress, and graduation rates by program and cohort.
- Ministry of HE Data: The Uzbekistan Ministry of Higher and Secondary Specialized Education might collect and publish graduation rate data for all universities.
- National Reports: National reports on HE may include national and university-specific graduation rate data."

TIIAME NRU:

"TIIAME NRU conducts monitoring of student placements from the previous academic year at the outset of each new academic year (September to November). This task falls under the purview of the Department of Marketing and practice of students, with university staff actively participating and studies conducted across various regions. A dedicated report, also referred to as a reference, is compiled for each student, consolidating the employment outcomes of university graduates. Moreover, the university is conducting surveys of graduates to gather data on their employment status, job satisfaction, and career paths annually. The university is focusing on the establishment of alumni networks to stay connected with graduates and track their career trajectories."

Question 5: How does your university use rankings to appeal to prospective students and faculty?

TSUE:

"No response was provided."

TSTU:

"Prospective Students:

- Highlighting Strong Rankings: TSTU's website and promotional materials might emphasize its position in national and international rankings, particularly if it performs well in areas relevant to prospective students' interests (e.g., specific programs, research output).
- Targeted Marketing: Rankings data can be used to create targeted marketing campaigns reaching students interested in universities with specific strengths, aligning TSTU's offerings with their preferences.
- Showcasing Success Stories: Featuring stories of successful alumni who benefited from their

TSTU education and achieved good employment outcomes can resonate with prospective students.

- Open House Events: Highlighting ranking achievements during campus tours and open house events can impress prospective students and their families.

Faculty Members:

- Advertising Strong Research Environment: If TSTU ranks well for research output or faculty collaborations, it can promote these aspects to attract top researchers interested in contributing to a productive environment.
- Competitive Salary and Benefits: Offering competitive salaries and benefits packages based on the university's ranking and reputation can attract qualified faculty.
- Research Funding Opportunities: Highlighting access to research funding and grants available at TSTU, potentially linked to ranking-related achievements, can entice faculty to seek support for their research endeavors.
- *Professional Development Opportunities: Showcasing opportunities for faculty development and career advancement, potentially influenced by ranking-driven initiatives, can attract ambitious academics."*

TIIAME NRU:

"The university actively engages in diverse educational events and exhibitions to showcase its achievements and attract both students and professors. Notably, our participation in the QS summit held in Malaysia in November 2023 resulted in the establishment of several collaborative relationships, with several international individuals expressing interest in studying and working at our institution."

Question 6: What measures is your institution taking to enhance its future ranking?

TSUE:

"Efforts are being made to enter the 1000."

TSTU:

- "Research: Invest in research infrastructure, attract renowned researchers, encourage faculty publications in high-impact journals, and pursue collaborations with leading international institutions.
- Teaching: Enhance classroom experiences with innovative pedagogies, hire experienced professors, and offer diverse learning opportunities like internships and study abroad programs.
- Student Services: Improve career support services, mental health resources, and academicadvising to ensure student success and satisfaction.

Boost Internationalization:

- Attract International Students: Offer scholarships, English-language programs, and culturally diverse events to attract students from abroad.
- Collaborate with International Universities: Engage in joint research projects, faculty exchange programs, and student mobility initiatives.

Improve Infrastructure and Facilities:

- Modernize Libraries and Laboratories: Upgrade technology and equipment to provide students with cutting-edge learning resources.
- Invest in Sustainable Practices: Implement green initiatives to reduce environmental impact and attract environmentally conscious students and faculty.
- Develop Modern Campuses: Improve dormitory facilities, sports complexes, and other amenities to create a more attractive learning environment.

Emphasize Transparency and Accountability:

- Publish Data and Reports: Make student outcomes like graduation rates and employment data readily available, demonstrating a commitment to transparency.
- Conduct Self-Evaluations: Regularly assess strengths and weaknesses using internal and external benchmarks to identify areas for improvement.
- *Address Feedback: Implement feedback from students, faculty, and alumni to continuously enhance the university experience."*

TIIAME NRU:

"In addition to recognizing the achievements

highlighted by QS and THE, our university conducts thorough assessments of any shortcomings identified. These aspects are carefully examined and addressed within the university's development programs. Particularly, there is a strong emphasis on enhancing the recruitment of foreign students and professors."

Question 7: What, in your opinion, are the most essential elements that determine the university rankings in Uzbekistan?

TSUE:

"No response was provided."

TSTU:

"Enhanced Research Output and Reputation:

- Collaboration with leading international universities: Partnering on research projects with prestigious institutions can lead to higher quality research, increased publications in high-impact journals, and improved citation rates, all of which are major factors in most ranking systems.
- Attracting international researchers: Bringing in renowned researchers from abroad can boost the university's research expertise, attract funding, and contribute to a more diverse and vibrant research environment.
- Increased international recognition: Participation in international research networks and conferences can raise the university's profile and reputation globally, potentially leading to higher rankings in international systems.

Improved Student Learning Experience:

- International student exchange programs: Exposing domestic students to diverse perspectives and cultural experiences can broaden their horizons, improve communication skills, and prepare them for a globalized workforce.
- Joint degree programs: Collaborating with foreign universities on joint degree programs can offer students internationally recognized qualifications and open doors to global career opportunities.
- Modernized curricula and pedagogy: Partnerships with international institutions can facilitate the exchange of best practices in teaching and learning, leading to more innovative and effective curricula.

Enhanced Faculty Development and Recruitment:

- Faculty exchange programs: Allowing faculty to participate in research and teaching opportunities at international universities can enhance their skills, knowledge, and research networks.
- Attracting international faculty: Recruiting talented faculty from abroad can bring diverse expertise and perspectives, enriching the teaching and research environment.
- *Professional development opportunities: Collaborations with international institutions can offer workshops, conferences, and other training opportunities for faculty, contributing to their professional development."*

TIIAME NRU:

"By strengthening internationalization and collaborations, the university can attract talented students and staff, enhance global visibility, attract more investments, improve academic and employer reputation, increase joint research activities, enhance entering the global education market and secure international grants and projects, among other benefits."

Question 8: How does the institution ensure the quality of research endeavours?

TSUE:

"It is improved every year based on the strategic plans of the university and the department."

TSTU:

"Academic Programs:

- Internal Quality Assurance:
- Curriculum development and review processes: Regular review and updates of program curricula based on industry trends, student feedback, and faculty expertise.
- Internal evaluations: Periodic self-assessments by faculty and administrators to identify strengths and weaknesses in programs.
- Student feedback surveys: Collecting feedback from students on course content, teaching ef-

fectiveness, and program structure,
- External Quality Assurance:
- National accreditation: Accreditation by a national body verifies that programs meet established quality standards.
- International accreditation: Some programs might seek additional accreditation from international bodies for global recognition.
- External peer review: Independent experts outside the university review programs and provide feedback for improvement.

Research Activities:
- Ethical guidelines: Adherence to established ethical guidelines for research conduct, ensuring integrity and responsible research practices.
- Peer review: Research proposals and publications undergo rigorous peer review by experts in the field.
- Data management and analysis: Implementing procedures for responsible data collection, storage, and analysis to ensure research accuracy and reliability.
- Internal review boards: For research involving human subjects or sensitive topics, internal review boards ensure ethical approval and compliance with regulations.
- *Research funding guidelines: Following best practices for managing research funds transparently and ensuring efficient use of resources."*

TIIAME NRU:

"The university ensures quality assurance by following methods.
- *Accreditation at the national level by the Ministry of HE, Science, and Innovation.*
- *International accreditation of the specialties by the international accreditation agencies. For example:* the *Accreditation Agency for Study Programmes in Engineering, Informatics, Natural Sciences and Mathematics (ASIIN).*
- *External evaluation of the academic programs, learning materials and courses done by the employers, stakeholders, universities, and industry.*
- *Internal quality assurance is done by the Department of Education Quality Control with the organization of different surveys among the students and teachers.*
- *Organization of continuous training and internships for staff at the university and abroad etc."*

Question 9: What is the significance of research output in university rankings, and how does your institution promote and finance research?

TSUE:

"It serves to increase the scientific pedagogical potential; it is taken into account when raising the rating of teachers in the Key Performance Indicator system."

TSTU:

"Impact of Research Output on Rankings:
- Significance: Research output, measured by publications in high-impact journals, citations, patents, and grants received, is a major factor influencing university rankings in most systems.
- Quality over Quantity: Rankings consider the quality and impact of research, not just the number of publications. Publications in prestigious journals with high citation rates carry more weight.
- Field-Specific Variations: 4"The importance of' research output can vary across disciplines. In fields like science and engineering, it might hold more weight compared to humanities or social sciences.

The Ways Universities Encourage Research:
- Funding: Providing internal grants, competitive funding opportunities, and support for external grant applications, facilitating research projects and attracting talent.
- Infrastructure: Investing in modern laboratories, libraries, and technology resources essential for conducting high-quality research.
- Faculty Development: Supporting faculty research through travel grants, conference attendance, collaborations with international institutions, and training workshops.
- Research Clusters and Centers: Establishing interdisciplinary research centers focusing on

specific themes, fostering collaboration and expertise sharing.

- Incentives and Recognition: Rewarding faculty for high-quality research output through promotion, awards, and salary increases, incentivizing research contributions.
- Research Partnerships: Collaborating with industry partners, government agencies, and other universities on joint research projects, leveraging diverse funding sources and expertise.
- *Open Access Initiatives: Encouraging faculty to publish open access, making their research accessible to a wider audience and potentially increasing citations."*

TIIAME NRU:

"Research output plays a significant role in university rankings as it reflects the institution's academic impact, reputation, and contribution to knowledge creation. That is why "TIIAME" NRU continuously supports the research activities at the university by providing well-equipped laboratories; providing funding and resources to support the research projects, grants, conferences, seminars etc.; organizing continuous seminars and workshops focused on research skills improvement, academic writing, preparation of research project proposals etc.; rewarding the most active researchers annually. Moreover, there is a system of providing incentives to authors who published articles in Q1, and Q2 journals and paying the funds spent on obtaining international patents."

Question 10: In what ways does the university foster inclusivity and diversity within its campus environment, and what implications does this have for its reputation?

TSUE:

"No response was provided."

TSTU:

"Promoting Diversity and Inclusivity:

- Recruitment: Proactively reaching out to diverse student populations through targeted outreach programs, partnerships with community organizations, and scholarships.
- Curriculum and Pedagogy: Integrating diverse perspectives and experiences into the curriculum, using inclusive teaching methods, and promoting critical thinking about social justice issues.
- Campus Climate: Creating a welcoming and supportive environment for all students through initiatives like cultural events, diversity training, and support groups.
- Faculty and Staff: Hiring diverse faculty and staff to reflect the wider community and ensure their voices are heard in decision-making processes.
- Accessibility: Ensuring physical and academic accessibility for students with disabilities.

Impact on Ranking:

While difficult to quantify directly, promoting diversity and inclusivity can positively impact rankings in several ways:

- Improved Student Satisfaction: Studies show diverse and inclusive campuses can lead to higher student satisfaction and retention; factors considered in some rankings.
- Enhanced Reputation: A reputation for diversity and inclusivity can attract top students, faculty, and research funding, all contributing to higher rankings.
- Innovation and Creativity: Diverse perspectives can foster innovation and creativity in research and teaching, leading to higher research output and international collaborations, both valued by rankings.
- Ethical Considerations: Some rankings incorporate ethical factors like social responsibility and commitment to diversity, potentially giving diverse and inclusive universities an edge.

Challenges and Considerations:

- Measuring Impact: Quantifying the impact of diversity and inclusion initiatives on rankings can be challenging due to complex and interconnected factors.
- Beyond Rankings: While rankings can be a motivator, universities should strive for genuine diversity and inclusivity, not just for ranking

benefits.

- *Addressing Systemic Issues: Addressing systemic barriers to access and inclusion requires ongoing efforts beyond superficial measures."*

TIIAME NRU:

"There is a criterion related to diversity and inclusivity in the international rankings. The university has support services and resources to address the needs of diverse student populations, including counselling services, disability accommodations, and cultural and affinity groups. In recent years, the university has been focusing on improving inclusive education."

Question 11: How does the institution interact with businesses and industry partners to ensure that its graduates have relevant expertise and skills?

TSUE:

"Organization of career days, organization of lectures and master classes on current problems of the enterprise, participation in MD and BMI commissions, cooperation in the development of qualification requirements."

TSTU:

"Engagement Strategies:

- Industry Advisory Boards: Establishing boards with industry representatives to provide feedback on curriculum, skills development, and industry needs.
- Internships and Co-ops: Offering students opportunities to gain practical experience and develop industry-specific skills through internships and cooperative placements.
- Guest Lectures and Workshops: Inviting industry professionals to deliver guest lectures, workshops, and seminars to share their expertise and trends.
- Joint Research Projects: Collaborating with companies on research projects that address industry challenges and provide students with real-world research experience.
- Career Fairs and Networking Events: Organizing career fairs and networking events to connect students with potential employers and explore career opportunities.
- Skills-Based Curriculum Development: Working with industry partners to identify and integrate relevant skills, such as communication, collaboration, and problem-solving, into the curriculum.
- Industry Certifications and Credentials: Offering opportunities for students to earn industry-recognized certifications or credentials, enhancing their employability.

Benefits of Industry Engagement:

- Relevant Skills and Knowledge: Equip graduates with the skills and knowledge sought by employers through practical experience and industry feedback.
- Increased Employability: Enhance graduates' job prospects by connecting them with potential employers and showcasing their industry-relevant skills.
- Funding and Resources: Attract additional funding and resources from industry partners for equipment, research, and scholarships.
- Innovation and Entrepreneurship: Foster a culture of innovation and entrepreneurship by exposing students to industry challenges and opportunities.

Challenges and Considerations:

- Finding Relevant Partners: Identifying and engaging industry partners allgned with the university's programs and student career aspirations can be challenging.
- Balancing Needs: Balancing the needs of industry partners with the university's academic mission and pedagogical approach requires careful planning and communication.
- *Sustainability: Maintaining long-term, mutually beneficial partnerships with industry requires constant engagement and effort."*

TIIAME NRU:

"The university has established ongoing cooperative relationships with industry partners and employers. As part of the 5+1 program, students engage in educational activities for five days at the university

and spend one day honing their skills at production enterprises. Additionally, educational programs and course offerings are determined in collaboration with employers."

Question 12: How does the university use student and alumni feedback to improve its academic programs and services, and how does this affect its ranking?

TSUE:

"By organizing surveys among students, the university graduates."

TSTU:

"Gathering and Analyzing Feedback:

- Student Surveys: Conduct regular surveys of students across different semesters and programs to gauge their satisfaction with courses, faculty, facilities, and overall experience.
- Alumni Surveys: Reaching out to alumni through surveys or online platforms to understand their career experiences, skills used in the workplace, and how their TSTU education prepared them.
- Focus Groups and Open Forums: Organizing focus groups and open forums with both students and alumni to delve deeper into specific aspects of their experiences and gather qualitative feedback.
- Social Media Monitoring: Tracking mentions of TSTU on social media platforms to gain insights into student and alumni opinions, addressing both positive and negative feedback.

Using Feedback for Improvement:

- Curriculum Development: Analyzing feedback to identify areas where the curriculum needs revision, updating courses to reflect industry trends and student needs.
- Faculty Development: Providing feedback to faculty on teaching methods, clarity, and engagement based on student input, leading to improved teaching practices.
- Support Services Enhancement: Utilizing feedback to identify areas where student support services, such as career counseling or mental health resources, need improvement.
- Infrastructure and Facilities Upgrades: Addressing feedback on facilities like libraries, laboratories, or dormitories to create a more conducive learning environment.

Impact on Rankings:

- Improved Student Satisfaction: Addressing student concerns through feedback can lead to higher student satisfaction, a factor considered in some university rankings.
- Enhanced Reputation: A university actively addressing student and alumni feedback demonstrates a commitment to improvement, potentially enhancing its reputation and attracting talent.
- Relevant Curriculum and Skills: Aligning curriculum and skills development with industry needs based on alumni feedback can contribute to higher graduate employability, another factor influencing rankings.
- Transparency and Accountability: Openly incorporating feedback demonstrates transparency and accountability, factors valued by some ranking systems."

TIIAME NRU:

"TIIAME NRU conducts an annual analysis of feedback from both current students and alumni through survey questionnaires tailored to each group. These surveys are openly accessible on the university's website."

Question 13: Are there any obstacles or limitations that hinder the progress of your institution in the rankings of HE institutions in Uzbekistan? If so, kindly describe them.

TSUE:

"International student and faculty shortage".

TSTU:

"Competition:

- National Competition: Other Uzbek universities might be actively pursuing strategies to improve their rankings, creating strong competition for top positions.
- International Competition: Universities in other

countries, particularly regional contenders, may offer similar programs and attract international students, making it challenging for TSTU to stand out.

Resource Constraints:

- Funding: Limited funding may restrict investments in research infrastructure, faculty recruitment, and internationalization initiatives, factors heavily weighted in QS rankings.
- Technology and Facilities: Outdated technology, libraries, or laboratories might hinder research capabilities and student learning experiences, impacting ranking scores.

Faculty and Research:

- Faculty Recruitment and Retention: Attracting and retaining top faculty can be challenging, especially its salaries or research opportunities aren't competitive with international institutions.
- Research Output: Increasing high-quality research publications in internationally recognized journals, a significant ranking factor, might require additional support and collaboration opportunities.

Internationalization:

- Limited Student Exchange: A lower number of international students participating in exchange programs can hinder the university's international outlook, a consideration in QS rankings.
- Collaborations with International Universities: Fewer partnerships with prestigious international universities might limit research opportunities and global recognition.

Data and Transparency:

- Data Availability: Incomplete or inconsistent data on key metrics like student outcomes, faculty qualifications, or research funding can lead to inaccurate or unfavorable rankings.
- Transparency in Reporting: Lack of transparency regarding data collection and methodology might raise questions about the reliability of the university's self-reported data."

TIIAME NRU:

"There are no restrictions or difficulties in the country or university. On the contrary, an appropriate state program has been developed with measures aimed at ensuring that the Republic's 10 most advanced universities enter the ranks of the Top 1000 universities in the world."

Appendix 2 – Analysis of Case 2: Expert`s View on Other Uzbek Universities

Case 2. Expert`s View (Local Consultant for TDPU, NUUz and JizPI)

Question 1: In your opinion, what are the main factors that impact the rating of higher educational institutions in Uzbekistan?

- *"Open policies: open administration and available information.*
- *Research collaboration.*
- *Student exchange*
- *Official web page of the universities: full and properly filled information.*
- *Increase PhD candidates."*

Question 2: What strategies does your institution employ to allocate resources and enhance its ranking?

"Every year the government allocates a signification amount of money to universities to improve their ranking. Still, most of them do not know how to allocate in the right way or where they should be allocated."

Question 3: Do you think the current ranking system in Uzbekistan effectively reflects the quality of HE?

"Unfortunately, the current ranking system does not meet the quality of education. Most of the things done by universities most of the time done for the sake of being ranked only. There is no part in the ranking determinants which shows the percentage of quality or anything about accreditation."

Question 4: How does your institution track and measure student outcomes, such as graduation and employment rates?

"The marketing department in the university

works to track employment-related things, but it is hard to control. Mostly, local universities do not know where their graduates are working, or they know but it is done just because of bureaucracy not because they care about it. Universities do not get feedback from their Alumni."

Question 5: How does your university use rankings to appeal to prospective students and faculty?

"Each ranked university has a separate page for information about their rankings on their official websites. Sometimes, they try to show it on the very first online page to acknowledge and emphasize it more."

Question 6: What measures is your institution taking to enhance its future ranking?

"The universities have their milestones which they establish according to the university`s strategies."

Question 7: What, in your opinion, are the most essential factors that determine the university rankings in Uzbekistan?

"Local collaboration is significantly low and even lower than international collaboration. Universities mention that it is hard to collaborate and work together with local universities compared to international ones. Thus, it directly hinders the potential of the university to be ranked higher. For example, in Kazakhstan local universities support each other whereas in Uzbekistan the universities view themselves as a competitor to each other."

Question 8: How does the institution ensure the quality of research endeavours?

"There is no real influence and universities do not put a lot of emphasis on it."

Question 9: What is the significance of research output in university rankings, and how does your institution promote and finance research?

"Most universities might state that they encourage research, but when students apply to international grants or intend to do research there will be weak support from the university side. It might be due to different reasons like too many obstacles or the wrong division of research grant funding due to corruption from the administration side. The administration has too much workload that it does not have time to support research and applying to international grants."

Question 10: In what ways does the university foster inclusivity and diversity within its campus environment, and what implications does this have for its reputation?

"There is no policy regarding diversity in local universities and that is why there is no specific information on it taking into consideration the official web page of universities. Where each university should have a policy document. However, there is no big influence on inclusivity, and it does not impact international ranking but is linked more with sustainability and impact rankings. Moreover, if we check local universities, we can hardly find inclusivity there and only one of the universities where it is present is Central Asian University in Tashkent. In the local universities, the infrastructure is old and there are no special conditions for disabled people".

Question 11: How does the institution interact with businesses and industry partners to ensure that its graduates have relevant expertise and skills?

"In local universities there are no career centres and universities do not care about the future of the students. There is some improvement made recently and this responsibility is now partially linked with the marketing department that announces free vacancies on the university`s pages."

Question 12: How does the university use student and alumni feedback to improve its academic programmes and services, and how does this affect its ranking?

"The university asks for feedback from students regarding their academic programs but not on the services. No alumni stories or feedback are coming from them."

Question 13: Are there any obstacles or limitations that hinder the progress of your institution in the rankings of HE institutions in Uzbekistan? If so, kindly describe them.

"There are a lot of things that limit the ability of the university to be ranked or increase the rankings. The theory does not meet the practice and there is a thing which is referred to as a crossroad in HE which consists of four things: policy, education, practice and research that need to be balanced for the institution to improve."

Appendix Case: 3. QS Consulting Team Analysis of Interviews with QS Representatives

Question 1: Could you kindly explain how QS ranks universities throughout Central Asia, including Uzbekistan?

"QS offers several rankings, including its flagship World University Rankings. These rankings are used worldwide to evaluate institutions. The Asia rankings now include Uzbekistan, Kazakhstan, Kyrgyzstan, and Tajikistan. Chemistry, performing arts, and management have specialised ranks. University rankings by QS include research, research and discovery, employability, global participation, and learning experience. Research production, impact, and academic reputation are evaluated. Scopus data comprises internationally renowned research from journals, publications, and conferences. Scopus rates regions by work citations and the National University of Uzbekistan has 4000.

Academic reputation is vital in all rankings. QS generates a big database of academics and professionals from various global businesses each year. QS will ask institutions to participate in a poll to propose up to 30 universities in their country and 30 throughout the world after they provide their contact information.

QS evaluates universities based on research production, impact, and reputation. The rankings help assess Uzbekistan and Central Asian universities. The QS Rankings evaluate universities worldwide in various fields, including cultural anthropology. Facts and scholarly opinions of graduates inform the rankings. Universities must disclose professors, students, international students, and sustainability practices. The QS Hub platform collects this data annually, with over 100,000 academic responses and much fewer employer responses.

Universities need to register and encourage academics and employers to collect data properly. The rankings consider foreign academics, students, and research networks. All universities want to be in the flagship World University Rankings. Universities that conduct research and collaborate internationally need this.

The rankings consider faculty-student ratio, student-faculty ratio, and Ph.D.-holding personnel. Many universities compete for the flagship World University Rankings. Since there are no Uzbek institutions worldwide, this sector can improve.

Uzbek universities have improved in Asia rankings, with 14 highlighted this year. This publicly available data can help identify top cultural anthropology research and teaching universities."

Question 2: How do university rankings influence the HE industry in Uzbekistan?

"For visibility and openness, universities are increasingly interested in worldwide rankings. This has increased university interest in new relationships, information, and research collaborations. Universities are also assessing current cooperation to strengthen them and pursue new strategic partnerships.

Universities must improve English-speaking teachers, professors, facilities, dorms, and infrastructure to attract international students. Rankins advises universities to take internationalisation seriously and holistically. This technique raises Uzbekistan's higher education profile by including more institutions in subject rankings.

There are obstacles to this process. Some universities may neglect overseas students in favour of rankings, resulting in hardened academics who lack resources and assistance. Student unhappiness may result. For visibility and accessibility, universities are increasingly interested in worldwide rankings.

There are other obstacles. Some universities harden academics, attract international students, or provide poor amenities. Universities must recognise and resolve these issues to succeed globally. Universities can boost worldwide visibility and success by focusing on internationalisation and partnerships."

Question 3: What are the most important factors influencing university rankings in Uzbekistan?

"Uzbek universities are gaining recognition from peers in Uzbekistan and neighbouring nations. This is largely due to internationalisation and universities' stronger contacts with researchers and institutions. Many universities lack good alumni monitoring and employer communication, therefore employer reputation is still developing.

Regional issues like Uzbekistan's absence of workplace email addresses hurt employer reputations. The faculty-student ratio in Pakistan is not ideal, but there are enough teachers. Some universities are gaining international students and faculty. Most Uzbek universities score approximately one out of 100 in international research.

Finally, most Uzbek universities' strongest or fastest-growing metric is academic reputation, followed by faculty-student ratio. Internationalisation and research, especially faculty and research, still need attention."

Question 4: To enhance its ranking, how does an institution prioritise or allocate resources?

"The question of university internationalization is complex, but from discussions on the ranking side, it is evident that universities invest heavily in research and academic partnerships. Some universities prioritize academic partnerships more, focusing on human resources and attention. However, this alignment is not always evident in all internationalisation efforts. Research requires significant resources, including money, equipment, labs, and human resources. It takes time for research to develop and become international-level, published, and captured by databases like Scopus and QS.

Infrastructure is another area where universities invest heavily, with some working on it but not necessarily reflected in rankings. Sustainability is a new topic for most universities, and some are dedicating resources to it. However, this is at the beginning stages.

Resources are not just about money funding, but also about human attention and administrative resources. University leadership prioritizes faculty members, researchers, and administrative faculty, and this area will likely see more development in the coming years. However, not all universities are diverting resources towards this area."

Question 5: In your perspective, does the current ranking system accurately reflect the genuine nature of HE excellence in Uzbekistan? Why, or why not?

"The QS rankings show their different goals. University students from Uzbekistan are treated fairly. This audience prefers national rankings. The QS rankings were designed for international students considering studying abroad and understanding. Top student city rankings were not discussed. See that ranking and decide, students. Which city is best for students? London or New York are options. They might find an answer there. Governments and other entities probably started utilising QS rankings. Consider partnerships by researchers considering migrating to a university after being offered a job. Uzbek universities' internationalisation and intranational significance reflect what's happening. I hope to see Uzbek universities, especially the top ones, in the World University rankings soon. I anticipate success. Time will tell. I understand their workload. Many connections are made. Many fronts are being worked. Their arrival is assured. Asia rankings show they're just not there yet, which is fair and extreme. Positive progress since Asia is competing with universities from China, India, Singapore, Japan, and South Korea and 14 of the 850 ranked Asian universities are from Uzbekistan. Compared to China and India's high education sectors and sizes, this is good.

Uzbek institutions recently internationalised again. They had overseas alliances before, but

significant activity began several years ago for socio-political and economic reasons.

The Soviet era isolated the CIS countries in research, thus they had to start from scratch with the Internet, international cooperation, research, and academics. In recent decades.

Regionally, it pretty well reflects the international outlook. Again as. University Uzbekistan expanded. I hope some rankings will be higher Internationally it is a fair representation".

Question 6 : How does a university use ranking systems to effectively appeal to prospective students and faculty members?

"Universities in Uzbekistan are increasingly ranked in international rankings, which can attract international students. This is a challenge as Uzbekistan has not been a traditional destination for international students. To attract more international students, the Ministry of Education and other government organizations must work together to make Uzbekistan a desirable standard. Rankings provide credibility, as it gives people a sense of worth paying attention to a university. Universities that have been ranked also often receive calls and emails from other institutions, indicating their quality in a particular field. This external evaluation confirms a university's reputation, making it more attractive to international students."

Question 7: Are there any obstacles or limits to the university getting a higher rating in the QS rankings for HE in Uzbekistan? So, what are they?

"Studying or working in Uzbekistan is difficult due to its limited recognition. However, some institutions are enhancing their HE systems, facilities, and foreign student support in Uzbekistan. This involves procedures that help international students integrate into the university, enough English support, and staff that speak strong English to teach and communicate with them. Uzbek universities also struggle with research. International rankings place Uzbek universities below China, South Korea, and Eastern Europe. Some scientists conduct international-quality research, but their faculty is small. Their study must be published in English in high-impact journals to be seen worldwide. This move is difficult for university employees who have published in Russian or Uzbek for decades.

Central Asian and CIS universities should promote their research effectively. Building trust and alliances takes time and is not unique. Due to their isolation, universities in the former Soviet Union have struggled to internationalise. This initiative began earlier or later in several countries. In conclusion, Uzbekistan struggles to attract international academics and promote research."

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ARTICLE

Effect of Using Number Line and Tale Assisted Instruction in the Learning of Redox Reaction (Electrochemistry) in Senior Secondary School

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ABSTRACT

This research aimed to explore the impact of incorporating number line and tale assisted instruction on secondary school students in chemistry, specifically focusing on the topic of redox reactions. Additionally, the study investigated whether gender influenced student performance in learning environments utilizing these instructional methods. Employing a quasi-experimental design with a 3 x 2 factorial structure, the research involved 120 senior secondary school students (SSS II) drawn from three public secondary schools in Anambra State, Nigeria. Pre-test and post-test scores were analysed using Analysis of Covariance (ANCOVA). The results revealed that students exposed to either number line or combined number line and tale assisted instruction demonstrated significantly higher performance compared to those taught through conventional classroom instruction. Also, there was no notable disparity in performance between male and female students across the experimental groups. Drawing from these findings, recommendations were proposed to implement relevant tales assisted and number line methodologies into chemistry teaching practices within Nigerian secondary schools.

Keywords: Number line; Tale assisted instruction; Learning; Redox reaction, Electrochemistry; Senior secondary school

1. Introduction

Chemistry is a pivotal subject with widespread implications across various industries and aspects of daily life, yet many students exhibit a reluctance to engage with it, resulting in poor academic performance. This issue underscores the importance of exploring effective teaching strategies to enhance students' comprehension and appreciation of chemistry concepts. Numerous scholars have

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examined the critical role of chemistry in areas such as oil and gas, electricity, agriculture, health, environment, and more (Zuru, 2009).[17] However, despite these prospects, students continue to struggle with understanding and internalizing chemical concepts, leading to subpar performance in examinations (Ojokuku, 2012).[14]

Research indicates that the teaching methods employed in chemistry education significantly influence students' learning outcomes. Scholars have highlighted the need for educators to employ innovative and engaging teaching strategies to make chemistry more accessible and meaningful to students (Chikendu, 2022).[4] Additionally, challenges arise from students' misconceptions and difficulties in grasping fundamental concepts like redox reactions. These challenges necessitate a closer examination of teaching methods and resources to address students' learning needs effectively (Emendu, 2017;[7] Jonah J. Kyado et al., 2021).[12]

Redox reactions, in particular, serve as a cornerstone of chemistry education, yet they pose significant challenges for both students and teachers. The complexities associated with redox reactions, such as understanding electron transfer processes and balancing chemical equations, contribute to students' conceptual difficulties (Luciane et al., 2020).[13] Consequently, there is a need to explore innovative approaches to teaching redox reactions to enhance students' comprehension and engagement.

One promising avenue for improving chemistry education is the integration of storytelling and visualization techniques. Storytelling has been recognized as a powerful tool for enhancing learning experiences by fostering connections among students, ideas, and real-world applications. Through storytelling, educators can contextualize abstract concepts like redox reactions and make them more relatable and memorable for students. Furthermore, storytelling accommodates different learning styles, catering to auditory, visual, and kinesthetic learners alike.

Incorporating visual aids, such as number lines, also holds promise for enhancing students' understanding of abstract mathematical concepts, which are integral to chemistry education. Number lines serve as effective tools for developing students' number sense and operational proficiency (Factsheet, 2022).[8] By providing a visual representation of numerical relationships, number lines promote active engagement and intuitive reasoning among students (Jeffrey Frykholm, 2010).[11]

Moreover, the integration of number lines can complement storytelling techniques in teaching chemistry concepts like redox reactions. By using real-life examples, such as the role of redox reactions in lithium batteries and metal extraction processes, educators can connect abstract chemical principles with tangible applications, thereby enhancing students' motivation and comprehension (Hasan Amjad, 2022).[9] Additionally, storytelling can help elucidate complex scientific phenomena in a manner that resonates with students' personal experiences, facilitating deeper learning and retention.

The techniques for educating embraced by educators are solid determinants of accomplishment in learning. The unfortunate poor achievement of most students in science has many science instructors, educators, and guardians worried as well as the public authority. This has prompted an overwhelming quest for fitting instructing strategies that would best further develop accomplishment of science students. As per Adimoyemma (2010),[1] these techniques for showing science incorporates: Interpretive, conversation, project, exhibit, disclosure, request, individualized guidance, field trips, feeling, gaming, addressing and group educating. This suggests the utilization of number line and stories technique which includes pictorial portrayal of numbers on a straight line to reinforcing science students' psychological portrayals of number size, number connections, and numerical tasks with the goal that they could then perform and comprehend a logical peculiarity in science? This inquiry required this review into the impact of utilizing number line and stories in the instruction of redox response involving electrolysis as contextual analysis. The hope is that this strategy will militate the fear students have towards the learning of complex chemistry procedrues. Therefore, the purpose of this

study was to investigate the affect of using number line and tale assisted instruction in the learning of electrolysis in senior secondary school chemistry.

Specifically, the study examined:

1. The difference in performance in chemistry of secondary school students taught using number line assisted instruction (NLAI), tale and number line assisted instruction (TNLAI), or those exposed only to conventional chemistry instruction (CI).
2. The influence of students' gender on their performance in chemistry, when they are exposed to number line assisted instruction or tale and number line assisted instruction.

Research Questions

1. Will there be any difference in the performance of chemistry students exposed to number line assisted instruction, tale and number line assisted instruction, or those exposed to only conventional chemistry instruction?
2. Does gender influence the performance of chemistry students taught chemistry with number line–assisted instruction?
3. Does gender influence the performance of chemistry students taught chemistry with tale and number line assisted instruction?

Research Hypotheses

The following research hypotheses were tested in the study.

Ho_1, there is no significant difference in the performance of students in chemistry when they are exposed to (i) number line assisted instruction, (ii) tale and number line–assisted instruction, and (iii) conventional chemistry instruction.

Ho_2, there is no significant difference between the performance of male and female students in chemistry when taught chemistry with number line assisted instruction.

Ho_3, there is no significant difference between the performance of male and female students in chemistry when they are taught chemistry with tale and number line assisted instruction.

2. Methodology

The study employed a quasi-experimental research design, specifically a pre-test, post-test, non-counterparts, non-randomized, control group design. The design incorporated a 3x2 factorial plan, involving three treatment groups: number line assisted instruction (experimental group 1), tale and number line assisted instruction (experimental group 2), and conventional chemistry instruction (control group), with a factor of two gender levels (male and female).

The experimental groups were sampled from secondary seniors chemistry students from Community High School (CHS) Nsugbe (Anambra State, Nigeria) and Nwafor Orizu College of Education Demonstration Secondary School Nsugbe (Anambra State, Nigeria). The control group was sampled from Fr. Joseph Memorial Secondary School Aguleri (Anambra State, Nigeria). Each group consisted of 40 students, with varying gender distributions. The sampling strategy aimed to align the intervention with the researchers' teaching assignments.

Research instruments included the treatment instrument, an experienced chemistry teacher, and the test instrument, Chemistry Achievement Test (CAT). The treatment involved self-instructional, interactive packages focusing on numeracy using number line and redox reactions, while the control group received conventional chemistry instruction. The CAT is comprised 30 multiple-choice questions drawn from past West African Examination Council (WAEC) chemistry papers.

Data collection involved pre-test assessments using CAT for all groups, followed by treatment implementation over five weeks. Post-test assessments were conducted using the rearranged CAT. Lesson presentations covered oxidation and reduction concepts, including mnemonic devices, models, and examples to facilitate understanding.

The development of the instructional package followed methodological phases of analysis, design, implementation, and validation. Analysis considered students' cognitive skills and evaluation instruments, while design focused on defining lesson topics. Im-

plementation incorporated teacher input, and validation involved review by chemistry experts.

Lesson presentations emphasized conceptual clarity through questions, explanations, and mnemonic devices. Examples illustrated oxidation and reduction processes, highlighting the roles of oxidizing and reducing agents. Reduction and oxidation half-equations were explained, reinforcing understanding through practical examples.

Week 2: Numeracy using number line (for experiment class only)

The researcher introduced empty number line for addition problems in other to encourage multiple and efficient strategies of mental computation by activating and extending mental partitioning. Compensation, complementary addition, counting on are also considered. Addition commutativity and bridging through 10 reviewed.

The researcher explained relative scaling (arbitrarily mark a number, then draw a series of scaled 10's and 1's). When asked what is different about this number line, and scaffold responses appropriately.

The researcher gave the following examples:

"16+28=?" on the board above a new empty number line.

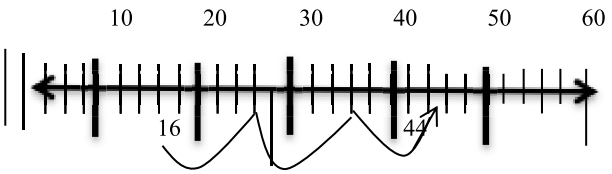


Fig. 1

"How can we solve this addition problem using an empty number line (ENL)?"

Additional examples demonstrated various strategies of adding 8 and 32 on ENL, using the following solutions and ensuring consistent scaling of the jumps: 8+(3x10)+2 (noting conversion of 30 into five 10's); 8+30+2.

The researcher asked, "If anyone can mentally add 8 + 30 prior to adding the 2?"

Explicitly add the sum of the jumps to check each solution. At this point, remind students of additive commutativity, e.g.: "When we add two numbers, is the order important? For example, 2+5 is 7, and so is 5+2, correct?"

-3 + 8

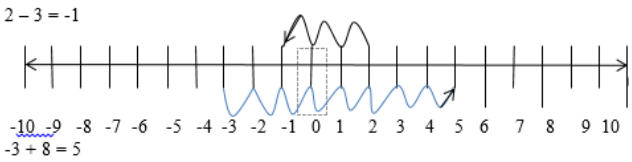


Fig. 2

Week 3: Oxidation number

In view of past information, the students were asked of the importance from the oxidation number. Students gave answers which incorporated the oxidation number as the nuclear number of the molecule. The analysts made sense of the significance of oxidation number. The oxidation condition of a component relates to the quantity of electrons (e-) that a particle loses, gains, (contrasted with its unbiased, uncombined structure) or seems to utilize while getting together with different iotas in compounds when it responds to frame particles or atoms. The valency (oxidation number) of the reactant changes as it losses or gains electron(s). With the guide of a graph, the chemist utilized the response among sodium and chlorine to make sense of how the compound was formed. For monatomic particles, for example, Na^+ or Cl^-, the oxidation number is equivalent to the charge, +1 and −1, for the sodium cation and chloride anion, separately. The chemist made sense of the guidelines administering how to relegate oxidation numbers to components as follows.

In deciding the oxidation condition of an iota, there are seven rules to keep: 1. The oxidation condition of a singular molecule is 0; 2. The complete oxidation condition of all particles is 0 or equivalent to the particle's charge; 3. Gathering 1 metals have an oxidation condition of +1 and Gathering 2 metals have an oxidation condition of +2; 4. The oxidation condition of fluorine is - 1; 5. Hydrogen usually has an oxidation condition of +1; 6. Oxygen usually has an oxidation condition of - 2; 7. In double metal mixtures, Gathering 17 components have an oxida-

tion condition of - 1, Gathering 16 components of - 2, and Gathering 15 components of - 3. The chemist utilized the above rules to make sense of the response oxidation condition of particles and mixtures. Students were approached to compose the ionic image for the different iotas sodium, potassium, calcium, oxygen and fluorine. Find the oxidation number of the underlined components, HNO_3, H_2SO_4, SO_2, $CaCO_3$ and NO_2. Independently, chemistry students found the oxidation quantities of components, showing each step they made to find the response. Two by two, they evaluated each other's responses. The examination took up right responses with the whole class.

For the number line experimental group (I)

The researchers introduced the lesson by asking the students to state the seven guidelines in determining the oxidation state of an atom. The researcher then wrote some equations on the board; reminding the chemistry students that electrons are negatively charged, and then asked the acceptance of electron(s) will move the state of the reactant towards which direction in the number line? The learners gave answers which include to the left.

Elements undergoing chemical reaction either gain or lose electrons. Since electrons involved in chemical reactions are negatively charged, number line can help the learners to understand this phenomenon. The researchers introduced the lesson by drawing a number line on the board with zero at the center and asked the learners the following questions?

- Moving right along the number-line is it positive or negative? Learners gave answers which included, positive.
- If a negative number is added to any point on the number line, which direction will the new position move? Learners gave answers which included, to the left..

The researcher presented the topic by explaining oxidation as the loss of electrons by species and reduction as gain of electrons by species. In Mathematics, negative multiply by negative is **positive**, while negative added to negative is **negative.** Therefore, in using number line, electron being negative when removed from a specie means a negative is subtracted, that is, - - which means (- x - = +). Hence, removal of electron moves towards positive direction. On the other hand, addition of electron means - + - = - (negative plus negative = negative), this means that the addition of electron will move towards the negative direction. Anything moving towards the negative direction is reducing hence, reduction. Oxidation-reduction reaction can be demonstrated using the reaction of sodium (Na) and fluorine (F) in number line.

$2Na(s) + F_2(g) \rightarrow 2NaF(s)$

Na has eleven (11) electrons while fluorine has nine (9) electrons before the reaction and after the reaction; Na has ten (10) electrons while F has ten (10) electrons.

From the direction of the arrow, it can be seen that fluorine accepted an electron to move one step left, that is, reducing from -9 to -10, hence reduction. Sodium moved -11 to -10, that is a shift to the right thus oxidation. The sodium which donates electron to the fluorine has reduced fluorine from -9 to -10; thus, sodium is a reducing agent and the fluorine that accepts the electron from sodium increasing Na from -11 to -10 is the oxidizing agent.

$2Na + Cl_2 \rightarrow 2NaCl$

In the above reaction, sodium atom (Na) from the guide is in the oxidation state of zero while chlorine atom is also in the oxidation state of zero (0) equally.

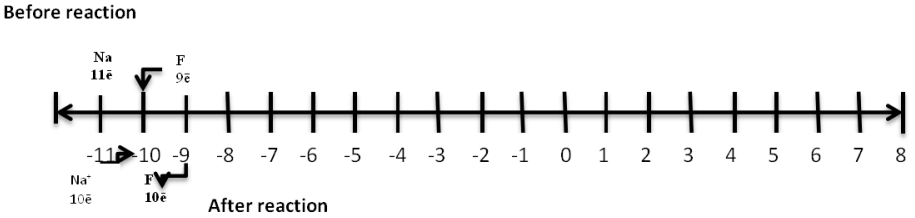


Fig. 3

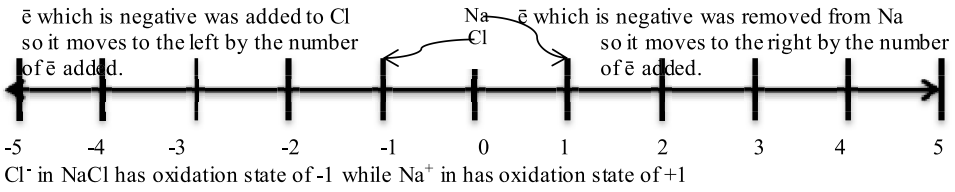


Fig. 4

The oxidation state of Na has increased from zero to +1; that is, it has been oxidized by Cl because of the increase in the oxidation number. Hence Cl is the oxidizing agent. The oxidation state of Cl has reduced from zero to -1; that is, it has been reduced by Na because of the decrease in the oxidation number. Hence Na is the reducing agent.

In the reaction, zinc (Zn) atom being higher in the electrochemical series (more electropositive) donates two (2) negatively charged particles (ē) to copper (Cu) in $CuSO_4$. Because two negative (-ive) particles were removed, Zn moves two places to the positive (+ive) direction (right direction). Moving to the positive direction is oxidation.

Negative Reduction positive Oxidation (NEGRED–POXY)

$Fe_2O_3(s)+2Al(s)\rightarrow Al_2O_3(s)+2Fe(s)$

-ē means loss of negatively charged particle (electron) while +ē means addition of electron. When negative values are being added to something, its positive value decreases, that is reduces; but when negative values are being removed from something, its positive value increases, that is, oxidized.

For the reaction: $Zn_{(s)} + CuSO_{4(aq)} \rightarrow Cu(s) + ZnSO_{4(aq)}$

For the reactants		For the products	
	Oxidation state		Oxidation state
Zn	0	**Zn**SO_4	+2
CuSO_4	+2	**Cu**	0

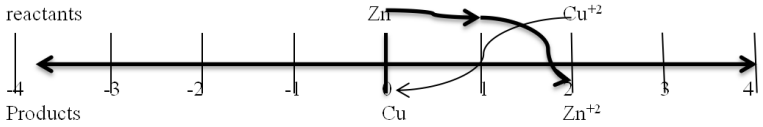


Fig. 5

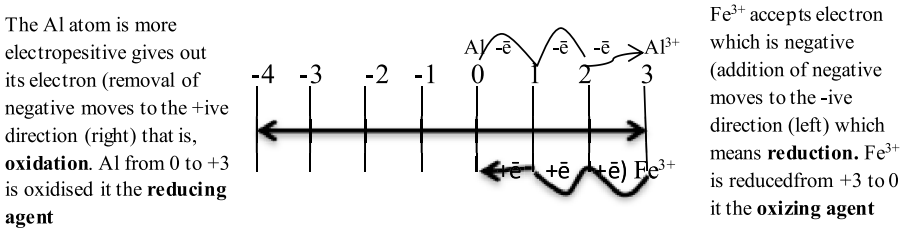


Fig. 6

For the number line and tale experimental (group II).

The researchers introduced the lesson by telling the learners story about one Mr. Camsi who had eight (8) children and later gave birth to set of twins. This twin have negative influence on Mr. Camsi, because he had used his energy in training the first eight children and now was unable to firmly get hold of this twins. There is also another man Mr. Ozojim who is desperately looking for child. When Mr. Camsi and Mr. Ozojim met, Mr. Camsi who was unable to hold his twins firmly, did not hesitate to give out the twin to Mr. Ozojim, who has the

power to accept the twins. Mr. Camsi became more positive because of the removal of his negatively influenced twins; while Mr. Ozojim became more negative because of the acceptance of the negatively influenced twins but more stable because he has found the children he had been looking for.

Relating this story to oxidation number, Mr. Camsi may be likened to calcium (Ca) which is in group two (II) and is very willing to donate (remove) the two (2) electrons that are negatively charged (which may also be likened to as the negatively influenced twins) in its valence shell. As Ca is donating its negatively charged electrons (as Mr, Camsi removed the negatively influenced twins) it becomes more positive (Mr, Camsi now has more rest of mind) while Mr. Ozojim who is accepting the negatively influenced twins is likened to as oxygen (O) which is in group six (vi) and is very willing to accept the two (2) electrons that are negatively charged (which may also be likened to the negatively influenced twins). If each of this negatively influence twins cost 96500 Colos (C), it means that the cost of two twins is 193000C.

The researcher evaluates the lesson by asking the students the following questions based on previous knowledge. Among the characters in the story, who is a reducer (reducing agent)? Give reason for your answer.

The reducing agent is Mr. Camsi because he is removing his negatively influenced twins to Mr. Ozojim who now spends more on the twins in terms of speech, finance and so on thereby reducing him to the more negative side than he was; Hence Mr. Camsi is a reducing agent.

Week 4: Balancing of redox equation

The researcher facilitated interactive sessions with students to demonstrate how to balance redox equations using the Half-Equation Method. Through examples like the reaction between Cu and Ag ions, learners were guided to identify oxidation and reduction half-reactions. The process involved assigning oxidation states and recognizing changes in oxidation states to determine redox reactions. The Half-Equation Method was then introduced, outlining steps to balance redox reactions by separating them into oxidation and reduction half-equations and adjusting coefficients accordingly.

To practice the method, sample questions were provided, such as balancing the reaction between Cu+ ions and Fe metal. Students followed steps to separate half-reactions, balance electrons, and combine equations to obtain a balanced overall equation. Through individual presentations and class discussions, learners reinforced their understanding and corrected any misconceptions.

For the number line experimental group (I)

The researcher used the number line to explain only the oxidation and reduction that involves the exchange of electron.

For the reaction $3Cu^{+}(aq) + Fe(s) \rightarrow Fe^{3+}(aq) + 3Cu(s)$;

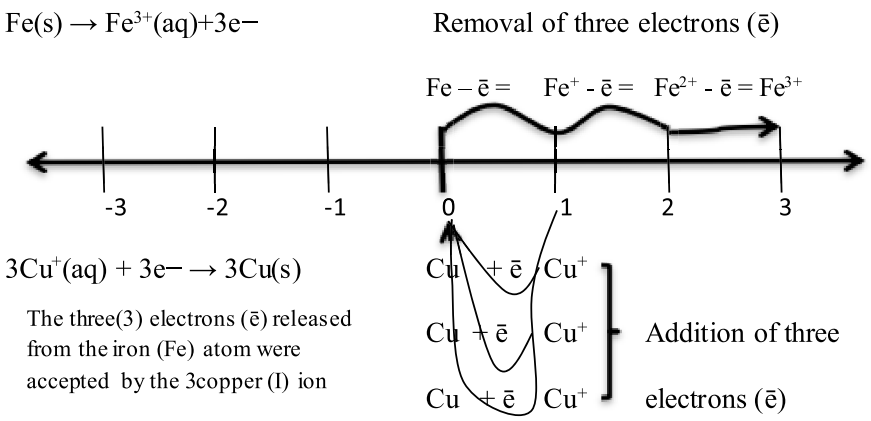


Fig. 7

For the number line and tale experimental group (II)

Week 5: Laws of electrolysis

The researcher introduced the lesson by revising the previous lessons. The researcher reminding the students that in their previous lessons of redox reactions, that they have been studying about the formation of compounds through the donation and acceptance of electron to form a new compound. The movement of these electrons is what brings about electricity (electric current). This week we are going to study how these compounds that were formed, can be decomposed (disintegrated), and how the charge on the ion formed affects the charge quantity of product liberated.

The specialist characterize electrolysis as separating an ionic compound (either liquid or in arrangement) into less difficult substances by utilizing an electric flow or the decay of a synthetic compound (electrolyte) achieved by the section of direct flow through the terminal. Electrolysis is the cycle where in electrical energy is utilized to make a nonspontaneous compound response happen.

The positive cathode is known as the anode. The negative terminal is known as the cathode (positive anode, negative cathode: - PANC). The electrolyte is the substance going through electrolysis (It is an ionic compound either liquid or in arrangement). Electrolysis includes the development of particles towards the cathodes (Particles can't move in a strong). Positive particles are known as cations, move towards the negative cathode during electrolysis. Negative particles are known as anions move towards the positive anode during electrolysis. Cations are shaped by loss of electron by a component while anions are framed by gain of electron as it has been exhibited in redox response. The positive charged particles are the cations, and they move towards the negative cathode (feline) while the adversely charged particles, the anions moves towards the positive anode (an). Power is being conveyed by electrons in the outside circuit, yet by the development and release of particles in the electrolyte. This can work assuming you have particles which are allowed to move. For that reason an electrolyte must be an ionic compound, either liquid or in arrangement.

During electrolysis, the compound formed during the redox reaction split to go back to its original stable form. For instance, sodium reacts with chlorine to form sodium chloride.

$$2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$$

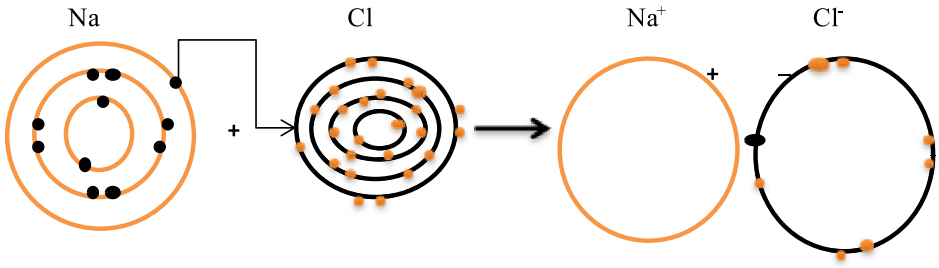


Fig. 8

In the product only the valence electron was used to represent the structure of Na^+ and Cl^-. During electrolysis the electrolysis of molten sodium chloride (Na^+Cl^-), the chloride ion (Cl^-), releases the electron it accepted from the sodium atom (to bond to the sodium) at the anode which is positively charged. The electron released from the Cl^-, passes through the external circuit and enters into the electrolyte through the cathode and the Na^+ now regained (accepted) the electron it donated to chlorine to form sodium chloride. Hence, the cathode that received the negatively charged electron is negatively charged while the anode from where the negatively charged electron leaves the electrolyte is positively charged.

Chlorine exists as diatomic molecule not as mono atomic molecule. Looking at fig. 8, only one atom of chlorine was used; therefore another atom of sodium

will be required to react with the second chlorine atom. This gives chemical equation as:

$2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$

At the anode OH^- being less electronegative than the SO_4^{2-} will migrate to the anode to lose electron which moves through the external circuit to the cathode and H^+ which is the only cation present migrates to the cathode to accepts the electron.

Anode (anodic half reaction)

$Cl^- \rightarrow \bar{e} + Cl$
Chloride releases electron
Chlorine atom cannot exist alone,
Hence another Cl^- releases electron
$Cl^- \rightarrow \bar{e} + Cl$

Cl_2

Cathode (cathodic half reaction)

$Na^+ + \bar{e} \rightarrow Na$
sodium ion accepts the electron
and another sodium ion accepts the electron.
$Na^+ + \bar{e} \rightarrow Na$

2Na

Overall reaction is: $2Na^+Cl^- \longrightarrow 2Na + Cl_2$

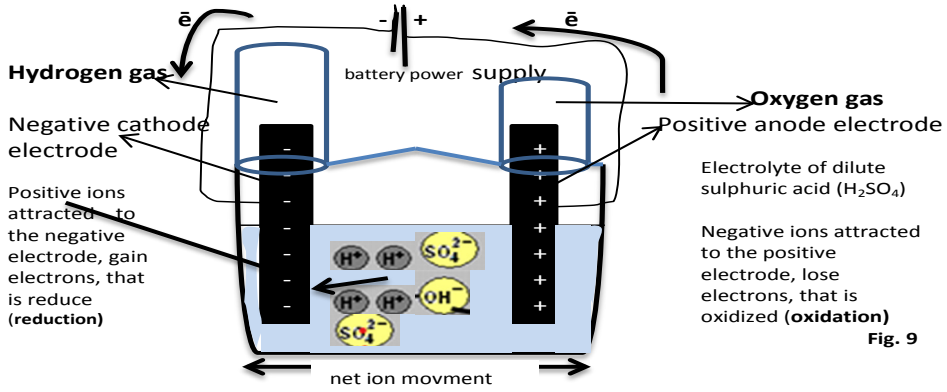


Fig. 9

Diagram for the electrolysis of acidified water

The ions present in the electrolytes are:-

$H_2O \rightarrow H^+ + OH^-$

$H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$

Oxidation and reduction in electrolysis

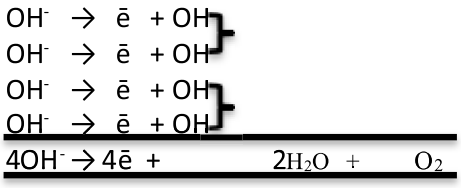
At the Anode

$OH^- \rightarrow \bar{e} + OH$
OH is not a stable molecule,
another $OH^- \rightarrow \bar{e} + OH$
$OH + OH \rightarrow H_2O + O$
O is not stable it is diatomic so the whole process repeats again
$OH^- \rightarrow \bar{e} + OH$
OH is not a stable molecule,
another $OH^- \rightarrow \bar{e} + OH$
$OH + OH \rightarrow H_2O + O$
$O + O \rightarrow O_2$

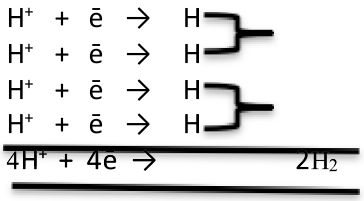
At the Cathode

$H^+ + \bar{e} \rightarrow H$
H is not also a stable molecule therefore,
another $H^+ + \bar{e} \rightarrow H$
$H + H \rightarrow H_2$

$H^+ + \bar{e} \rightarrow H$
H is not also a stable molecule therefore,
another $H^+ + \bar{e} \rightarrow H$
$H + H \rightarrow H_2$
$H_2 + H_2 \rightarrow 2H_2$



Anodic half reaction
The OH groups are not stable, so, they are not added. The oxygen atoms are not stable also, hence, they are not equally added.



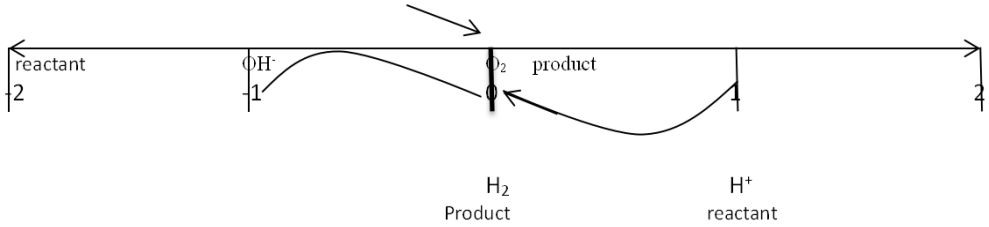
Cathodic half reaction
The H atoms are not stable. Thus, not added

The hydrogen ions are gaining electrons. Gain of electrons is reduction (RIG). The reaction happening at the cathode is reduction. The hydroxide ions are losing electrons. The loss of electrons is oxidation (OIL). The reaction happening at the cathode is reduction.

For the number line experimental group (I)

The ions migrating are OH^- ion and H^+ ion. The OH^- ion is losing electron and the H^+ ion is gaining. Representing this in number line:

The H^+ ion made movement to the left, that is, negative direction, hence reduction (NEGRED: Negative reduction). The OH^- ion made movement to the right, that is, positive direction, hence oxidation (POXY: Positive oxidation). The OH^- ion was oxidized, therefore it is the reducing agent. The H^+ ion was reduced, thus, it is oxidizing agent.



Faraday's Laws of electrolysis

Faraday's first law of electrolysis states that the mass (m) of an element discharged during the electrolysis of an electrolyte is directly proportional to the quantity of electricity (Q) passing through it. Thus,

M α Q But Q = It Therefore, Q α It

Hence M = EIt or M = EQ

M = mass in gram (g)

I = current in Amperes (A)

t = time in seconds(s)

Q = quantity of electricity in Coulomb (C)

E = Electrochemical equivalent in gA^-s^- or gC^-

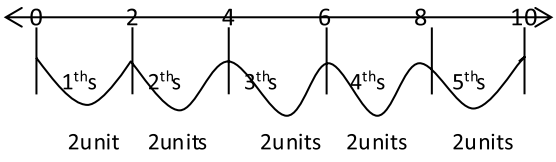
For a particular electrolytic process at different time, Faraday's first law of electrolysis can also be expressed as

$M_1Q_1 = M_2Q_2$ or $M_1/I_1t_1 = M_2/I_2t_2$

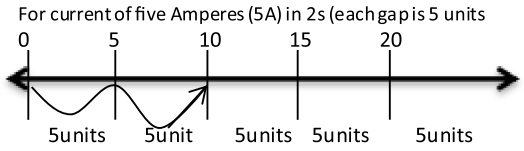
For the number line and experimental group (I)

Taking for instance in the electrolysis of a particular electrolyte, in two different experiments (i) and (ii) in which the duration of the experiment differs, such as five seconds (5s) and ten seconds (10s) respectively and the current (I) was kept constant at 2 amperes (A).

In experiment (i): The current of two amperes occurred for five (5) times which is the time (t). Each gap represents two amperes which occurred for five times.

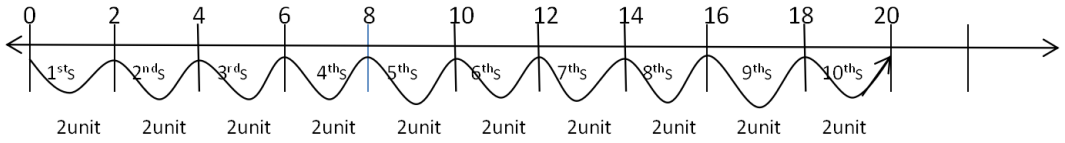


The quantity (Q) is ten Coulomb (10 C).



The same quantity of is 10 C but in a shorter time.

In experiment (ii): The current of two amperes occurred for ten (10) times which is the time (t). Each gap represents two amperes which occurred for ten times.



The quantity (Q) is twenty Coulomb (20 C).

For the number line and tale experimental group (II)

The researcher introduced topic by narrating this story to the learners. In certain spring water in my village, there are two holes from where water comes out of the ground. In one of the holes, the hole is big and the amount of water comes out very fast. When measured, it was found that the quantity of water flowing out of this hole is 1000 cm^3 of water per second. Two persons that went to this hole to fetch water and one of them (A) fetched for three seconds (3 x 1000) and the other (B) fetched for eight seconds (8 x 1000); the quantity of water each fetch depends on the time. This is likened to electrolysis. Here the volume of water fetched represents the mass of element deposited is dependent on the time.

In the second hole, the flow is at the rate, 500 cm^3s^{-1}; from this hole, for A to fetch the same quantity of 3000cm^3, it will take a longer time, six seconds. Hole B will take 16 seconds to fetcher volume of 8000cm^3. This can be likened to the first law of electrolysis which states that the mass (m) of an element discharged during the electrolysis of an electrolyte is directly proportional to the quantity of electricity (Q) passing through it. While the volume of water fetched represents the mass deposited, the flow rate of the water represents the magnitude of the current passed and the time used in fetching represents the time of passage of electricity. The higher the time of flow, the bigger the quantity deposited or fetched; also, the higher the current or flow rate, the more the quantity deposited or fetched.

In the explanation of Faraday's second law of electrolysis, the researcher narrated another story of a philanthropist in his community who donated forty (40) artificial hands to those with amputated hand(s). The researcher grouped these persons into two equal groups: those with only one amputated hand, twenty (20) persons, and those with two amputated hands also twenty (20) in number. The forty (40) artificial hands were shared equally between the two groups, that is, twenty (20) artificial hands per group. Those with one amputated hand will give twenty (20) complete persons while those two amputated hands will give only ten (10) complete persons.

In relating this story to the Faraday's second law of electrolysis which states when the same quantity of electricity is passed through different electrolytes, the relative number of moles of the elements discharged is inversely proportional to the charges on the ions of the elements. The two groups represent the different electrolyte, the electrolyte with one amputated hand represents electrolytes with one charged element, while that with two amputated hand represents electrolytes with two charged element. The equal sharing of the artificial hand to the two groups represents the same quantity of electricity passing through different electrolyte with different charges on the ions of the elements. Those with lesser charge, that is, those with one amputated hand discharged more that is 40; while those more charge, that is, two amputated hands discharged lesser that is 20. With this the inverse proportionality is explained.

3. Results

The scores of students in the three groups were analysed using ANCOVA. The analysis was done using the three research hypotheses stated for the study. The results of the analyses and discussions are as stated below.

HO_1, there is no significant difference in the performance of students in chemistry when they are exposed to (i) number line assisted instruction, (ii) tale and number line–assisted instruction, and (iii) conventional chemistry instruction.

To determine the relative effectiveness of the three instructional treatments, the students' scores were analysed using ANCOVA and the result is as shown in Table 1.

Table 1. Analysis of Covariance of Mean Score of students Exposed to (NLAI), (TNLAI) and (CI)

Source of Variation	Sum of Squares	df	Mean square	F	Significance of F
Covariates (Pre-test)	981.571	1	981.571	433.589	.000
Main effect (treatment)	167.160	2	83.580	36.920	.000
Explained	1148.731	3	382.910		
Residual	262.604	116	2.264		
Total	197.465	119	11.8599		

Denotes F is significant at 0.05 alpha level.

An assessment of Table 1 uncovers that a F (2, 117) = 36.920, α = 0.000 for the primary impact (treatment) was huge. This shows a statistical difference between (NLAI), (TNLAI), and the traditional chemistry instruction (CI) on the post-test execution of understudies when the covariate impact (pre-test) was measurably controlled. A subsequent Scheffe test was directed to find where the differences existed among the three mean scores of the three treatment bunches as demonstrated in Table 2.

The information in Table 2 reveals that there exists a statistical differences in the post test mean scores of chemistry students NLAI (X=17.8750) and TNLAI (X =20.0500), those instructed with story and number line helped guidance (TNLAI). It additionally shows a statistical difference in the post test scores of chemistry students instructed with TNLAI (X = 20.0500) compared with students instruction with CI (X = 14.0500).

Ho_2, there is no significant difference between the performance of male and female students in chemistry when taught chemistry with number line assisted instruction.

Analysis of covariance (ANCOVA) was used to find out the effect of the main treatment (NLAI) on the performance of the male and female student. The result is presented in Table 3.

Table 2. Scheffe Test of Significance on the Mean Scores of Students Exposed to (NLAI), (TNLAI), (CI)

Groups	Mean Scores	Group 1 (CAI)	Group II (CCAI)	Group III (CCI)
Group I (NLAI)	17.8750		*0.014	*0.000
Group II (TNLAI)	20.0500	* 0.014		*0.000
Group III (CI)	14.0500	*0.000	*0.000	

*The mean difference is significant at the 0.05 level.

Table 3. Analysis of Covariance of Mean Scores of Male and Female Students Exposed to Treatment

Source of variation	Sum of squares	df	Mean squares	F	Significance of F
Covariates (Pre-test)	213.621	1	213.621	85.793	*0.000
Main Effect Gender	1.074	1	1.074	0.431	**0 .515
Explained	214.695	2	107.348		
Residual	92.129	37	2.490		
Total 306.8 39	7.8672				

** denotes F is not significant at 0.05 alpha level.

An assessment of Table 3 shows that a F (1, 37) = 0.431, α = 0.515 for the primary impact (treatment) was not critical at 0.05 alpha level. This outcome shows that the male and female chemistry students' achievement, when taught using number line and tale assisted instruction, were not statistically different when the covariate (pre-test) was applied.

Ho_3, there is no significant difference between the performance of male and female students in chemistry when they are taught chemistry with tale and number line assisted instruction.

Analysis of Covariance (ANCOVA) was used to find out the effect of TNLAI (the main treatment) on the performance of female and female students. The result is presented in Table 4.

An assessment of the outcomes in Table 4 shows that a F (1, 37) = 0.115 α = 0.737 for the primary impact (treatment) was not critical at 0.05 alpha level. The outcome shows that the mean scores of the male and female chemistry students were not statistically different, when the covariate (pre-test) was applied.

4. Discussion of Findings

The analysis of covariance (ANCOVA) conducted on the academic performance of chemistry students across different instructional settings yielded significant findings. Students taught using number line assisted instruction (NLAI), tale and number line assisted instruction (TNLAI), and conventional classroom instruction exhibited notable differences in performance. This finding aligns with previous research highlighting the efficacy of innovative instructional approaches in enhancing student learning outcomes (Adu-Gyamfi, 2016;[2] Bilatam-Mayeem et al, 2023;[3] Ibole, 2015).[10]

Specifically, the Scheffe test revealed a significant difference in performance between students exposed to NLAI and TNLAI, with the latter demonstrating superior performance. This result suggests that incorporating storytelling alongside number line assisted instruction may contribute to better comprehension and retention of chemistry concepts (Chikendu, 2022).[4] In contrast, students in the NLAI group, although still outperforming the control group, exhibited slightly lower performance compared to those in the TNLAI group. This discrepancy underscores the potential added value of narrative-based instructional methods in facilitating conceptual understanding and engagement (Elena & Natalia, 2021;[6] Emendu et al, 2017).[7]

Moreover, when comparing the experimental groups (NLAI and TNLAI) with the control group (conventional instruction), significant differences favoring the experimental groups were evident. This outcome corroborates findings from previous studies highlighting the effectiveness of innovative instructional approaches, such as incorporating technology and storytelling, in improving student learning outcomes across various disciplines (Vanessa, 2017;[15] Darshana, 2023).[5] The results underscore the importance of adopting pedagogical strategies that cater to diverse learning needs and preferences to optimize student achievement in Chemistry education.

Regarding the influence of gender on academic performance, hypotheses two and three examined potential differences in student performance based on gender within the experimental groups. The ANCOVA results indicated no significant gender disparities in academic performance for students

Table 4. Analysis of Covariance on Mean Scores of Male and Female Students Exposed to TNLAI

Source of variation	Sum of squares	df	Mean squares	F	Significance of F
Covariates (Pre-test)	487.626	1	487.626	225.108	0.000
Main effect (Gender)	0.249	1	0.249	.115	**.737
Explained	487.875	2	243.938		
Residual	80.149	37	2.166		
Total	568.024	39	14.565		

** denotes not significant at 0.05 level.

taught using NLAI and TNLAI settings. These findings suggest that instructional approaches integrating number line assistance and storytelling are equally effective for both male and female students in facilitating learning and comprehension in Chemistry (Jonah et al, 2021;[12] Bilatam et al, 2023).[3]

This finding is consistent with existing literature emphasizing gender-neutral instructional practices that prioritize inclusivity and equitable learning opportunities for all students (Adimoyemma, 2010).[1] It highlights the importance of creating classroom environments that foster gender equity and minimize potential biases in educational settings (Walanda et al, 2017).[16]

5. Conclusion

In conclusion, the findings of this study highlight the significant impact of using number line and tale assisted instruction in enhancing the learning of redox reactions, particularly in the context of electrochemistry, among senior secondary school students. The results indicate that incorporating innovative teaching strategies, such as storytelling and visual aids like number lines, contributes to improved comprehension, engagement, and overall academic achievement in chemistry education.

However, it is important to acknowledge the limitations of this study. Firstly, the research did not explore alternative delivery methods, such as utilizing the internet for course content dissemination, which could have provided additional insights into effective instructional approaches. Additionally, the focus of the curriculum content was limited to redox reaction topics within the broader chemistry curriculum, potentially limiting the generalizability of the findings to other areas of chemistry education.

Moving forward, several recommendations emerge from this study. Firstly, educators are encouraged to adopt innovative teaching strategies, such as incorporating storytelling and interdisciplinary approaches involving mathematics, to enhance students' understanding of fundamental principles in chemistry. Furthermore, parents play a crucial role in supporting their children's learning journey by fostering a conducive environment for exploration and discovery at home, thereby promoting the development of cognitive skills essential for academic success.

Additionally, it is recommended that teachers actively participate in professional development opportunities, such as seminars and conferences, to exchange experiences and insights into effective teaching and learning strategies. By staying abreast of advancements in pedagogy and educational research, educators can continually refine their instructional practices to meet the evolving needs of students and optimize learning outcomes.

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