Abstract
This narrative inquiry study aimed to understand, investigate, and interpret experiences of physics teachers when using virtual simulations. The participants were chosen using purposive sampling techniques. The data was gathered through an initial survey and face-to-face interviews that followed an interview protocol. Creswell's data analysis and interpretation were used to generate themes from the verbatim transcripts of participants. Five themes emerged from their experiences: First, Novice Explorers, which shows the teachers' ability to explore the virtual simulation. Second, essential and efficient strategy, indicates that teachers have found that using simulations with students is a good teaching strategy in which students actively participate in the teaching and learning process. Third, the challenges of utilizing simulation, which points out the difficulties that physics teachers face when using simulations. Fourth, externalizing difficulties, shows how teachers manage the challenges they encounter in employing virtual simulation in the classroom. Lastly, unexpected outcomes and delightful stories, outlines the positive outcomes and realizations of teachers with the simulation. The findings provided insights for the basis of the matrix of activities for the in-service training workshops for secondary teachers. To conclude, teachers needed in-service training that would enhance the values and technology integration inside the classroom to properly implement the virtual simulations and improve their knowledge and skills. Given the limitations of this qualitative study, quantitative research is recommended as the next step in developing a comprehensive intervention to assess the effectiveness of virtual simulations in the teaching and learning process.

Keywords: Physics Teachers, Virtual Simulations, In-Service Training, Workshops, Narrative Inquiry
Introduction

The significance of incorporating technology into education and using educational technologies in the teaching-learning process is widely accepted in the field of science education (Inchik, 2022). Teachers, particularly science teachers, are integrating technology into their classrooms these days. Technology in the form of interactive simulations is one of the available resources that can and is being used to ensure that students develop conceptual understanding in science, particularly in physics (Osborne & Hennessy, 2003).

Virtual simulations are software programs that replicate the basic components of the real world to provide controlled learning environments (Colace, De Santo, & Greco, 2014). As a type of educational technology, digital simulations demonstrate a promising future as a student-centered learning tool in an active learning environment (Krajcik & Mun, 2014; National Science Board, 2018). If used properly, it allows students to engage in scientific inquiry and solve complex problems through observation, investigation, reconstruction, and collecting and analyzing large quantities of data in a short period of time (NGSS Lead States, 2013).

Although technology seems ubiquitous in today’s classrooms, debate still exists about how teachers can best use digital tools to support student learning (Evans, 2019). Nonetheless, there is still little research on science teachers' perceptions of these digital tools. Existing research has revealed that teachers rarely use these digital tools (Alneyadi, 2019; Hechter & Vermette, 2014; Maharaj-Sharma, Sharma & Sharma, 2017). Because teachers are frequently the key determinants of whether and how digital tools are used in the classroom, it is important to investigate why some teachers adopt them while others do not.

Despite teachers’ increasing use of interactive simulations, it was discovered that there is still debate about how teachers can effectively use digital resources to increase student learning in physics classes, as well as a lack of appropriate training on how to use a specific application. Under these conditions, this study investigated the physics virtual simulations used by teachers and focused on understanding their stories when using virtual simulations. The results of this study were used in designing the types of in-service training workshops that are required for physics teachers.

Methods

This study utilized the narrative inquiry method to understand, investigate, and interpret the experiences of physics teachers using virtual simulations. The participants were seven (7) junior and senior high school physics teachers in four public secondary schools in one of the municipalities in the fifth district of the province of Iloilo, Philippines. They were purposively selected for an in-depth interview with inclusion criteria provided.

A preliminary survey was conducted with the use of a validated researcher-made questionnaire regarding the virtual simulation employed by the physics teachers in the municipality. To determine which virtual simulations the teachers employed, the researcher used a frequency count. Following the initial survey, an in-depth interview was conducted using a validated interview protocol. The participants were given informed consent before participating in the study, including their right to withdraw anytime in the research process, right to privacy, and confidentiality. The real names of the participants were replaced with a pseudonym in the presentations of the stories.
The data collected from the participants were thematically analyzed following the procedure of Creswell’s book (2009) data analysis – (1) Organizing and Preparing Data for Analysis, (2) Reading Through All Data, (3) Coding the Data, (4) Coding Process, (5) Interrelating Themes, and (6) Interpreting the Meaning of Themes.

Results and Discussion

Virtual Simulation Employed by Teachers in Teaching Physics

The initial survey of virtual simulations used by teachers in teaching physics included fourteen secondary science teachers from one of the municipalities in the fifth district of Iloilo. A frequency count was used to determine which virtual simulations employed teachers in teaching physics. In the preliminary survey, it was found that 40% used Physics Education Technology (PhET) Colorado, which is the most commonly used virtual simulation among physics teachers. 20% of the teachers used both PhET Colorado and Physics Classroom, and 6% of teachers checked the form in Physics Classroom alone. In addition, 7% of the teachers checked for others in the survey form and attempted to use the Department of Science and Technology—Philippine Nuclear Research Institute (DOST PNRI) simulation, and 27% of the teachers checked that they never used any virtual simulations in teaching. They are usually teachers who have been in service for a certain number of years and will be retiring soon. Figure 1 shows the most commonly used virtual simulation by teachers based on the initial survey.

![Physics virtual simulations employed by teachers in teaching physics from the initial survey form.](image)

Furthermore, seven participants took part in an in-depth interview about their experiences with virtual simulations. According to interviews, the most commonly used virtual simulation is PhET Colorado, followed by Physics Classroom.

The PhET simulation project was founded in order to improve the way science is taught and learned around the world through the use of free interactive simulations. Banda and Nzabahimana (2021) study recommended incorporating PhET simulations into physics teaching and learning. They provide a powerful interactive visualization and animation teaching aid to improve students’ conceptual understanding of physics.
Experiences of Teachers in Using Virtual Simulations

The narratives provided insights into the lived experiences of physics teachers who used virtual simulation. The text was generated from audio recordings of in-person interviews. Transcriptions were completed and returned to participants for member checking to ensure accuracy. Member checking was done by checking in with the research participant about the validation of information by checking the accuracy of their statements and reviewing the transcript. According to Creswell and Creswell (2018), all qualitative study participants agreed to member checking, which is one of the strategies to ensure internal validity and involved taking the data back to them for their verification.

There were five themes that described the lived experiences of teachers. These themes highlight the physics teachers' stories about their experiences with virtual simulation. Table 1 shows the themes together with their subthemes that were identified from the narratives of the physics teachers using virtual simulations.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Subthemes</th>
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<tbody>
<tr>
<td>Novice Explorers</td>
<td>Average Users</td>
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<td></td>
<td>Exploring Ability</td>
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<td>Essential and</td>
<td>Interactive Engagement</td>
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<td>Efficient Strategy</td>
<td>Commendable Application</td>
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<td>Intermittent Connectivity Issues</td>
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<td>Shortage of Materials</td>
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<td>Challenges of</td>
<td>Embracing Patience and Sacrifices</td>
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<td>Utilizing Simulations</td>
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<td>Externalizing</td>
<td>Activating Creativity</td>
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<td>Difficulties</td>
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<td>Unexpected Outcomes</td>
<td>Students’ Feelings of Joy and Wonder</td>
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<td>and Delightful Stories</td>
<td>Teachers’ Sense of Fulfillment</td>
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Novice Explorers

Exploring something without adequate training or limited knowledge about it is difficult to manage. When it comes to simulation, the participants admitted that they are not experts because it is still new to them. And they are considered novices, specifically novice teachers. Farrell (2012) suggests that there is no clear definition of a novice teacher. However, he emphasized that novice teachers could be anyone who first teaches something new. There was no universal agreement on how long the teaching period was required to complete the novice stage.

As novice explorers, teachers considered themselves average users. Teachers' use of technology is an important part of their professional development as educators; however, not all teachers are born to be experts or literate in this new teaching trend. Most of them
admitted openly that there are numerous things they need to learn in order to become experts in this field. When given the opportunity to rate themselves on a scale of 1 to 10, with 10 being considered expert, they chose 7 and 8.

“Maybe from 1-10, it seems 6 or 7. Even me, I’m still exploring. I am not that expert user.”

“Actually, I could rate myself maybe average. Not necessarily that good.”

“Maybe 8 for the reason that remaining 2, I did not explore yet other topics that I will be using.”

Teachers' exploring abilities in the simulation allowed them to learn something new, which improved their skills. They are open to change and to new teaching skills, as learning never stops for teachers.

“Still learning, of course when you teach you should one book ahead to your students. You should explore it first.”

“Of course, if you are familiar on it, you should explore it with yourself.”

Prensky (2001) found that the teachers in charge of educating the Z generation (students) are digital immigrants. Digital immigrants are people who were not born in the digital world but have adopted most aspects of new technology at some point in their lives. They, like the participants, are examples of digital immigrants, albeit inexperienced. They do, however, attempt to adopt and learn the simulation for students.

**Essential and Efficient Strategy**

Teachers utilize virtual simulations to motivate students to be active and engaged in the lesson, making class discussions more interactive. Teachers revealed that there is interactive engagement among students in the teaching and learning process with the use of virtual simulations. Student engagement is defined as students' level of interest, how they interact with others in the course, and their motivation to learn about the topics (Briggs, 2015).

“For me, the way when we use virtual simulations activates... attention and participation of students in any topic...they learn because they are actively engaged in teaching and learning process as we discuss they are actively participating in the discussion.”

“They're quite interested and then they are active when it comes to analysis of the questions. They're very active participants.”

All of the participants commended the fact that virtual simulation is a good instructional tool for teaching physics. Thus, it is considered a commendable application since students can visualize the concepts in physics presented in the simulations, even the in-depth topics.

“They can clearly see and hear what you're trying to discuss on them.”
“There are given the chance to manipulate, they can see the changes in variables. If there are changes in variables, what is the effect, where are the changes... There are some topics in physics where you cannot touch, you cannot see or do anything. So very applicable since it simulates and is really close to actual (representation), so a big help for them.”

Teachers concluded in previous subthemes that using virtual simulations made students engage well in class and listen well because they focused their attention on the simulation. Students learned physics concepts, even on complex topics. Thus, virtual simulations are used for effective understanding of physics concepts.

“I mean the learning, since most of the concepts in physics are more imaginary and non-tangible. So, if we have this simulation, you could give them a more tangible experience, so they have an in-depth understanding with the use of simulations.”

“And then they can define... They can define the terms by simply observing. Through simulation they can define terms.”

The preceding narratives are also anchored in constructivism, an instructional philosophy based on the theoretical belief that student understanding is constructed through the reflection of personal experiences. The ability to act out constructivist theories toward knowledge acquisition is more easily facilitated by using computers to help students experience concepts. According to constructivists, student learning is an active process in which students construct new ideas or concepts based on their current and prior knowledge (Kearsley, 2002).

**Challenges of Utilizing Simulations**

Among the benefits of simulations for student learning, teachers encountered a variety of challenges when using simulations, including both physical and emotional challenges. The lack of resources, such as gadgets and internet connectivity problems, and how they embrace patience and sacrifices in dealing with simulations and experiencing technological gaps.

The development of the teaching strategy in this modern world, like the simulation, requires an internet connection. Though other simulations have offline features, there are still activities that need a connection to the internet in order to download them and sometimes to update the application. The majority of the participants' experiences are based on a poor internet connection, particularly when dealing with the simulation.

“It is really difficult if there is no internet connection. You know, there are features that you need online access, you need to download. Given our location here, it is really challenging to get internet access.”

“Actually, it's quite challenging because you know Internet connection here. It's not that very very accessible.”

“In my experiences. Sometimes the way we play the simulation is quite difficult. There are instances that the simulation will not take in(log).”

According to Azcarraga and Peña (2019) internet connectivity remains a problem in the Philippines. Despite the government's increased efforts to improve connectivity, current
Internet and smartphone penetration rates are well below target, which is thought to be due to institutional rigidities. The Philippines formally connected to the Internet in 1994, but the Internet remains largely problematic even today. Data revealed that the Philippines is one of the world's lowest-ranked countries in terms of Internet speed, Internet accessibility, and information sharing (PIDS, 2016).

Moreover, the participants encountered difficulty employing the simulation because of the unavailability of learning tools or devices at school that could enhance teaching and learning. In previous research, the Department of Education (DepEd) has proposed reallocating funds from projects and programs from the maintenance and other operating expenses (MOOE) budget and putting pressure on the special education fund (SEF) of local government units (LGUs) as a counterpart to support the effective implementation of blended learning in the country. They also emphasized that the assistance of various stakeholders is critical in assisting learners, particularly those who cannot afford to have all of the facilities (Ronda, 2020).

“Usually, the problem here is the availability of material. Plus, due to the number of students, we have insufficient computers compared to the number of students.”

“And challenging also because not all of our learners have the laptop or cell phone. Lack of available gadgets for the learners.”

Despite the positive aspects of technology, teachers face a hidden challenge. Every teacher has a unique experience in terms of how much patience and sacrifice they have made in their career. Nonetheless, when dealing with simulations, participants revealed common sacrifices and patience.

“But the problem is that sometimes it is really difficult to give instruction, and there are students that are really left behind.”

Teachers' experiences with giving instructions to students really require a great deal of patience. Patience is more than a virtue for teachers; it is a part of the job. Teachers, like most people, will have pet peeves and annoyances, probably more so than in most other professions. The real answer to how teachers can develop patience is to accept that things change on a daily basis and that not everything will always go your way (Incompassing Education, 2022).

Also, teachers' preparation for the simulation, on the other hand, is also a significant challenge for them that could affect their self-esteem.

“If you are a fresh graduate, then you need to teach right away. Then try to imagine their age and the fact that you have a really close age gap. So, I need to try that at least I will give the best for them, especially in physics since they are STEM students.”

The teacher’s self-esteem in delivering the lesson is important. According to Mbuva (2017), self-esteem is an important component of the development of both teachers and students, who interact in a variety of capacities on a daily basis. Teachers' self-esteem would be linked to self-concept as well, because self-concept is based on how we think and evaluate ourselves (Brookover, Thomas, & Paterson, 1964; Rosenberg, Schoenbach, & Rosenberg, 1995).
Educators have a self-concept when they are aware of who they are. Unfortunately, teachers who have a distorted self-image may become incapacitated in their teaching career.

Aside from the patience and sacrifices teachers have made with this new teaching strategy, there are still technical errors and gaps in technology that they have admitted are difficult for them at times and that they do not know how to fix.

“I am one step behind the use of technology. And I have a lot of things to do. I have a lot of things to learn to be on what is called this latest trend in teaching.”

“There is a time when I experience technical difficulty or a technical problem, and I don’t know how to fix it.”

Participants' statements about how they experience gaps with technology, wherein they admitted that sometimes they still have flaws in terms of technology, revealed that their sense of self-efficacy is low, which has a negative impact on the teaching and learning process. Self-efficacy is an individual's confidence in his ability to complete a task or action required to achieve a specific result (Bandura, 1997). In fact, teacher self-efficacy is a central phenomenon that can be viewed as one of the contributors to the learning process and effective teaching.

**Externalizing Difficulties**

Teachers are expected to be resourceful with all tasks assigned to them. Resourcefulness is the way of devising means. Being resourceful necessitates more cognitive ability. It is necessary to be able to process information both emotionally and intellectually (Jaleco, 2021). Likewise, teachers did their best and really activated their skills and thought of a solution to the problems they were experiencing due to a lack of physical facilities. They used existing resources to create something they needed for implementing quality physics teaching, particularly through simulation.

“Back to the basics, ma'am: whatever is available in offline features, those are the things I am using.”

Aside from using offline, other participants have the same ways of utilizing the available gadgets that can be found at their school just to employ the simulation, which can be called innovative teaching.

“I sometimes borrow projectors from other teachers. And then there is the time when I swap classrooms with a teacher who has a TV. I am the one who demonstrated.”

“So, what I did was provide a guided question-and-answer portion of instruction for the student. I am the one who demonstrated the simulation. Then, just like in a guide, there are continuous questions. The result is like an activity, only that I am the one who operates... then they just observe it.”

Besides from being creative in overcoming the lack of equipment at their school, participants also had ways of compensating, like using multi-lingual instruction, grouping students, being patient, and guiding or helping their students. Teachers also become more adaptable in their teaching strategies in order for the students to easily catch up on the activities' lessons.
“It is necessary that you repeat it for them. English instruction is not effective for them, yet they like their mother-tongue language.”

“So, I tried at some point. I actually tried having the students in groups; you know, half or 1/3 of the class will have a class first, and then the other will have a break ahead or something like that. At least the class size is small when they watch the simulation. They can focus well.”

“I think I handled those problems, uh, with utmost patience. Having that kind of internet is really difficult for us.”

“Teach them how to use the computer first. You know, ma’am, that we live here in rural areas. It is necessary to give guidance to them. Like, you open this, you go there, and you should be there to guide them (in using the simulation).”

Based on the above narratives, the participants are regarded as flexible teachers. The ability to use a variety of teaching techniques and strategies is referred to as flexibility. This skill is also useful in the classroom when the teacher needs to change his or her plans for the day for a variety of reasons. Under certain conditions, a flexible teacher can make changes to the plan (Eder, 2010).

**Unexpected Outcomes and Delightful Stories**

A teacher's happiness comes from watching his or her students learn, unlearn, and relearn while having fun. Though teaching requires extensive preparation on the part of teachers, when they see positive results in their students' learning, all of their efforts are literally rewarded. Teachers are overjoyed to share that their students enjoy the virtual simulation. This is one of the reasons why they continue to learn and explore simulations even though they have no training in this field, because most of them discovered that their students were captivated by the activities presented in the simulation, where they felt joy and wonder.

“They really enjoy it. When you get their attention, there is no need for you to be angry. And that is the best part. You know, when it comes to computers, it is new to them. They are amazed.”

In this sense, educational enjoyment can be defined as the joy of learning when a student believes he or she can value the content and manage and complete the activities that are presented to him or her. As a result, enjoyment is regarded as critical for later satisfaction, which supplements academic success (Ainley & Hidi, 2014).

Furthermore, the participants' stories reveal an important event in their lives that had a significant impact on their teaching method as well as their professional development as teachers. They never imagined that teaching something to students without adequate training and abilities would result in positive outcomes in the students' learning. Most of them learned and studied the simulation at their own pace, which is known as self-learning, no training was provided by the administration. Teachers still felt successful because they used simulation with students with their own might.

“Self-learning only. So that when your principal is trying to observe you for class, you have a classroom observation. You can say that your breath and confidence are
A teacher’s responsibilities and roles as a leader, counselor, tutor, manager, and team member are extremely difficult. Job satisfaction, according to Kumari (2008), is the sense of fulfillment and pride felt by people who enjoy their work and do it well. Job satisfaction is also the extent to which a job provides the worker with gratification, actualization, and enjoyment. Job satisfaction can also refer to how satisfied a teacher is with his or her success in meeting career goals and expectations (Heller, 1988).

Figure 2 below was created and established to visually explain how participants explored their experiences with simulations. This is known as the schematic structure of physics teachers’ experiences with virtual simulations. The important details being investigated in this study distinguish each structure. After all of the narratives were identified and analyzed, the rectangle shapes represented the five emerging themes. The oval shapes represent the sub-themes found within each theme that occurred. And the black lines represent the themes in order of how the teachers arrive at unexpected outcomes based on their experiences that fulfilled them in using the virtual simulation.

Figure 2: The schematic structure of physics teachers’ experiences with virtual simulations.

The participants’ life experiences were enhanced by narrative inquiry. They have proved that if you are determined to use or explore something for student learning. Their untold stories...
were highlighted and are now being heard as the basis of in-service training workshops for secondary teachers.

**Training Workshops for In-Service Science Teachers**

A three-day in-service training workshop on ICT and values integration is designed based on teachers' holistic experiences, with a matrix of activities and topics included in the workshops to strengthen teachers' virtual simulation skills and knowledge. This carefully designed 3-day training workshop is divided into sections: (1) **Identifying Information**, (2) **Rationale**, (3) **Objectives**, (4) **Working Committees**, (5) **Methodology**, (6) **Expected Outputs**, (7) **Matrix of Activities**, and (8) **Budgetary Requirements**.

This in-service training workshop is titled: 3-day district training workshops on values and technology integration to improve teachers' knowledge and skills in using virtual simulations as a teaching strategy. This training workshop was a great assistance to science teachers in improving their teaching strategy as well as their lesson planning skills with the incorporation of simulations and the integration of values inside the classroom. The training design was validated and evaluated by three experts in behavioral, content, and curriculum. And it was already copyrighted by the researcher in the intellectual property office of the Philippines.

**Conclusions**

The results of the study give insights that the Physics Education Technology (PhET) Colorado simulation is an effective virtual simulation used by secondary physics teachers in the teaching and learning process. Their experiences revealed that a transformation is possible to adjust their current situation of using virtual simulations as a new teaching strategy to supplement the learning needs of 21st century learners. To conclude, incorporating virtual simulations into the classroom is a truly effective teaching strategy for teachers in teaching physics as well as a significant aid in improving students’ conceptual understanding. Thus, teachers needed in-service training that would enhance the values and technology integration inside the classroom to properly implement the virtual simulations and improve their knowledge and skills.

Based on the results of the study, the researcher recommended that the Department of Education allow for the adaptation of simulations in the curriculum as a virtual laboratory for teaching in-depth topics in science. The Department of Science and Technology should use this study as a foundation for future research or investigations into digital simulations. IT professionals should create more simulations that do not require internet access to perform a specific activity. Local Simulation Designers and Filipino simulation designers should create local offline simulations for use in classrooms so that teachers are not dependent on American-based online simulations. The PTA and other school stakeholders should hold a mandatory meeting at least twice a year so that they will know what facilities and resources are lacking at the school; this could also strengthen the partnership between the school and stakeholders. In-service Teacher coordinators should consider looking into the results of the study. It would be beneficial if the researcher-created in-service workshops were considered and supported in the implementation of the 3-day in-service training for science teachers. Physics or science teachers should attend and participate in the implementation of the in-service training workshops. They will be given the opportunity to learn about other offline simulations that could be used in science classes. Learners should be familiarized with the features of the simulations used in the classroom. Given the limitations of this qualitative
study, it is also recommended that quantitative research be conducted as the next step in developing a comprehensive intervention to assess the effectiveness of virtual simulations in the teaching and learning process in public schools.

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