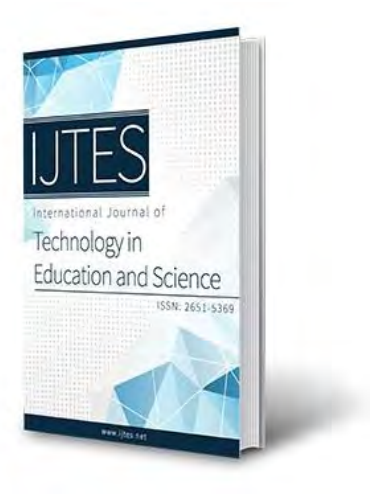

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Practices and Challenges of Teachers in Teaching Science Online

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Abstract

Educational disruption brought by this pandemic changed the practices and challenged teachers and students to navigate the new learning landscape. This descriptive research study determined the practices and challenges of science teachers in teaching amidst the COVID-19 pandemic. A total of 54 science teachers in Zambales, Philippines, responded to the researcher-made Practices and Challenges of Science Teachers Questionnaire (PCSTQ). Results revealed that science teachers use printed modules in their classes as a learning delivery modality. They often employ varied science teaching strategies, utilize assessment strategies and incorporate technology integration in teaching during educational disruption. They frequently encounter challenges in academic workload, laboratory experimentation, and physical infrastructures, while they sometimes face challenges regarding digital infrastructure, instructional resources, digital competence, and assessment and supervision. There are significant differences in the teachers' teaching strategies by trainings and technology integration practices by trainings and modality used. Furthermore, there are significant differences in the challenges in instructional resources, physical infrastructure, digital competence, and academic workload by years in service; challenges in digital competence by zone; and challenges in academic workload by age. The paper discusses the implications of the study on pedagogy, policy, and practice. Additionally, it contributes to the limited literature on science teaching during the COVID-19 pandemic by describing the challenges and practices of teachers in this context.

Introduction

The COVID-19 pandemic has caused major disruptions in the education system, presenting challenges for both teachers and students. Two key factors have been affected by the pandemic. Firstly, it has become clear that pedagogical adaptations are crucial. Secondly, teachers have had to adjust how they divide their time between teaching, interacting with students, and administrative tasks (Barron et al., 2021). The sudden shift of learning mode resulted in the gradual transition to online ways of delivery, and teachers' workloads have been significantly increased (Allen et al., 2020). Many public institutions, including childcare centers, schools, universities, and further education providers, have transitioned to distance learning due to the global pandemic. World Bank (2020), as cited by Lapada et al. (2020), reports that numerous countries, such as Colombia, Italy, Japan, and the

Philippines, have followed the guidance of the World Health Organization (WHO) through their respective Ministry of Education.As a result, DepEd promotes flexible learning modalities, which means that learning programs are developed based on the students', schools', or community's ability (Handog, 2020).

Handog (2020) reported that a lot of Filipino students are facing difficulties with remote learning, and their parents are unable to afford smartphones, laptops, computers, and internet connections. While radio, television, and online technology have made things easier, nothing can replace a teacher's wish to meet their students in person again. As a result of the financial constraints, module-based learning has become an option for students (Punzalan, 2020). Numerous Filipino students are currently grappling with the challenges of distance learning, primarily because of the exorbitant costs of acquiring the technological tools necessary for their coursework.

As the COVID-19 Pandemic wreaks havoc around the world, it is important to prioritize the educational needs of children and youth during this crisis period (Gee, 2022; Priyambada et al., 2022; Reimers & Schleicher, 2020; Rivaldo, Sutrisno, & Manik, 2022; Wang, Liu, & Ho, 2022). Hence, online and distance education have proven to be the panacea for this current global pandemic. It also emphasizes that the issues with e-learning and teaching are well established, as are the issues with accessibility, affordability, responsiveness, teaching, and lifelong learning (Pokhrel & Chhtri, 2021). This study was supported by Dizon et al. (2021), wherein the availability and adequacy of technology infrastructure and efficient and effective management of technology infrastructure were crucial problems that needed to be addressed at schools amidst this pandemic. In addition, the absence of laboratory experiments, field trips, and other off-campus engagements changed the current sense as it transitioned to online delivery of courses. According to Landicho (2020), the sudden shift in learning delivery gives rise to new challenges, such as redesigning lessons and tests, technical resource limitations, and the impact of other variables, including reduced social connections between learners and teachers.

In Indonesia, online learning faces difficulties and challenges due to three key factors: technology, students, and teachers. Access to the internet is the most challenging aspect of online learning, according to 42.4% of students. Other issues raised by 21.5% of students included a lack of motivation, poor time management skills, and a shortage of communication devices like smartphones. Teachers were responsible for 36.1% of the problems, mainly due to inadequate explanations and the use of online teaching applications (Wisanti et al., 2021).

Currently, there are only a few studies that discuss how science teachers are navigating the obstacles of teaching during the pandemic. As a result, this research project sought to identify the specific practices and challenges science teachers face when conducting classes amidst the COVID-19 pandemic. The research focused on the experiences of science teachers in the Department of Education (DepEd) Division of Zambales and how they have adapted their teaching methods to the current circumstances.

Literature Review

This study is based on the TPACK model, which was derived from the pedagogical content knowledge (PCK) framework proposed by Shulman in 1986. The TPACK model focuses on the intersection of technological,

pedagogical, and content knowledge (TPACK). The term PCK refers to knowledge that encompasses both content and pedagogy (Barksdale et al., 2021; Cox & Graham, 2009; Mishra & Koehler, 2006; Mutlu et al., 2019; Putri et al., 2022; Schmidt et al., 2009; Schiering et al., 2023). In 2006, Mishra and Koehler put forward the TPACK framework. They explained that the most important part of TPACK involves creating a new type of knowledge that combines existing teaching methods with technology in order to improve their effectiveness.

In this study, the use of technology by science teachers is considered as the technological dimension. The assessment strategies used by teachers are considered as part of the content knowledge sub-variable, while the pedagogical dimension of TPACK is evaluated based on the teaching strategies employed by teachers. The challenges have been identified based on a thorough literature review conducted by researchers. These challenges can be classified into three dimensions: technological knowledge (TK), content knowledge (CK), and pedagogical knowledge (PK). Under the TK dimension, challenges related to digital infrastructure and digital competence have been identified. Under the CK dimension, challenges related to assessment and supervision, as well as heavy workload, have been identified. Lastly, under the PK dimension, challenges related to instructional resources, physical infrastructures, and laboratory experimentation have been identified.

The utilization of technology in teaching and learning has been a valuable asset in the Philippines during the pandemic, as it has allowed for educational continuity. The Department of Education has implemented the basic education learning continuity plan (BE-LCP) for the 2020-2021 school year through the issuance of DepEd Order No. 12, s. 2020 in June 2020 in response to the COVID-19 public health emergency. The order suggests various learning modalities, including face-to-face, distance learning (online, modular, TV/Radio-based instruction), blended learning, and homeschooling. Technology is particularly evident in distance learning, including online instruction and TV and radio-based instruction. Additionally, blended learning also incorporates technology in the teaching-learning process.

Regarding science education, online learning can be beneficial in terms of conceptual retention, student engagement, and reinforcement of abstract concepts. The use of technological tools such as PhET simulations, virtual labs, and other similar virtual applications can enhance conceptual and procedural knowledge in science. Science teachers play a vital role in facilitating technology-based teaching to ensure learners remain engaged despite the pandemic.

Method

Research Design

The study employed a descriptive quantitative research design to determine the practices and challenges of Science teachers in teaching science amid COVID-19 pandemic.

Respondents and Location

The respondents in this research were Science teachers from the Division of Zambales, encompassing areas from

Subic to Sta. Cruz in the province of Zambales. The teachers were chosen through snowball sampling. Table 1 shows the demographics of respondents.

Table 1. Respondents' Demographics

Profile	**F (N=54)**	**%**
Age		
under 25	2	3.70
25-29	17	31.48
30-39	22	40.74
40-49	10	18.52
50-59	3	5.56
Sex		
Male	16	29.6
Female	38	70.4
Grade Level Taught*		
Grade 12	13	24.07
Grade 11	15	27.78
Grade 10	26	48.15
Grade 9	23	42.59
Grade 8	16	29.63
Grade 7	20	37.04
Teaching Position		
Master Teacher II	3	5.56
Master Teacher I	1	1.85
Teacher III	21	38.89
Teacher II	12	22.22
Teacher I	17	31.48
Specialization		
Biological Science	27	50.00
General Science	16	29.63
Physical Science	4	7.41
Mathematics	3	5.56
Chemistry	2	3.70
Araling Panlipunan	1	1.85
Filipino	1	1.85
Years of Teaching Science		
1 year and below	6	11.11
2-7 years	28	51.85
8-13 years	11	20.37
14-19- years	5	9.26

Profile	**F (N=54)**	**%**
20 years and above	4	7.41
Number of Science-Related Trainings Attending during Pandemic		
0	17	31.48
1-3	20	37.04
4-6	12	22.22
7-9	0	0.00
10 and above	5	9.26
District		
Botolan	5	9.26
Candelaria	1	1.85
Castillejos	7	12.96
Iba	1	1.85
Masinloc	5	9.26
Palauig	1	1.85
San Antonio	5	9.26
San Marcelino	11	20.37
San Narciso	1	1.85
Santa Cruz	4	7.41
Subic	13	24.07
Learning Delivery Modality Used in Science Class*		
Online Digital Modules	11	20.37
Offline Digital Modules	11	20.37
Printed Modules	48	88.89
Radio / Television	2	3.70
Blended (TV+Radio+Digital & Printed Modules)	3	5.56
Online Meet	1	1.85

**Multiple responses*

As shown in the Table 1, science teachers with aged 30-39 dominated the distribution with a total of 22 (40.74%), followed by aged 25-29 had a total of 17 (31.38%), aged 40-49 had a total of 10 (18.52%), aged 50-59 had a total of 3 (5.56%) and aged under 25 had a total only of 2 (3.70%). Out of 54 science teachers, 30 or 70.4% are female and 16 or 29.6% are male. The result shows that there is a greater number of female respondents. In addition, a total of 26 (48.15%) teachers teaches Grade 10, 23 (42.59%) teachers teaches Grade 9, 20 (37.04%) teachers teaches Grade 7, 16 (29.63%) teachers teaches Grade 8, 15 (27.78%) teachers teaches Grade 11 and 13 (24.07%) teachers teaches Grade 12. The result shows that most of the grade level taught by science teachers are Grade 10.

Out of 54 respondents, 21 (38.89%) are Teacher III, 17 (31.48%) are Teacher I, 12 (22.22%) are Teacher II, 3 (5.56%) are Master Teacher II and only 1 (1.85%) for Master Teacher I. The result revealed that there are more Teacher III position than Masters Teachers. In terms of specialization, it shows that 27 (50.00%) or half of the respondents are Biological Science, 16 (29.63%) are General Science, 4 (7.41%) are Physical Science, 3 (3.70%) are Chemistry and 1 (1.85%) are Filipino and Araling Panlipunan. It described that most of science teachers have the specialization of Biological Science. On the other hand, it also revealed that there are non-related teachers and have a specialization of Filipino and Araling Panlipunan that teaches science subject. As shown, 28 (51.85%) of the respondents are in 2-7 years in service, 11 (20.37%) are in 8-13 years in service, 6 (11.11%) are in 1 year and below, 5 (9.26%) reached 14-19 years and only 4 (7.41%) reached 20 and above years in service.

As illustrated in the table, 20 (37.04%) of the respondents attended 1-3 times training during the pandemic, 17 (31.48%) responded no trainings at all, 12 (22.22%) had 4-6 trainings attended and 5 (9.26%) had 10 or above trainings. This implies that only few had the chance to have 10 and above trainings while some had 1-3 trainings and others responded no trainings at this time of pandemic. In terms of district, 13 (24.07) science teachers are from Subic, 11 (20.37%) are from San Marcelino, 7 (12.96%) are from Castillejos, 4 (7.41%) are from Sta. Cruz, 5 (9.26%) are from Botolan, Masinloc, and San Antonio, and 1 from Candelaria, Iba Palauig and San Narciso. The result shows that the greater number of respondents are from Subic. Furthermore, science teachers use printed modules (48 or 88.89%), online and offline modules (11 or 20.37), blended learning (3 or 5.56), radio/television (2 or 3.70), and only 1 for online meet (1.85). This indicates that most science teachers use printed module as their learning modality in their classes.

Research Instrument

The study utilized a questionnaire called the Practices and Challenges of Science Teachers Questionnaire (PCSTQ), which was created by researchers and based on works by various authors. This tool consists of 96 items that are rated on a 4-point scale (ranging from 1= never to 4= always). The questionnaire is divided into three dimensions for science teachers' practices: teaching strategies (11 items, α=0.845), assessment strategies (26 items, α=0.938), and technology integration (10 items, α=0.936). There are also seven dimensions for the challenges science teachers face, each with seven statements: instructional resources (α=0.914), physical infrastructures (α=0.945), digital infrastructure (α=0.957), laboratory experimentation (α=0.973), digital competence (α=0.945), assessment and supervision (α=0.943), and heavy workload (α=0.941). Overall, the questionnaire demonstrated excellent internal consistency, with a Cronbach alpha coefficient of α=0.963 for practices and α=0.985 for challenges.

Data Gathering Procedure

The researchers began by creating a research instrument and having professional validators verify it. They obtained permission from professionals to conduct a survey via Google Forms, and informed science teachers about the study's purpose and consent at the start of the survey. Two weeks later, they retrieved the survey questionnaire with 96 items and proceeded to analyze and interpret the data collected.

Data Analysis

After the data were encoded, tabulated, and organized, the researchers analyzed the data using SPSS and MS Excel. Frequency and percentage were used to describe the demographic of science teachers in terms of age, sex, grade level taught, teaching position, specializations, years of teaching science, number of relevant trainings, district and learning delivery modality used in science class. The weighted mean and standard deviation were utilized to determine the practices and challenges of the respondents in teaching science amidst this pandemic. The study also used the one-way analysis of variance to check the significant difference of the respondents' practices and challenges of teaching science when grouped according to profile variables.

Results and Discussion

Practices of Science Teachers in Teaching Science at a Distance amidst COVID-19

Table 2 shows science teachers' practices in teaching science in terms of teaching strategies. The table reveals that these teachers frequently utilize a range of techniques, with a weighted mean of 3.13 (SD=0.48). This suggests that they possess effective methods for helping students achieve successful learning outcomes, particularly in the context of new normal blended learning. Furthermore, it demonstrates that science teachers have an excellent pedagogical knowledge (PK), even in light of the challenges posed by the pandemic.

Table 2. Respondents' Practices in Teaching Science in terms of Teaching Strategies

Statements	**M**	***SD***	**VD**
1. I transform my science lectures into smaller modules to help my students understand science concepts.	3.30	0.66	O
2. I utilize modular-based teaching approach for my science class with the use of self-learning module.	3.74	0.48	A
3. I give a pre-recorded science video lectures to my students to supplement their learning.	2.37	1.00	S
4. I have video tutorial to ensure my students are grasping the work assigned.	2.19	0.93	S
5. I have live chats to ensure my students know what to do in their self-learning modules.	3.09	0.96	O
6. I gather relevant resources from the web to design a self-learning module.	2.94	0.90	O
7. I give more practical and relevant performance task to my students.	3.46	0.69	O
8. I consider students' situations and give them extra time in accomplishing their learning tasks.	3.74	0.48	A
9. I have backup plans for some potential issues without causing my students to fall behind in their learning.	3.57	0.50	A
10. I apply humor and keep my online teaching engaging.	2.80	1.09	O
11. I design learning activity sheets for my science class to achieve the most essential learning competencies at the end of the course.	3.19	0.78	O
Weighted Mean	**3.13**	**0.48**	**O**

Note: Always (A) 3.50-4.00; Often (O) 2.50-3.49; Sometimes (S) 1.50-2.49; Never (N) 1.00-1.49

The science teachers have adopted effective teaching practices, with the highest mean scores being for strategies such as using modular-based approaches for science classes with self-learning modules (M=3.74), accommodating students' situations by providing extra time for completing tasks (M=3.74), and having backup plans to address potential issues without compromising students' learning progress (M=3.57). Their commitment to supporting each student's learning is evident, as they provide resources and strategies that keep students motivated and engaged during remote learning and offer guidance for hands-on learning opportunities.

The findings indicate that some science teachers utilize certain teaching methods, such as providing pre-recorded science video lectures (M=2.37) and creating video tutorials to guide students in their self-learning assignments (M=2.19). However, these strategies are not frequently employed as all the science teachers follow a modular-based teaching approach in their classes.

According to Handog (2020), that many Filipino students struggle with distance learning and parents cannot afford to purchase smartphones, laptop, computer, and internet connections. Science teachers who implement effective teaching strategies can help prevent early school leaving during a pandemic crisis. It is up to the teacher to plan and implement successful teaching strategies that engage their students. Teachers should be passionate about teaching and learning, and also be attentive to their students' needs and interests.

Table 3 shows science teachers' practices in teaching science in terms of assessment strategies. Science teachers often practice science teaching in terms of assessment strategies based on a weighted mean of 3.00 (SD=0.49). This indicates that these teachers consistently evaluate their students and utilize effective methods to ensure that learning goals are achievable and tailored to the students' needs, particularly in the new collaborative learning environment.

Table 3. Respondents' Practices in Teaching Science in terms of Assessment Strategies

Statements	**M**	***SD***	**VD**
1. I utilize social media platforms (e.g. Facebook messenger) in assessing and providing immediate feedback to my students in addition to numeric score or grade.	3.46	0.77	O
2. I give homework that is stimulating or creatively challenging.	3.07	0.84	O
3. I manage to gather information about my students and respond to their needs.	3.33	0.75	O
4. I obtain enough feedback from my students despite the flexible teaching and assessment policies.	3.31	0.64	O
5. I collect data from the submitted hard copy outputs of my science students.	3.78	0.46	A
6. I collect data from the submitted digital outputs of my science students.	3.24	0.91	O
7. I creatively develop and administer my own assessment in order to monitor my students' learning, especially in this time of COVID-19 pandemic.	3.44	0.63	O

Statements	M	*SD*	VD
8. I use audio/video materials to assess student understanding about science concepts.	2.46	1.02	S
9. I assess my students through online interview.	2.22	1.00	S
10. I use group/ peer assessment to evaluate the learning of my students.	2.28	1.04	S
11. I use paper and pen test at the end of the unit to determine how well my students met the learning competencies.	3.70	0.60	A
12. I assess my students at the end of the quarter through paper and pen test.	3.69	0.75	A
13. I use self-assessment in the module to increase the interest and motivation of my students.	3.46	0.69	O
14. I assess my students through the performance tasks included in their self-learning module.	3.57	0.72	A
15. I assess my students through demonstration of their projects, presentation and products.	3.07	0.93	O
16. I check the learning of my students through their journal entries.	2.89	0.95	O
17. I provide rubrics/checklist in evaluating my students' works.	3.72	0.49	A
18. I make use of visual displays like charts, posters in assessing students' learning.	3.17	0.77	O
19. I use written reports in evaluating my students' learning.	3.20	0.79	O
20. I engage my students in home-based experiments to measure their applied skills in understanding the science concepts.	3.20	0.68	O
21. I administer online exam or quiz to my students to check their learning progress.	2.35	1.17	S
22. I employ computer-assisted games as an assessment to my students.	2.11	1.13	S
23. I employ online observations in my students to effectively evaluate learning outcomes.	2.24	1.04	S
24. I practice virtual oral recitations to assess my students' learning.	2.09	1.12	S
25. I include virtual experiments to assess the lab skills of my students.	1.93	1.11	S
26. I utilize the DepEd Commons portal to provide free and high-quality learning opportunities to my students.	2.93	0.80	O
Weighted Mean	**3.00**	**0.49**	**O**

Legend: Always (A) 3.50-4.00; Often (O) 2.50-3.49; Sometimes (S) 1.50-2.49; Never (N) 1.00-1.49

According to ratings from science teachers, certain practices are consistently implemented. These practices include collecting hard copy outputs from science students to gather data (M=3.78), utilizing rubrics/checklists to evaluate student work (M=3.72), administering paper and pen tests at the end of a unit to gauge understanding of learning competencies (M=3.70), conducting paper and pen tests at the end of the quarter (M=3.69), and evaluating students through performance tasks in self-learning modules (M=3.57). These findings demonstrate that teachers are effectively assessing student work and providing resources to aid in meeting learning goals.

Many teachers use various methods to assess and provide immediate feedback to their students. Social media platforms like Facebook Messenger are often used (M=3.46), along with self-assessment modules, to increase students' interest and motivation (M=3.46). Some teachers also creatively develop and administer their own assessments to monitor students' learning during the COVID-19 pandemic (M=3.44). Gathering information about students and responding to their needs is also common practice (M=3.33), as well as obtaining enough feedback from students despite flexible teaching and assessment policies (M=3.31). Teachers may collect data from submitted digital outputs (M=3.24), engage students in home-based experiments (M=3.20), and make use of visual displays like charts and posters (M=3.17) to assess their learning. Homework that is stimulating or creatively challenging (M=3.07) is also given, and students are assessed through demonstrations of their projects, presentations, and products (M=3.07). Teachers use the DepEd Commons portal to provide students free and high-quality learning opportunities (M=2.93), and they check their students' learning through journal entries (M=2.89). Teachers also provide tools and tactics to help students stay motivated and engaged while learning remotely and guidance to provide hands-on learning experiences.

On the other hand, the results revealed that the science teachers sometimes apply audio/video materials to assess student understanding about science concepts (M=2.46); administer online exams or quiz to students to check their learning progress (M=2.35); use group/ peer assessment to evaluate the learning of students (M=2.28); employ online observations in students to effectively evaluate learning outcomes (M=2.24); assess students through online interview (M=2.22); employ computer-assisted games as an assessment to students (M=2.11); practice virtual oral recitations to assess students' learning (M=2.09); and virtual experiments to assess the lab skills of students (M=1.93). Since all Science teachers are facing the new normal set-up of teaching these practices and strategies are needed to apply to help students engage in learning Science.

Teachers use various assessment techniques in science to evaluate their students' conceptual understanding, which aligns with the content knowledge (CK) dimension of TPACK. To keep students motivated, teachers must change their approaches and be inventive. Teachers' time allocation between teaching, engaging with students, and administrative responsibilities has been re-calibrated as a result of the pandemic (Barron et al., 2021). The assessment practices of teachers during the COVID-19 pandemic has been challenged most especially in ensuring that students' responses and outputs are done by students themselves, and are not generated by AI (artificial intelligence) tools. Recent studies reported different assessment strategies employed by teachers despite the challenging times (Gamage et al., 2020; Rahim, 2020; Scully et al., 2021; Senel & Senel, 2021; Tartavulea et al., 2020).

In Table 4, the practices of science teachers in integrating technology into their teaching during the pandemic are displayed. It is evident from the computed mean of 3.13 (SD=0.48) that science teachers frequently use technology in their teaching. This is in line with the current trend of blended learning in some schools, where teachers rely more on educational technology to deliver instruction, especially in the field of Science. This practice aligns with the technological knowledge (TK) dimension of TPACK, which emphasizes the importance of integrating technology to enhance instruction for students.

Table 4. Respondents' Practices in Teaching Science in terms of Technology Integration

Statements	M	SD	VD
1. I use electronic board/whiteboard/SMART board in my science class.	1.98	1.09	S
2. I utilize online collaborative tools (e.g.Mentimeter, Kahoot, Tricider) in my online discussion.	1.87	1.06	S
3. I employ PowerPoint or other digital slides in my science class.	2.61	1.22	O
4. I manage to have clicker response system in my science class.	1.96	1.05	S
5. I use overhead projector/opaque projector in presenting my science lessons via Zoom or Google Meet.	1.91	1.10	S
6. I include links of documentary, movie, video clips or Youtube videos in the science modules of my students.	2.70	1.13	O
7. I utilize simulations and animation (e.g. PhET interactive simulation) in discussing concepts in my science class.	2.06	1.14	S
8. I make use of improvised apparatus or equipment in conducting experiments for my science class.	2.41	1.06	S
9. I ask my students to visit relevant website to supplement their learning in science.	3.09	0.98	O
10. I write in my digital tablet or any document-writing technology to discuss problem-solving and topics which involve computation.	2.19	1.10	S
Weighted Mean	**3.13**	**0.48**	**O**

Legend: Always (A) 3.50-4.00; Often (O) 2.50-3.49; Sometimes (S) 1.50-2.49; Never (N) 1.00-1.49

Three of these practices under technology integration were rated often by the respondents. This practice includes asking students to visit relevant website to supplement their learning in science (M=3.09); include links of documentary, movie, video clips or Youtube videos in the science modules of students (M=2.70); and employ PowerPoint or other digital slides in science class (M=2.61). This implies that despite of the sudden shift into distance learning, they make use other possible ways to further supplement students' learning by utilizing available technologies.

On the other hand, teachers sometimes exercise on making use of improvised apparatus or equipment in conducting experiments for science class (M=2.41); writing in digital tablet or any document-writing technology to discuss problem-solving and topics which involve computation (M=2.19); utilize simulations and animation (e.g. PhET interactive simulation) in discussing concepts in science class (M=2.06); use of electronic board/whiteboard/SMART board in science class (M=1.98); manage to have clicker response system in science class (M=1.96); use overhead projector/opaque projector in presenting science lessons via Zoom or Google Meet (M=1.91); and utilizing of online collaborative tools (e.g.Mentimeter, Kahoot, Tricider) in online discussion (M=1.87). This signifies that they occasionally practice these technologies aside from modular learnings. The use of different technology-based tools in classroom during the pandemic helped educators to smoothly deliver their lessons at a distance. Recent scholarly articles reported the crucial role of technology in virtual classes during the COVID-19 pandemic (Christopoulos, & Sprangers, 2021; Hakim, 2020; Hu et al., 2021; Khatoony, &

Nezhadmehr, 2020; lemay et al., 2021; Tamah et al., 2020).

The information given in Table 5 summarizes the teaching practices of science teachers. Overall, it is evident that they frequently utilize these methods (M=3.09). The table highlights that teachers place a high emphasis on using effective teaching strategies (M=3.13), integrating technology (M=3.13), and implementing successful assessment techniques (M=3.00). This indicates that despite the challenges posed by the pandemic, science teachers continue to employ these practices to ensure that the learning process remains engaging and worthwhile.

Table 5. Summary of Science Teachers' Practices

Practices	**M**	**SD**	**VD**
Teaching Strategies	3.13	0.48	O
Assessment Strategies	3.00	0.49	O
Technology Integration	3.13	0.48	O
Overall	**3.09**	**0.48**	**O**

**M=Mean; SD-Standard Deviation; VD-Verbal Description; O-Often*

Challenges of Science Teachers in Teaching Science at a Distance amidst COVID-19

In Table 6, the challenges faced by science teachers in terms of instructional resources are presented. The results indicate that teachers sometimes encounter difficulties with instructional resources, with a weighted mean of 2.40 (SD=0.75). This suggests that challenges are rare and that teachers are generally able to provide adequate resources and materials for their science classes.

Table 6. Respondents' Challenges in Teaching Science in terms of Instructional Resources

Statements	M	SD	VD
1. I face difficulty designing the self-learning module due to a lack of relevant resources.	2.59	0.81	O
2. I have a problem searching for good references online to supplement the educational material for my science class.	2.41	0.88	S
3. I do not have adequate access to suitable digital instructional aids (e.g. laptops, tablets, phones).	2.09	0.98	S
4. I cannot teach science concepts effectively because of the absence of laboratory apparatuses.	2.59	1.06	O
5. I have difficulty accessing updated instructional materials for my science class.	2.44	0.90	S
6. I struggle to find some relevant visual, audio, and audio-visual materials for my science class.	2.31	0.93	S
7. I have limited textbooks, workbooks, and handbooks for my science class.	2.33	0.97	S
Weighted Mean	**2.40**	**0.75**	**S**

Legend: Always (A) 3.50-4.00; Often (O) 2.50-3.49; Sometimes (S) 1.50-2.49; Never (N) 1.00-1.49

However, it revealed that respondents ranked two specific challenges as the most difficult. These include having difficulty designing the self-learning module due to a lack of relevant resources (M=2.59) and being unable to effectively teach science concepts due to a lack of laboratory apparatuses (M=2.59). This implies that Science teachers must be creative, flexible in finding resources in order to mitigate these challenges.

Science educators face difficulties in obtaining up-to-date teaching materials and helpful online references to supplement their lessons. Furthermore, they encounter obstacles in locating relevant visual, audio, video, and audiovisual aids to improve their teaching, as well as limited access to Science textbooks. They also have inadequate access to digital teaching aids such as laptops, tablets, and phones. However, despite these challenges, teachers still manage to obtain resources to aid their teaching. The findings support the conclusion of Mupa and Chinooneka (2015) that several teachers are experiencing difficulty in teaching Science due to limited resources.

Table 7 shows science teachers' challenges in teaching science in terms of physical infrastructures. As seen in the table, the science teachers had often experience challenge in teaching science in terms of physical infrastructures based on the weighted mean 2.52 (SD=0.84). Teaching science can be difficult for educators who lack proper physical infrastructure. Science teachers face challenges when conducting laboratory activities, as students are unable to perform the same experiments at home. Additionally, demonstrating science activities in different learning spaces can be a challenge due to limited space. Therefore, teachers should explore new approaches and tools to compensate for the lack of physical labs.

Table 7. Respondents' Challenges in Teaching Science in terms of Physical Infrastructure

Statements	**M**	**SD**	**VD**
1. I cannot focus in my science discussion because of the physical noises in the environment.	2.09	0.96	S
2. I cannot let my students conduct some experiments due to limited physical infrastructure they have at home.	2.78	0.98	O
3. I cannot teach the science concepts well because of the absence of a laboratory room.	2.48	1.06	S
4. I cannot utilize the I.T. room for my science classes.	2.57	1.19	O
5. I find it difficult to teach science as my students are in different learning spaces.	2.70	0.98	O
6. I find it challenging to demonstrate science activities due to the limited space I have at home.	2.61	1.02	O
7. I am unable to find alternative resources for my home-based experiments.	2.43	0.94	S
Weighted Mean	**2.52**	**0.84**	**O**

Legend: Always (A) 3.50-4.00; Often (O) 2.50-3.49; Sometimes (S) 1.50-2.49; Never (N) 1.00-1.49

Furthermore, the results shows that science teachers were noted irregularly experience challenge teaching science concepts well because of the absence of a laboratory room (M=2.48); unable to find alternative resources for my home-based experiments (M=2.43); and cannot focus on science discussion because of physical noises in the

environment (M=2.09); With this result, science teachers taken actions to overcome the challenges to accommodate laboratory learning while students are in remote learning.

Teachers of science have made necessary changes to their lessons, such as transitioning laboratory activities to online or blended delivery methods. Due to this, academics have had to adapt to remote teaching and alternative techniques to maintain laboratory delivery. This has created challenges in the education environment, as students have had limited access to laboratory facilities and face-to-face instruction has been unavailable. Despite these challenges, students have been able to work at their own pace and have more control over their learning during these remote laboratory activities.

Table 8 shows science teachers' challenges in teaching science in terms of digital infrastructure. As reflected in Table 8, teachers are sometimes experiencing challenges in teaching science in terms of digital infrastructure as revealed by the weighted mean of 2.49 (SD=0.92). This implies that teachers are facing challenges when it comes to incorporating digital technologies into their teaching methods and creating the necessary products and projects. To adapt to the new normal, teachers must acquire proficiency in various tools and resources, which requires a significant learning curve.

Table 8. Respondents' Challenges in Teaching Science in terms of Digital Infrastructure

Statements	**M**	**SD**	**VD**
1. I struggle with limited accessibility and network connection when teaching in online classes.	2.81	1.12	O
2. I face difficulty in motivating myself to use ICT in teaching laboratory activities.	2.43	1.04	S
3. I have a problem with document management tools such as MS Office, Onedrive, and Gsuite in storing and organizing files for my modules.	2.24	1.04	S
4. I have limited access to online whiteboards when teaching in online classes.	2.59	1.04	O
5. It is hard for me to utilize social media platforms/channels in sending lectures to group chats.	2.22	1.06	S
6. I do not have premium subscription to online videoconferencing apps (e.g. Google Meet, Zoom, Edmodo, and Google Classroom) to teach my students.	2.43	1.11	S
7. I have trouble accessing online applications (e.g. Kahoot, Mentimeter) due to poor signal.	2.74	1.10	O
Weighted Mean	**2.49**	**0.92**	**S**

Legend: Always (A) 3.50-4.00; Often (O) 2.50-3.49; Sometimes (S) 1.50-2.49; Never (N) 1.00-1.49

Some respondents were often struggling with limited accessibility and network connection when teaching in online classes (M=2.81); also, trouble accessing online applications (e.g. Kahoot, Mentimeter) due to poor signal (M=2.74); and having limited access to online whiteboards when teaching in online classes (M=2.59). The results specified that during this pandemic the respondents are facing problems in teaching Science due to limited access on useful applications online.

Teaching with technology can be challenging for educators. Some common hurdles include difficulty finding motivation to use lab technology, limited access to high-quality video conferencing apps, trouble managing documents using MS Office and Gsuite, and reluctance to incorporate social media into lectures. COVID-19 pandemic situation has posed unprecedented challenges requiring teachers to adapt to teaching online and with that teachers had to change to online teaching, requiring them to use various digital tools and resources to solve problems and implement new approaches to teaching and learning (König et al., 2020). Moreover, the importance of online teaching has been emphasized particulary during the educational disruption due to COVID-19 pandemic (Canese et al., 2022; Kaleli, 2021; Tanguay, & Many, 2022).

Table 9 shows science teachers' challenges in teaching science in terms of laboratory experimentation. As shown, science teachers often experience challenges in laboratory experimentation based on the weighted mean of 2.82 (SD=0.90). This indicates that the pandemic brought difficulties for teachers to conduct experiments that will supplements to the learning of students. Also, most accessible mode of learning is through printed modules.

Table 9. Respondents' Challenges in Teaching Science in terms of Laboratory Experimentation

Statements	**M**	**SD**	**VD**
1. I cannot let my students experience the laboratory tools in the current learning setup.	3.02	1.02	O
2. I face difficulty in teaching laboratory experiments in a flexible learning setup.	2.91	0.98	O
3. I struggle in providing my students with appropriate laboratory activities in their module.	2.76	0.97	O
4. I am having a hard time evaluating my students' home-based experiments.	2.69	1.02	O
5. It is difficult for me to catch my students' interest in simulation or online labs.	2.72	1.07	O
6. I am unable to demonstrate the process of the experiment through online discussion.	2.72	1.05	O
7. I find it challenging to have collaborative laboratory experiments/activities due to the students' movement restrictions.	2.91	1.01	O
Weighted Mean	**2.82**	**0.90**	**O**

Legend: Always (A) 3.50-4.00; Often (O) 2.50-3.49; Sometimes (S) 1.50-2.49; Never (N) 1.00-1.49

Providing students with lab tools and experiments has become challenging for teachers due to movement restrictions. Creating appropriate lab activities for modules can also be a struggle. It is difficult to engage students in online labs and demonstrate the process through online discussion. Additionally, evaluating home-based experiments poses a challenge. It is clear that conducting experiments is a challenge in the current setup. There are many science concepts that require experiments, which can be difficult for both learners and teachers.

Table 10 shows science teachers' challenges in teaching science in terms of digital competence. As gleaned from

the table, teachers are sometimes experiencing challenges in teaching science in terms of digital competence as shown by the weighted mean of 2.28 (SD=0.80). This indicates that teachers experience these challenges irregularly. Although, it signifies in the table that they often experience hard time developing and integrating digital content in my science class (M=2.50), teachers should be creative, and curious on how to integrate digital platforms.

Table 10. Respondents' Challenges in Teaching Science in terms of Digital Competence

Statements	M	SD	VD
1. I have difficulty browsing, evaluating, storing, and recovering digital information, data, and science content.	2.28	0.96	S
2. I struggle to share the science self-learning module (SLM) with my students online.	2.19	1.03	S
3. I have a hard time developing and integrating digital content in my science class.	2.50	1.04	O
4. I am not knowledgeable about protecting my students' personal data, digital identity, and learning content.	2.04	1.03	S
5. I find it hard to identify gaps in digital competencies, technological needs, and responses of my students.	2.41	0.86	S
6. I lack knowledge in using appropriate online tools (Google classroom, Edmodo etc.) when giving activities or assignments to students.	2.28	1.02	S
7. I do not have sufficient information on how to utilize office applications and how to troubleshoot computer and printer malfunction.	2.26	1.03	S
Weighted Mean	**2.28**	**0.80**	**S**

Legend: Always (A) 3.50-4.00; Often (O) 2.50-3.49; Sometimes (S) 1.50-2.49; Never (N) 1.00-1.49

Teachers sometimes find it challenging to identify gaps in their students' digital competencies and technological needs. They may also struggle with browsing, evaluating, storing, and recovering digital information and science content. Additionally, some teachers lack knowledge in using appropriate online tools, such as Google Classroom and Edmodo, for assigning activities to students. They may also face difficulties in utilizing office applications and troubleshooting computer and printer malfunctions. Sharing science self-learning modules with students online can also be a struggle. Finally, some teachers may not be knowledgeable about protecting their students' personal data, digital identity, and learning content. This indicates that teachers can manage online applications but occasionally they experience these challenges. It is crucial that those who will pursue teaching must enhance their digital literacy and competence (Aslan, 2021; Baterna et al., 2020).

Table 11 shows science teachers' challenges in teaching science in terms of assessment and supervision. As shown in the Table 11, the science teachers sometimes experienced challenges in teaching science in terms of assessment and supervision based on the weighted mean 2.26 (SD=0.85). This indicate that teachers seldom experienced these challenges.

Table 11. Respondents' Challenges in Teaching Science in terms of Assessment and Supervision

Statements	M	SD	VD
1. I face difficulty giving feedback to my students online.	2.31	1.02	S
2. It is hard for me to balance the diverse learning needs of my students in online learning.	2.44	1.06	S
3. I have a tough time critiquing my students' work.	2.30	0.92	S
4. I am unable to employ formative assessment to monitor my students' learning.	2.06	0.96	S
5. I am unable to give feedback to my students' works immediately.	2.28	1.04	`S
6. I am unable to discover new, alternative and diverse approaches to monitor learning outcomes in my students.	2.30	1.00	S
7. I find it difficult to evaluate my students' performance task.	2.17	1.04	S
Weighted Mean	**2.26**	**0.85**	**S**

Legend: Always (A) 3.50-4.00; Often (O) 2.50-3.49; Sometimes (S) 1.50-2.49; Never (N) 1.00-1.49

Balancing the varying needs of students (M=2.44) and providing feedback (M=2.31) are challenging aspects of online learning. Critiquing work (M=2.30), monitoring outcomes (M=2.30), and delivering prompt feedback (2.28) are also difficult tasks. Additionally, evaluating performance tasks (M=2.17) and conducting formative assessments (2.06) present their own set of challenges. This shows that science teachers can manage their learners by assessing and by giving supervisions.

Table 12 shows science teachers' challenges in teaching science in terms of heavy workload. As shown in Table 12, the science teachers often visibly challenged in teaching science in terms of heavy workload based on the weighted mean 2.91 (SD=0.83). As incident of COVID-19 spread widely, the effects of school lockdowns on student learning, involvement, and achievement have drastically affects the workloads of the teachers. While the workload of teachers has risen exponentially in 2021, teachers stress level has been worsened as country still handling phases of distance learning.

Table 12. Respondents' Challenges in Teaching Science in terms of Heavy Workload

Statements	M	SD	VD
1. I struggle with the printing of voluminous modules of my students.	3.13	0.97	O
2. I have a hard time checking modules simultaneously.	3.20	0.90	O
3. I struggle in handling large classes due to heavy teaching loads.	2.94	1.00	O
4. I am unable to record a video for laboratory experiments due to the preparation and writing of modules.	2.87	1.01	O
5. It is challenging for me to talk to parents and students due to my heavy workload.	2.69	1.04	O
6. I find it difficult balance the module checking and attendance to meetings and webinars.	2.91	1.00	O
7. I cannot address all the queries of my students due to the volume of paper works.	2.63	1.09	O
Weighted Mean	**2.91**	**0.83**	**O**

Legend: Always (A) 3.50-4.00; Often (O) 2.50-3.49; Sometimes (S) 1.50-2.49; Never (N) 1.00-1.49

Amid the pandemic, science teachers have faced challenging situations and have done all that they can to support their students. From printing modules to handling large classes and staying connected with parents, educators have worked tirelessly to ensure that their students receive quality education. Though teaching is a challenging profession, teachers have a profound impact on the development of learners.

We must recognize that the discrepancies in learning opportunities are not the fault of educators, but rather a larger issue of injustice within our educational system. As science teachers continue to support their students, it is critical to learn from their efforts and recognize their hard work. By working together, we can have a broader conversation about schools, teachers, and parents and emerge stronger.

Table 13 shows the summary of the science teachers' challenges. Generally, science teachers sometimes experienced these challenges based on the overall weighted mean (M=2.53). Although it is important to emphasize that they often experience challenge on heavy workload (M=2.91); laboratory experimentation (M=2.82), and physical infrastructure (M=2.52). In addition, they sometimes experience on the following challenges: digital infrastructure (M=2.49); instructional resources (M=2.40); digital competence (M=2.28); and assessment and supervision (M=2.26).

Table 13. Summary of Science Teachers' Challenges

Challenges	**M**	**SD**	**VD**
Instructional Resources	2.40	0.75	S
Physical Infrastructures	2.52	0.84	O
Digital Infrastructure	2.49	0.92	S
Laboratory Experimentation	2.82	0.90	O
Digital Competence	2.28	0.80	S
Assessment and Supervision	2.26	0.85	S
Heavy Workload	2.91	0.83	O
Overall	**2.53**	**0.84**	**S**

Difference in the Science Teacher's Practices by Profile Variables

An analysis of variance was conducted to investigate the variations in science teachers' teaching practices based on their profile variables. Results indicate that there is no significant difference in the means of teaching strategies of science teachers based on their age, sex, grade level taught, teaching position, specialization, years of teaching, district, and learning delivery modality used. However, it was found that science teachers who attended ten or more science-related trainings during the pandemic exhibited different teaching strategies, indicating the importance of such seminars and trainings in enhancing professional development during these times. According to Kelly (2019), training gives teachers the best chance of success and helps senior teachers stay on track as they face new problems in the classroom. There is a risk that instructors will leave the profession early if this training is not provided. Because many of these trainings and seminars are available for free, teachers should take advantage of these possibilities for self-improvement and professional growth.

An analysis of variance was conducted to investigate the difference in assessment strategies used by science teachers based on their profile variables. The results indicated that there was no significant difference in the means of teaching strategies used by science teachers across different demographic profiles. Classroom evaluations can include various procedures to determine the effectiveness of new material.

This study found that a teacher's demographic profile did not have a significant impact on their assessment practices. According to Widiastuti (2018) that teachers mainly develop their practices in assessment strategies depending on norms and experience in grading student's learning performance. As COVID- 19 disrupts educational system, teacher's practices have been challenged in strategizing assessment especially in the online set up so it is very essential that teachers must provide and develop the practices to engage and provide student's progress.

The study found no significant differences in technology integration based on age, sex, grade level, teaching position, specialization, years of teaching, or district. However, there were differences based on science-related trainings attended during the pandemic and learning delivery modality used in science class. This indicates that science-related trainings and seminars is very important in today's situation as it plays a vital role for providing and enhancing teacher's practices in incorporating technology into their teaching and learning delivery.

Difference in the Science Teacher's Challenges by Profile Variables

The challenges faced by respondents in terms of instructional resources do not differ significantly based on their age, sex, grade level taught, teaching position, specialization, number of trainings attended, district, or learning delivery modality used. However, the number of years teaching science has a significant impact ($p=0.007$) on these challenges. Similarly, there is no significant difference in the challenges faced by respondents in physical infrastructure based on the aforementioned profile variables, but years of teaching science ($p=0.027$) does have a significant impact.

Additionally, it appears that there is no significant variation in the difficulties experienced by respondents with regards to digital infrastructure, regardless of their profile variables. This suggests that science teachers of all ages, genders, grade levels, teaching positions, specializations, years of experience, number of trainings and seminars attended, as well as district and learning delivery modality, have encountered challenges with digital infrastructure. Due to the pandemic, most regions have implemented lockdowns, which have resulted in the closure of activities that require physical interactions and gatherings, including schools. As a result, teachers have had to adjust to a new digital infrastructure for teaching and learning. According to Akash (2018), digital infrastructure is a fundamental distinction among schools that has completely changed how educational information is delivered in classrooms. The use of digital technology in education is slowly but surely changing the way education is delivered, making the concept of "show me and I comprehend" a reality. Unfortunately, many teachers continue to struggle with digital infrastructure, which hinders them from fully utilizing the benefits that information and communication technologies may provide.

There is no significant difference in the respondents' challenges in laboratory experimentation when grouped according to profile variables. This indicates that laboratory experimentation has been a challenge for every science teacher regardless of age, sex, grade level taught, teaching position, specialization, years of teaching, no. of trainings and seminars and even district and learning delivery modality used. Laboratory experimentation is an important component of science teaching, which provides learners with the opportunity to observe physical phenomena, touch and manipulate equipment, manage instruction, and enhance the learning of scientific skills. When conducting laboratory experiments, the true joy of science is discovered, and the ties between knowledge and understanding crystallize (Abbey & Hoxley, 2020) but as COVID-19 outbreak, science teachers are forced to teach through screen and doing laboratory experimentations had been a great challenge.

Also, there is no significant difference in the respondents' challenges in digital competence when grouped according age, sex, grade level taught, teaching position, specialization, no. of trainings and seminars and learning delivery modality used. Meanwhile, it shows that there is a significant difference in the respondents' challenges in digital competence when grouped according to years of teaching science ($p=0.046$) and district ($p=0.023$). In terms of years of teaching science, teachers who has teaching experience of 1 year and below gained the highest mean ($M=3.07$) while in terms of district, zone 2 garnered the highest mean ($M=2.73$). This indicates that new teachers in the field of teaching as well as teachers belongs to zone 2 must provide with adequate digital- related competency trainings and seminars for continuous professional development. Teachers' digital competence is a major predictor of integrating ICT in teaching. As COVID 19 disrupts educational system and requires learning online, producing digital competent teachers is highly important to address the issue as it proved to be essential in the transition to online education.

There is also no significant difference in the respondents' challenges in assessment and supervision when grouped according to profile variables. This indicates that assessment and super vision has been a challenge for every science teacher regardless of age, sex, grade level taught, teaching position, specialization, years of teaching, no. of trainings and seminars and even district and learning delivery modality used. On the other hand, teachers who handled 2-3 and above ($M=2.37$), science teachers whose position is Teacher I ($M=2.36$), science teachers who had 1-3 trainings ($M=2.33$) have little difference with no trainings ($M=2.28$), male respondents ($M=2.27$) and female respondents ($M=2.26$), as well as those who employ 1-2 modalities ($M=2.27$) faced great challenge in terms of laboratory experimentation. They experience challenge on assessment and supervision not regularly. Although, there were no statistically shows the significant difference between means of laboratory experimentation and profile variables.

There is no significant difference in the respondents' challenges in heavy workload when grouped according sex, grade level taught, teaching position, specialization, years of teaching, no. of trainings and seminars and even district and learning delivery modality used. As shown, among these profile variables of the respondents, only age ($p=0.026$) had significant difference on respondents' challenge on heavy workload.Teacher workloads are as high as they've ever been. With heavy workload and extended hours, it's easy to become a victim of teacher burnout. Hence, according to Jomuad et al. (2021) providing balanced work for teachers and reviewing their workload is very important because it can be a way to improve the quality of their instruction.

Conclusion

This study aimed to investigate the experiences of science teachers during the COVID-19 pandemic, particularly in terms of their teaching practices and challenges. The findings indicate that these teachers primarily relied on printed modules as a means of delivering instruction, while also implementing various teaching strategies, assessment techniques, and technology integration to adapt to the disruptions caused by the pandemic. However, they faced difficulties related to their workload, limited access to laboratory resources, and inadequate physical facilities, as well as digital infrastructure, instructional resources, digital competence, and assessment and supervision. The study also revealed that the teachers' training and the modality used for instruction had a significant impact on their teaching strategies and technology integration practices. Additionally, the challenges related to instructional resources, physical infrastructure, digital competence, and workload varied depending on the teachers' years of service and age, as well as their location.

Recommendations

This research suggests that educational institutions may need to review the needs of teachers in order to help them succeed in the face of current and evolving challenges during this time of educational disruption. It is important to support teachers by investing in their skill development and capacity building through ICT integration training and seminars so that they can reach their full potential. It is equally important to provide socio-emotional support to help teachers combat burnout and maintain their well-being. Additionally, researchers recommend that the developed research tools be used based on contextualization. Although this study provided valuable information about the practices and challenges faced by science teachers during the COVID-19 educational disruption, there are limitations to the study. The number of respondents was limited to 54 science teachers, which may affect the generalizability of the results. The study was also limited to science teachers in the Division of Zambales, and further research may be needed to include the entire country of the Philippines for better results and generalizability. In addition, non-science teachers who teach science should be included in future studies to achieve better outcomes. Future studies should also focus on the challenges faced by science teachers in greater detail and explore whether these challenges are related to one another.

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