STEM EDUCATION NEWSLETTER

Samtse College of Education

AUTUMN 2021

Inside this issue

COORDINATOR'S MESSAGE

Dear Reader,

The STEM Education Research Center (STEMERC) of Samtse College of Education (SCE) is pleased to present the Autumn 2021 issue of the STEM Education Newsletter.

STEM education is increasingly being recognized around the world as pivotal to national development and productivity, economic competitiveness, and societal well-being. As a global educational reform, it aims to equip students with 21st-century knowledge, skills, and dispositions such as creativity, innovation, critical thinking, analytical and problem-solving skills, technology literacy, communication, and collaboration for empowering them to thrive in this technological era.

STEMERC's core vision is to be the Center of Excellence for Research in STEM Education Curricula, Pedagogy, and Assessments, as well as STEM disciplines, through collaborative partnerships with national and international STEM education stakeholders. Similarly, the center also organizes scholarly discourse to promote STEM literacy in Bhutan, and has created knowledge dissemination platforms such as a website and newsletter. It is hoped that STEM educators and learners would be able to apply relevant STEM knowledge and skills disseminated through these platforms to existing and emergent teaching, learning and assessment challenges.

We hope you will enjoy and benefit from reading the first issue of the STEM Education Newsletter. We invite your feedback and suggestions for future improvements.

For an electronic copy of the newsletter, please go to http://stem.sce.edu.bt.

Reeta Rai (PhD)
Coordinator
STEMERC

EDITORIAL TEAM

Dr. Reeta Rai,
Lecturer

Dr. Kinley,
Assistant Professor

Ms. Sapna Thapa,
Assistant Lecturer

Kinley Wangchuk,
M.Ed I Chemistry

DESIGN & LAYOUT

Ratna Bahadur Dahal,
M.Ed I Mathematics

Mr. Phurba Singh Moktan,
ICT Associate

What is TPACK and Why am I drawn to it?

Several studies have shown that the decline in science education quality is due to inadequate use of classroom teaching pedagogy, technology, and assessment in schools, which is a critical attribute in achieving educational quality. To address this issue, on December 17th, 2020, His Majesty the King symbolically handed over the Royal Kasho on Education System Reform to the people. In the Royal Kasho, His Majesty has strongly stated that, "In preparing our youth for the future, we must take advantage of available technologies, adapt global best practices, and engineer a teaching-learning environment suited to our needs. To ensure that teachers are not disconnected from their students, professional development of teachers should integrate technology, digitalisation, artificial intelligence, and automation." The Royal Kasho focused on the use of technology in particular because it is the foundation for the country's advancement.

Bhutan is still using the traditional (low-tech) teaching method. Some studies have found that Bhutanese science curricula are extensive, content-oriented, less flexible, and do not encourage practical application of learned concepts. In fact, our science curriculum is beyond what a child can digest and apply when they graduate from grades 10 and 12. Because of the extensive nature of the science curricula, teachers have been forced to use mostly teacher-centered lessons in order to complete the syllabus on time. Therefore, it is the responsibility of all responsible stakeholders and teachers in our country to redesign the curriculum in a STEM

TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK)

pattern and to implement strategies that are appropriate for 21st century students.

Technological Pedagogical Content Knowledge (TPACK) is a framework that 21st-century teachers require in order to properly integrate pedagogical strategies, content knowledge, and relevant technology for teaching. According to some academics, the proper implementation of technology in STEM classes has enabled active student-centered learning. The TPACK method is used in classroom teaching because students will take an active role in discovering and understanding concepts. Nonetheless, the TPACK framework is a new concept in Bhutanese education, with only three studies conducted so far.

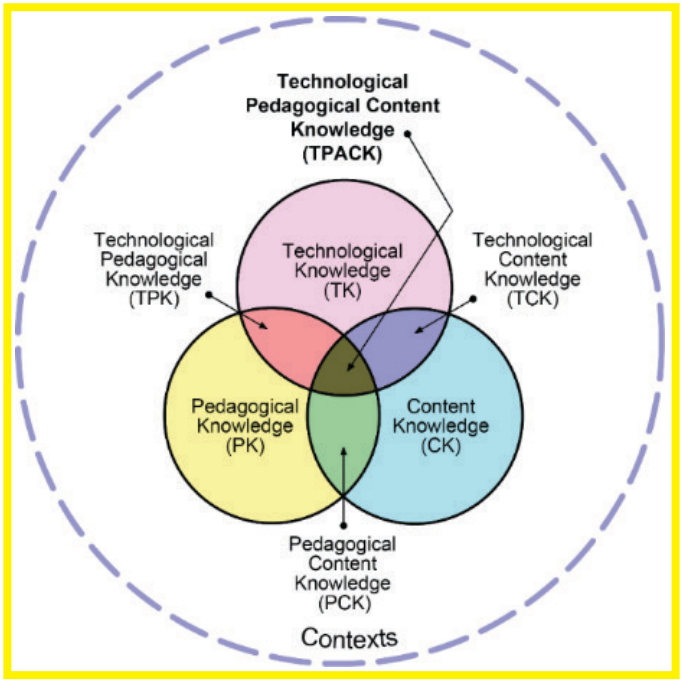


Figure: *The components of the TPACK framework (Koehler & Mishra, 2006)*

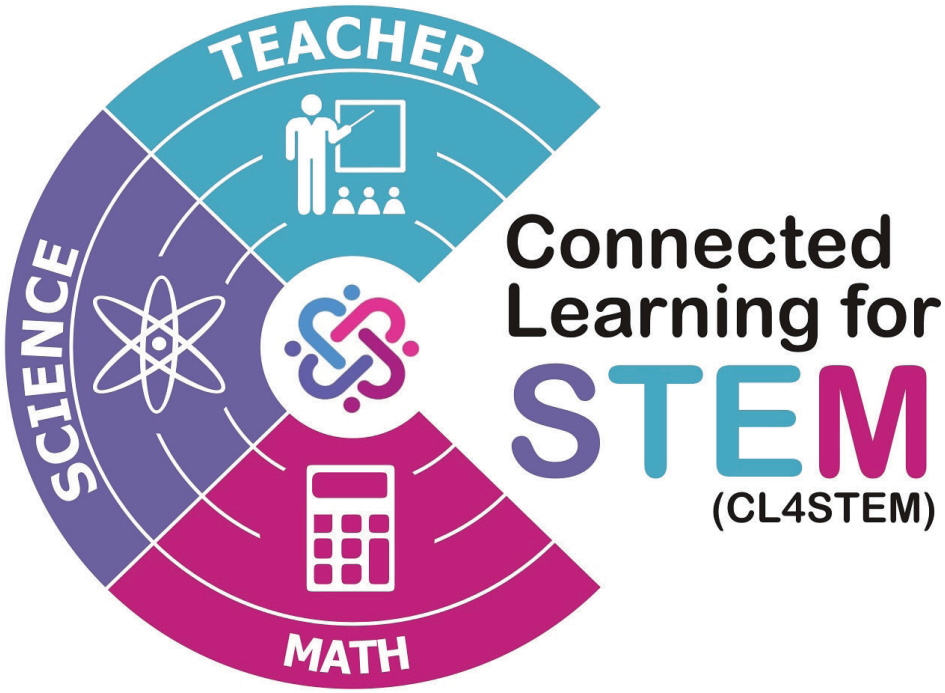
As a result, I believe that TPACK is an essential element of today's education system because it accommodates the growing demand for the use of technology in the classroom while keeping the focus on content and how we deliver it. To effectively incorporate TPACK into their teaching, teachers must be knowledgeable about the TPACK curriculum and component. As digital natives, students learn more effectively with technology, and students will be more engaged in their learning if technology is integrated into the existing PCK model.

In the upcoming education reform, relevant stakeholders must consider technological knowledge and skills very seriously, in addition to content and pedagogical advancements, as an important component of teachers' professional standards. All relevant stakeholders must recognize that, in today's technology-driven world, it is unjust to waste students' potential due to teachers' lack of technological knowledge. As a result, I recommend TPACK as a viable strategy for teaching STEM subjects.

Dorji Penjor

M.Ed I Chemistry

Connected Learning for Teacher Capacity Building in STEM (CL4STEM): An IDRC Funded Project



Introduction

Samtse College of Education (SCE), in collaboration with Ibrahim Badamasi Babangida University, Lapai (IBBUL), Nigeria, Open University of Tanzania (OUT), Tanzania, and Tata Institute of Social Sciences (TISS), India, has been awarded a research grant through the Global Partnership for Education Knowledge and Innovation Exchange (GPE-KIX) to carry out a project titled Connected Learning for Teacher Capacity Building in STEM (CL4STEM). The research grant is supported by the International Research Development Centre (IDRC), Canada.

The consortium is a South-South collaboration of higher education institutions that aims to address the global undersupply of quality STEM teachers. The project mainly aims to involve STEM teacher educators in curating Open Educational Resources (OERs) in three Sciences and Mathematics that are aligned with the national curricula framework and tailored to local contexts and needs of secondary levels (Classes VII to XII), followed by piloting the innovation in selected secondary schools and conduct evidence-based research to generate knowledge for scaling the innovation. The entire process

is expected to build the capacity of the STEM teacher educators and STEM teachers in secondary schools in incorporating Technological Pedagogical Content Knowledge (TPACK), Universal Design for Learning (UDL), Higher-Order Thinking with Inclusion and Equity, Design Thinking, and Reflective Writing of their practices.

Objectives of the project

The project's overall objectives are as follows:

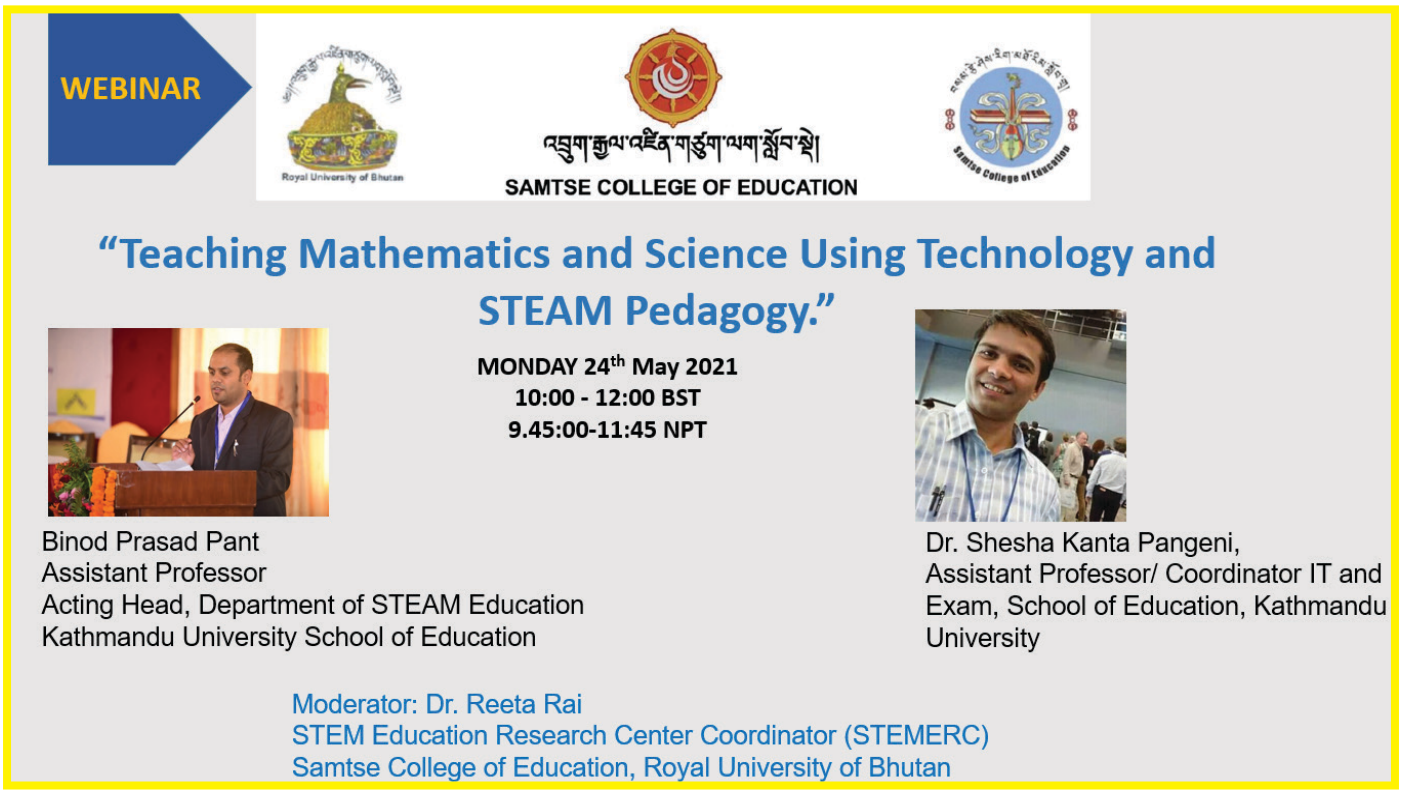
- Develop a selection of OERs that will be curated and adapted for suitability to local contexts and needs;
- Integrate OERs for TPACK and inclusive education into the Initial Teacher Education (ITE) programs and Newly Qualified Teachers (NQTs);
- Develop certificate courses for STEM teachers for integrating OERs for TPACK and inclusive education; and
- Build vibrant Communities of Practice (CoP) for the capacity development of the STEM teachers in the respective partner institutions.

The project activities will be carried out in four thematic phases: Knowledge Transfer and Capacity Building, Situational Analysis Study (SAS), Research and Knowledge Generation, and Knowledge Dissemination and Scalability. During the knowledge transfer phase, TISS consultants trained STEM teacher educators at SCE in the curation of OERs incorporating TPACK, UDL, inclusive pedagogies, and Design Thinking. Similarly, teacher educators were trained in the establishment and management of CoPs for the professional development of school STEM teachers and the design and adaptation of research tools for various research activities.

The Ministry of Education (MoE) is the project's primary stakeholder. Initially, the project was intended to be implemented in five Dzongkhags: Samtse, Thimphu, Paro, Zhemgang, and Trashigang, and the readiness of the schools for project implementation was also assessed. However, due to the country's current Covid-19 situation, the project will only be implemented in Samtse Dzongkhag. Nevertheless, OERs will be made available to all secondary STEM teachers. These OERs will facilitate STEM teachers' professional development in content knowledge enhancement, inclusive pedagogies, and the use of technology in their daily practices. The project's activities will also complement the MoE and Royal Government of Bhutan's initiatives in achieving some key educational goals related to the iSherig-2 Education ICT master plan 2019-2023. Similarly, the project will support the realization of His Majesty's vision for STEM education, as articulated in the Royal Kasho on Education Reform.

Reeta Rai (PhD)
Coordinator
STEMERC

Teaching Mathematics and Science with Technology and STEAM Pedagogy



On May 24th, 2021, STEM Education Research Center hosted a webinar on teaching mathematics and science with technology and STEAM Pedagogy.

Dr. Shesha Kanta Pangeni, Assistant Professor from Kathmandu University's School of Education, and Mr. Binod Prasad Pant, Assistant Professor from Kathmandu University's Department of STEAM Education, had been invited virtually to share their experiences and expertise in the field of teaching mathematics and science using technology and STEAM Pedagogy. STEM faculty and M.Ed Math and Science students attended the webinar. The main goal of the webinar was to familiarize participants with the teaching and learning of STEM subjects using technology and STEAM Pedagogy. It was also intended to comprehend and share experiences, skills, and knowledge related to teaching and assessing with technology.

Dr. Shesha Kanta Pangeni emphasized the significance of being proficient in the use of various technologies in the teaching of mathematics. He expressed concern about being exposed to various technological tools and not being able to fully utilize all of the aspects and attributes of the tool in a better way. He also expressed his concern about the technology used by teachers to teach students. He stated that when selecting technology for teaching and learning, one should consider the level of the students, the teaching context, and the subject content. He recommended a few learning management systems for interactive lessons, including Moodle, Google Classroom, and Microsoft Team. He also demonstrated on different features of Microsoft white-board, Microsoft mathematics, Ink Equations, and GeoGebra.

Mr. Binod Prasad Pant shared his experiences with STEAM (Science, Technology, Engineering, Arts, and Mathematics) pedagogy when teaching mathematics and science. He emphasized the significance of incorporating the arts or a humanistic approach into STEM (STEM +A) education. He stated that while STEM education produces highly knowledgeable scientists, we also need arts and humanistic approaches to produce responsible and valuable citizens. He also educated the participants on the various lenses of STEAM education, the STEAM conceptual model, the STEAM pyramid, and STEAM pedagogy. In addition, he discussed STEAM project principles and presented his recently completed STEAM project.

Nima Dorji

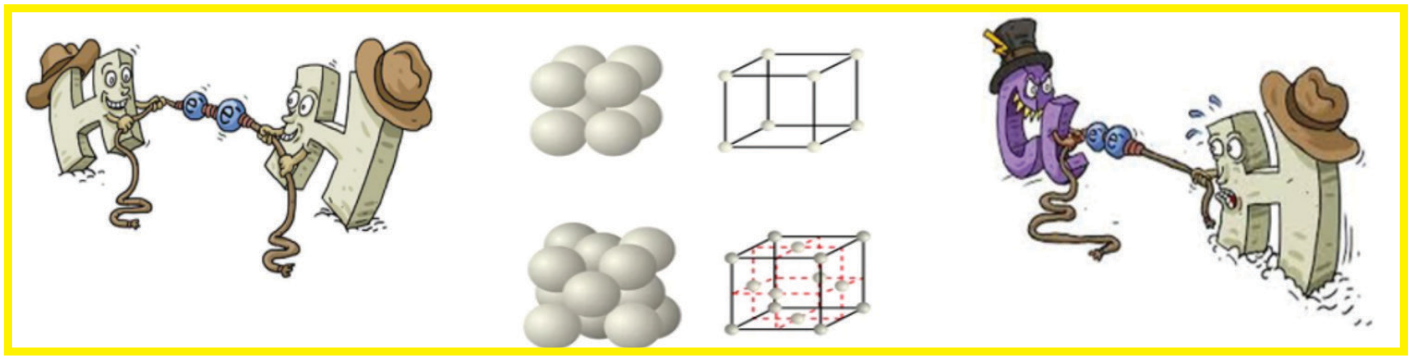
M.Ed II Maths

Examining the Concept of Covalent Bonding Using Concrete Models and Technology (TPACK)

A covalent bond is a chemical bond that is formed by the sharing of electrons between atoms in order to achieve stability. The concept of covalent bonding is considered one of the fundamental topics in Chemistry, and it contributes to understanding the nature of chemical compounds. Understanding other Chemistry concepts such as chemical reactions, chemical reactivity, matter structure, and change of state will be facilitated by a firm understanding of covalent bonding. As a result, the study of covalent bonding is introduced from the lower secondary level curriculum itself.

However, the covalent bonding concept is perceived by students as abstract to comprehend and thus leads to the development of misconceptions. Earlier studies have shown that the majority of students have misconceptions related to covalent bonding in the areas such as the kinds of atoms that form covalent bonding; how covalent bond is formed; the types of covalent bonding; and the characteristics of covalent compounds. Similarly, a case study titled "ninth-grade students' misconceptions on covalent bonding" was undertaken to investigate the misconception of students on covalent bonding. The study comprised 20 grade 9 students (10 boys and 10 girls) from one of the Higher Secondary Schools in Dagana Dzongkhag. A test comprising the questionnaires with two-tier MCQ (Multiple choice questions with the addition of choices of reasons for each) was employed to collect data.

The findings revealed that students had mis-



conceptions about 'what types of atoms form covalent bonds,' as well as 'the nature of the formation of the covalent bond and its types.' Furthermore, many students believed that a covalent bond is formed between a metal and a nonmetal atom. Some studies have found that using concrete models and technology such as video simulations to correct misconceptions about covalent bonding among students has a positive impact on their learning. As a result, video simulation and concrete models were used as interventions in this study to investigate their impact on correcting the students' misconceptions, as shown in Figure 1.

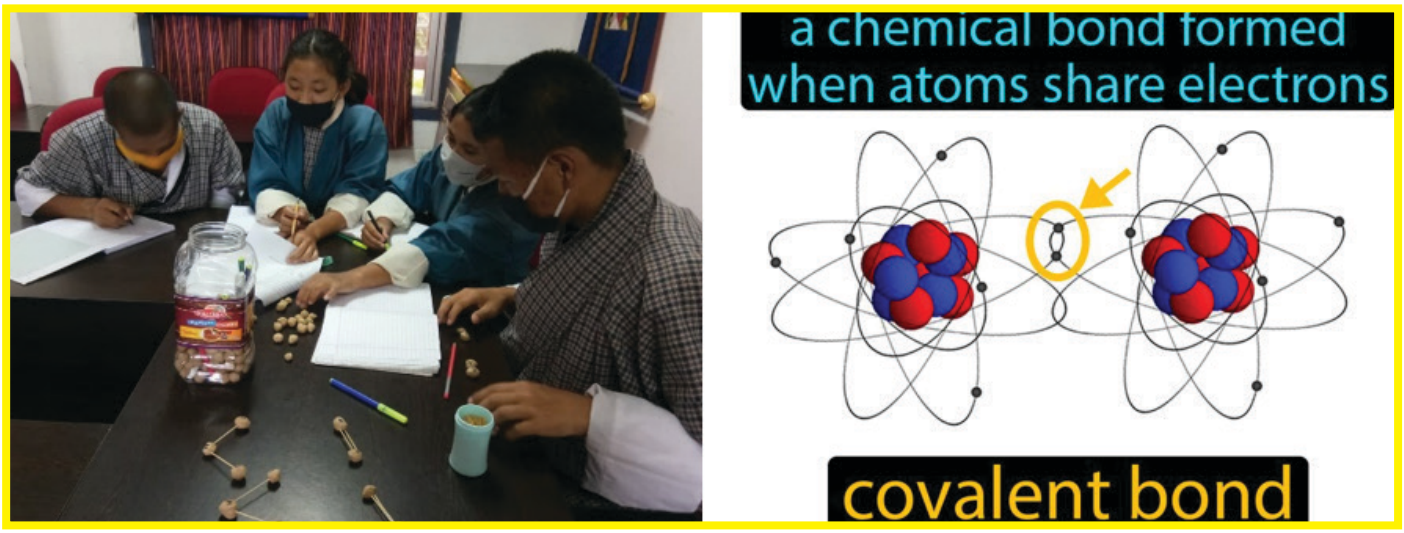


Figure 1: *Photo showing the implementation of intervention methods: (Use of concrete models and simulation)*

The use of video simulation and concrete models was found to be effective in teaching students about covalent bonding. It was discovered that when students were taught using technology, they were able to grasp the concept more realistically. Students were able to see and visualize the microscopic structure by incorporating technology into the lesson, which they would not have been able to do otherwise. Students gain a deeper understanding and meaningful learning when technologies are used in the teaching and learning process. It also aided students in correcting their misconceptions through investigation and reflection. Furthermore, student participants believe that the use of technology in teaching promotes interest and increases their enjoyment of learning Chemistry concepts more deeply. Furthermore, students asserted that they can learn and understand the concept better when they can see structure for themselves rather than relying on assumptions.

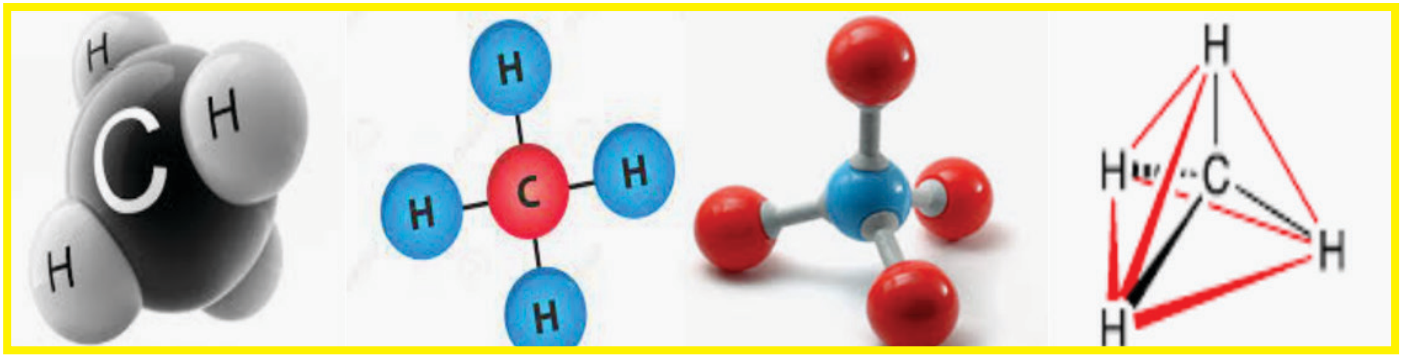


Figure 2: *Structure of the covalent compound (methane).*

The results were analyzed by comparing the pre-test and post-test scores. The findings revealed that the impact of technology and concrete models in explaining the concept of covalent bonding to students was effective in correcting students' misconceptions, as shown in Table 1.

Table 1: *Summary of Students' Specific Misconceptions Identified from the Covalent Bonding (%)*

Thematic areas	Misconceptions	Percentage (%)		Correct Concept
		Pre-test	Post-test	
Kinds of atoms that form covalent bonding	A covalent bond is formed between a metal and a non-metal.	**50**	**5**	A covalent bond is formed between two non-metals that have similar electronegativities.
How covalent bonding is formed	A Water molecule is formed by transferring electrons from hydrogen atoms to oxygen atom.	**35**	**5**	A water molecule is formed by sharing electrons between oxygen atom and hydrogen atoms.
Types of covalent bonding	A double bond is formed by the sharing of two electrons between the oxygen atoms.	**70**	**5**	A double bond in an oxygen molecule is formed due to sharing of two pairs of electrons.
Characteristics of covalent compounds	Covalent compounds are good conductors of electricity due to the presence of free ions.	**35**	**0**	Covalent compounds are bad conductors because it cannot ionize to form free ions.
Lewis dot structure and stable electronic configuration	Fluorine molecule shares two pairs of electrons between atoms.	**35**	**5**	Fluorine molecule share only a pair of electrons to gain its stability/attain octet configuration.

For example, after implementing the intervention strategies, students' misconception on the theme (Kinds of atoms that form covalent bonding) decreased from 50% to 5%. Similar trends were also observed in other themes. As a result, the use of concrete models and teaching through computer video simulations were discovered to be effective in correcting students' misconceptions.

While teaching covalent bonding, the use of computer simulation and models was found to be effective in engaging students in meaningful learning. The study recommends curriculum designers and textbook authors to use such a strategy and technology when designing and preparing future Chemistry curricula. Furthermore, it is suggested that Chemistry teachers use teaching strategies such as video simulation and concrete models to teach covalent bonding concepts.

Phuntsho Dorji

M.Ed II year (Chemistry)

A Contemporary Mathematical Model to Predict Temperature at Samtse College of Education's Campus: A Contemporary Mathematics

Introduction

Temperature is a physical quantity that expresses the hotness or coldness of the surrounding environment or objects. The temperature of a location varies due to altitude as well as changes in weather and season. The Global Climate Report (Annual, 2020) estimates that the Earth's temperature has risen at a rate of 0.14° F (0.08° C) per decade. According to temperature data from the National Oceanic and Atmospheric Administration (NOAA), 2020 was the second-warmest year on record, with land areas reaching new highs (Lindsey and Dahlman, 2018). According to the National Centre for Hydrology and Meteorology (NCHM), Bhutan experienced near-normal average temperatures from 1996 to 2019, compared to the long-term average (Wangmo, 2021). Wangmo (2021) also reported that the analysis of 21-years data from 1996 to 2017, collected from 15 weather stations indicated an increasing temperature trend in the country. Further, she added that climate projection for surface temperature in Bhutan indicates the possibility of an increase of about 0.8°C to 1.6°C between 2021 and 2050 and about 1.6°C to 2.8°C by the end of this century.

Climate change, according to scientists, is the greatest global health threat of the twenty-first century. It is a threat to everyone, but children, the elderly, low-income communities, and minorities are particularly vulnerable. As the temperature rises, so does the number of illnesses, hospital visits, and deaths (Denchak, 2016). According to Causes of Climate Change (2017) temperature of the Earth is determined by the balance of energy entering and leaving

the planet's system. As incoming solar energy is absorbed by the Earth system, it warms up the Earth. When the sun's energy is reflected into space, the Earth avoids overheating. As absorbed energy is discharged back into space, the Earth cools. A variety of natural and human events can cause changes in the Earth's energy balance.

The temperature at Samtse College of Education (SCE) campus has been rising over the years. The changes in temperature rise observed may be attributed to increased infrastructural development on the SCE campus, a change in the weather, or global warming. As a result, this study was carried out in order to create a mathematical model to predict temperature changes on the campus of SCE.

Data collection

Data were collected from the college weather forecast station thrice in a day (morning: 6:30 a.m., afternoon: 1:30 p.m., and evening: 6:00 p.m.) for 15 days, from April 13th to April 28th, 2021 (Table 1).

Figure 1: *Collection of data from the weather* station.

Table 1: *Temperature Records*

Sl. no	Date	Morning 6:30 AM	Noon 1:45 PM	Evening 6:30 PM	Daily average temperature
1	13/04/21	20	31	26	25.7
2	14/04/21	22	31	26	26.3
3	15/04/21	21	30	24.5	25.2
4	16/04/21	20.5	30	20	23.5
5	18/04/21	16.5	22	19	19.2
6	19/04/21	17	27	24	22.7
7	20/04/21	19	30.5	24	24.5
8	21/04/21	20	29	25	24.7
9	22/04/21	21	30.5	26	25.8
10	23/04/21	20	28	21	23
11	24/04/21	21	30	26	25.7
12	25/04/21	21.5	32	26	26.5
13	26/04/21	22	32	26	26.7
14	27/04/21	22	33	28	27.7
15	28/04/21	22	34	27	27.7
	Average	**20.4**	**30.0**	**24.6**	**24.99**

Data Analysis and Presentation of Results:

Data analysis was carried out by using record tables, graphing the data, and interpreting the results. The minimum, maximum, and average temperatures of the morning, afternoon, and evening were studied separately from the re-

cord tables to determine the pattern of temperature changes on a daily basis (Table 2).

Table 2: *Pattern of temperature change on daily basis*

Time	Minimum	Maximum	Average
Morning	16.5	22	20.4
Noon	22	34	30.0
Evening	19	28	24.6
Daily average	19.2	27.7	24.99

In the mornings the highest temperature measured was 22^{0}C, and the lowest was 16.5^{0}C, indicating that the weather was cool and pleasant on the college campus. The maximum temperature at noon was 34^0 C, and the minimum was 22^0 C. Almost every day for the next 15 days, the temperature rose above 25^0 C. However, due to heavy rain on one particular day, the temperature dropped. In the evenings the highest temperature measured was 28^0 C, and the lowest was 19^0 C. The weather was warmer in the evening than it was in the morning and noon.

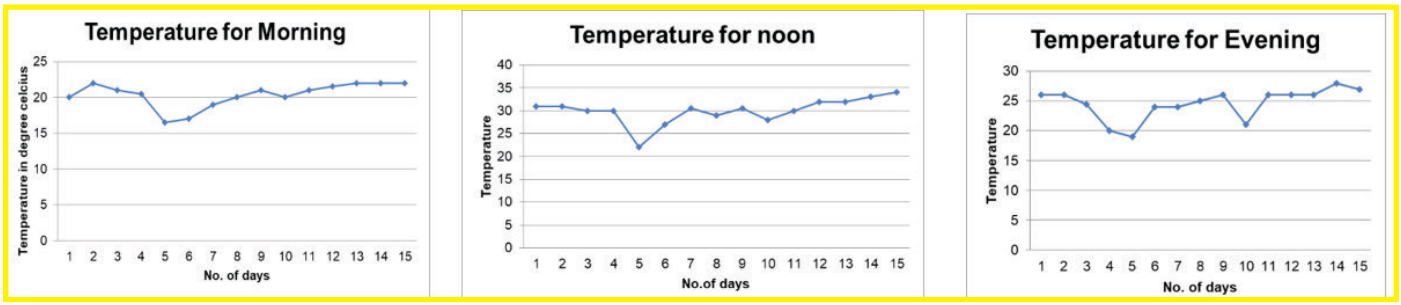


Figure 2: *Graphical representations indicating changes in temperature in the morning, noon and evening.*

Using Trigonometric Functions to Model Temperature

Trigonometric Cosine functions y=Acos B(x-C)+D, where A, B, C, D are constants, 'y' is the temperature in 0°C, and 'x' represents the number of days, can be used to design a model to represent temperature fluctuations, interpret the pattern of temperature change, and predict the temperature of SCE campus. This trigonometric functions to model climate was created specifically to measure the daily temperature of the weather and was adapted from NIWA (Mackintosh, 2001).

The following is a detailed description of the variables A, B, C, D, and x in the equation:

When the data from Table 2 were fed into the formula, the following results were obtained:

Substituting the values of A, B, C, D and x in y=Acos B(x-c)+D, we get a model that can be used to represent the fluctuations in temperature, interpret the pattern of change in temperature and predict the temperature of SCE campus as follows:

$$A = amplitude = \frac{ymax - ymin}{2};$$

$$B = \frac{2\pi}{15};$$

$$C = units\ translated\ to\ the\ right\ (C=1 \text{ or } C=2)$$

$$D = ymin + amplitude = units\ translated\ up,$$

$$x = 1,2,3,4,5,\ldots,15 \text{ days}$$

Therefore, the required model for the SCE campus temperature for the month of April can be either:

$$A = \frac{27.7-19.2}{2} = \frac{8.5}{2} = 4.25 \approx 4.3;$$

$$B = \frac{2\pi}{15} \text{ (Given in the function);}$$

$$C = 1 \text{ or } 2$$

$$D = 19.2 + 4.3 = 23.5 \text{ (D= ymin + A).}$$

$$x=1,2,3,4,5,\ldots,15 \text{ days}$$

Conclusion

The findings showed that the noon temperatures at SCE campus were higher than the morning and evening temperatures during the month of April. Furthermore, the temperature was observed to rise every day. It means that

$$y = 4.3\cos\left((x-C)\frac{2\Pi}{15}\right)+23.5$$

$$where\ x = 1,2,3,4,5,...,15\ days$$

$$and\ C = 1\ or\ 2\ .$$

the weather is quite cool in the morning and very hot in the afternoon, but the temperature drops in the evening and the weather becomes

$$y = 4.3\cos\left((x-2)\frac{2\pi}{15}\right)+23.5 \quad or$$

$$y = 4.3\cos\left((x-1)\frac{2\pi}{15}\right)+23.5$$

warm at SCE campus in the month of April. The fluctuation of the day's temperature, on the other hand, is dependent on the weather conditions. The study also revealed a linear pattern of daily temperature change. The findings also revealed that the daily average temperature in April is higher than 24^{0}C. The contemporary mathematics explored in this study is the use of Trigonometric Cosine functions y=Acos B(x-C)+D to study the change in temperature during the day depending on the weather conditions and framing a model to represent the fluctuations in temperature, interpret the pattern of change in temperature, and predict the future temperature.

As a result, the model defined in this study is either

$$y = 4.3\cos\left((x-2)\frac{2\pi}{15}\right)+23.5 \quad or$$

$$y = 4.3\cos\left((x-1)\frac{2\pi}{15}\right)+23.5$$

for the month of April, at SCE campus.

However, due to the limited amount of data, the findings of this study are not generalizable. So, further research is recommended to obtain a better study result and to develop a more effective and authenticated model to predict the temperature of SCE campus more accurately.

Lecturer:

Purna Bahadur Subba

M.Ed Maths Year I:

Dorji Phuntsho, Sasila Limboo, &

Reshma Pradhan,




Workshop on Design Thinking: Summary Report

Background on workshop

On May 22, 2021, the STEM Education Research Center (STEMERC) at Samtse College of Education (SCE) hosted a professional development (PD) on Design Thinking for the teachers of Tendruk Central School. The PD was held virtually because it coincided with the lockdown in Samtse Dzongkhag caused by the COVID-19 pandemic surge. Mr. Alexander Sivitskis, a specialist in Place-Based Education (PBE) and Geological Information Systems (GIS), a visiting faculty from Teton Science Schools (TSS) to SCE, facilitated the PD. Dr. Kinley and Dr. Reeta Rai from SCE coordinated and supported it. The PD was attended by 55 teachers, including the school Principal. Tendruk Central School is located in Samtse Dzongkhag, approximately 79 kilometers west of the Samtse Dzongkhag. The school currently has students from Pre-Primary to Grade 12, and it also has a Special Education Needs (SEN) program.

Aims and objectives

The PD was a prelude to a larger research project on implementing design thinking in classroom teaching and learning in secondary schools in Bhutan. It was hoped that workshop participants would be able to teach students in defining a challenge or opportunity with empathy and come up with creative proposals and solutions. The PD was planned with the following objectives:

1. Introduce design thinking as a pedagogy to Bhutanese secondary school teachers

2. Support participants in incorporating design thinking into their classroom and assessments

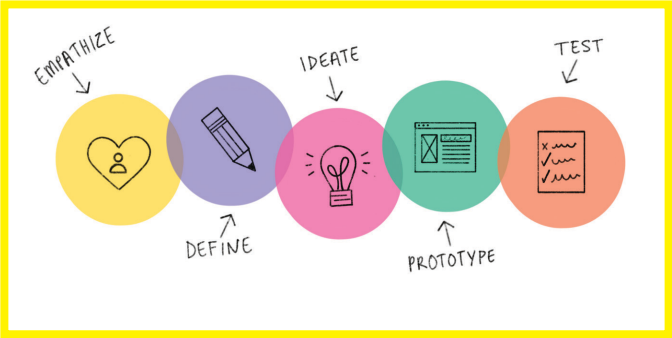
3. Create lessons using the steps of design thinking.

Summary of the Proceedings

Dr. Reeta Rai began the session with introductory remarks in which she welcomed participants to the webinar by emphasizing the workshop's key rationale and outcomes. She highlighted the challenges and opportunities we have as teachers to make better use of the resources at our disposal in difficult times with the statement, "this pandemic taught us to actually think about and rethink who we are educating, how we are educating them, why we are educating them, and how we can fill in the gap". With this statement, she urged the participants to seriously reconsider and reflect on the Royal Kasho on education reform, "Educationists and experts have identified what twenty-first century competencies mean for children everywhere. By developing their abilities for critical thinking, creative thinking, and learning to be life-long learners, we have to prepare them to be inquisitive, to be problem-solvers, to be interactive and collaborative, using information and media literacy as well as technological skills. We must prioritize self-discovery and exploration, and involve learners in the creation of knowledge rather than making them mere consumers of it." She used this Royal Kasho statement to remind participants of their responsibilities as teachers, as well as the importance of rethinking the curriculum, teaching pedagogy, personal skills and values, and resources needed for teachers to equip our 21st century learners to keep up with an ever-changing world. The webinar participants were then introduced to the webinar's aims and objectives. She also stated that the webinar on the design thinking process was a small effort from SCE to assist 20th century teachers in equipping 21st century students with 21st century skills.

Design Thinking in Teaching, Learning, and Assessment

Mr. Alexander Sivitskis introduced workshop participants to core concepts of implementing design thinking in teaching and learning process and provided hands-on learning of design thinking steps through a variety of activities. The design thinking content presented to the participants was adapted from Teton Science School (TSS) and Hasso Plattner Institute of Design at



Stanford.

Figure 2: *Five steps of design thinking*

An activity titled "A Day in the Life" was used to introduce the steps of the design thinking process to the participants. This activity was created for workshop attendees to allow them to practice and gain experience with the design thinking process step by step. Participants were introduced to the concept of each step (empathize, define, ideate, prototype, and test) through activities with clear instructions on what they needed to do. Activities included pair discussions in the zoom breakout rooms, reflections, and empathizing with their partners' emotions that have affected their lives. This was followed by empathizing with the problem and devising creative and innovative solutions through ideation and the creation of a prototype in the form of a story board. They were actively engaged in providing feedback to one another throughout the process in order to improve on their ideas. Other topics covered included the integration of the design thinking approach in teaching, as well as some relevant examples.

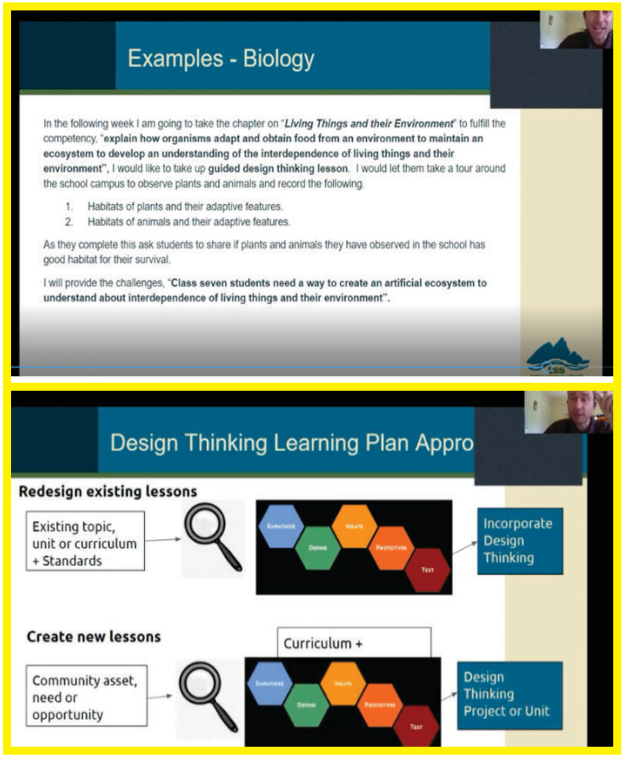


Figure 3: *Sample lessons on Design Thinking.*

Conclusion

Dr. Kinley delivered the workshop's closing remarks. He summarized the workshop's key takeaways and outlined the next steps to be taken. The participants' next steps included implementing a design thinking approach to teaching, learning, and assessment in the classroom. He emphasized that this workshop will lay a research-based foundation for implementing design thinking in secondary schools. He also assured the participants that SCE will closely monitor the school's implementation of design thinking, including co-designing lessons, classroom observations, and gathering challenges and opportunities of the design thinking approach in the teaching and learning process. As a result, this workshop was expected to have a significant impact on the learners and community by producing some creative problem solvers.

Mr. Sherub Chophel

M.Ed II Biology

Women Who Contributed Significantly in Combating COVID-19

Women from all over the world are also making an important contribution to the COVID-19 crisis response, accounting for nearly two-thirds of the global health workforce. The women featured in this article made significant contributions to the fight against Coronavirus.

Dasho Dechen Wangmo (Health Minister of Bhutan and President of World Health Assembly)

Dasho Dechen Wangmo is Bhutan's only female Minister in the current cabinet. She has a Master in Public Health (MPH) from Yale School of Public Health, New Haven, USA and a Bachelor in Cardiopulmonary Science from Northeastern University, Boston, USA. Prior to joining politics she also worked as a public health international consultant with primary focus on health system, governance, policy and strategic planning for governments and civil societies in many countries. Under her leadership, Bhutan could successfully manage the sporadic community outbreaks of virus with a limited health personnel and facilities.

On the 17th of December 2020, in recognition of her outstanding service to the nation in fighting COVID-19, His Majesty the King conferred the "Red Scarf," one of the highest honors conferred on a Bhutanese civilian. Further, member states of the WHO's South East Asia Region nominated her to be the President of the 74th World Health Assembly (WHA) in 2020. She will serve as the President for one year, and it is an honor bestowed on Bhutan for the first time since it became a member of the WHO in 1982. Similarly, she has received the prestigious Association of Yale Alumni in Public Health (AYAPH) award for her leadership in containing the spread of COVID-19 in the country. Bhutan has achieved 93 percent vaccination coverage for eligible citizens under her leadership, with only three people succumbing to the virus.

Virologist Minal Dakhave Bhosale (The woman behind India's first testing kit)

Virologist Minal Dakhave Bhosale, research and development Chief of Mylab Discovery in Pune headed the team that designed India's first testing kit called, "Patho Detect." Despite the scientist's own deadline for the delivery of her child, the kit was created in only six weeks, which normally takes three to four months. She gave birth to her daughter hours after the kit was approved and earned the label "She delivered kit, then her baby." Minal also worked on the swine flu disease at NIV in Pune during the 2009 outbreak.

Dr. Soumya Swaminathan (Chief Scientist at WHO)

Dr. Soumya Swaminathan is the Chief Scientist at the World Health Organization (WHO) since

March 2019. She is an Indian pediatrician and clinical scientist known for her research on tuberculosis (TB) and human immunodeficiency virus (HIV). She received her Bachelor of Medicine and Bachelor of Surgery (MBBS) from Armed Forces Medical College (India) and Doctor of Medicine (M.D.) from All India Institute of Medical Sciences, as well as a Diplomate of National Board from the National Board of Examinations. She then completed a Post-Doctoral Medical Fellowship in Pediatric Pulmonology at Children's Hospital Los Angeles, Keck School of Medicine at the University of Southern California.

Her other areas of interest are epidemiology and pathogenesis, and the role of nutrition in HIV-associated TB. During this pandemic, she played a significant role by urging the countries to perform more frequent whole genome sequencing of the SARS-CoV-2 virus. She served on the High Level Scientific Panel for the Global Health Summit, hosted by the European Commission and the G20 in May 2021.

Dr. Maria Van Kerkhove (Infectious disease epidemiologist)

Dr. Maria Van Kerkhove is an infectious disease epidemiologist and the COVID-19 Technical Lead at WHO. Dr. Van Kerkhove specializes in emerging and re-emerging pathogen outbreaks and is the Head of the Emerging Diseases and Zoonosis Unit within the WHO's Health Emergencies Programme, in addition to her role as COVID-19 Technical Lead. She received her bachelor's degree at Cornell University, Master's degree at Stanford University, and Doctorate in infectious disease epidemiology at the London School of Hygiene and Tropical Medicine. Dr. Van Kerkhove's main research interests are zoonotic, respiratory, and emerging/re-emerging viruses like avian influenza, MERS-CoV, Ebola, Marburg, plague, and Zika. She is particularly interested in factors associated with animal-human transmission, the epidemiology of zoonotic pathogens, and ensuring that research directly informs public health policies for action. Dr Van Kerkhove previously served as the Head of the Outbreak Investigation Task Force at Institut Pasteur's Center for Global Health, where she was in charge of establishing public health rapid response teams for infectious disease outbreaks. She previously worked at Imperial College London's MRC Center for Outbreak Analysis and Modelling, where she collaborated with WHO on influenza, yellow fever, meningitis, MERS-CoV, and Ebola Virus Disease.

Ms.Tshering Zangmo

M.Ed I Chemistry

Bhutan and its Space Program

If we believe that we are the only living beings in the universe, we will be extremely self-centered. We are a tiny part of a solar system that includes a sun, planets, and moons. There are millions of stars in the whole galaxy and many more. This gives us an idea of how little space we take up in the universe, which leads us to wonder if life exists somewhere other than on Earth. Satellites are being built and launched to find out if there is life on other planets and to explore space.

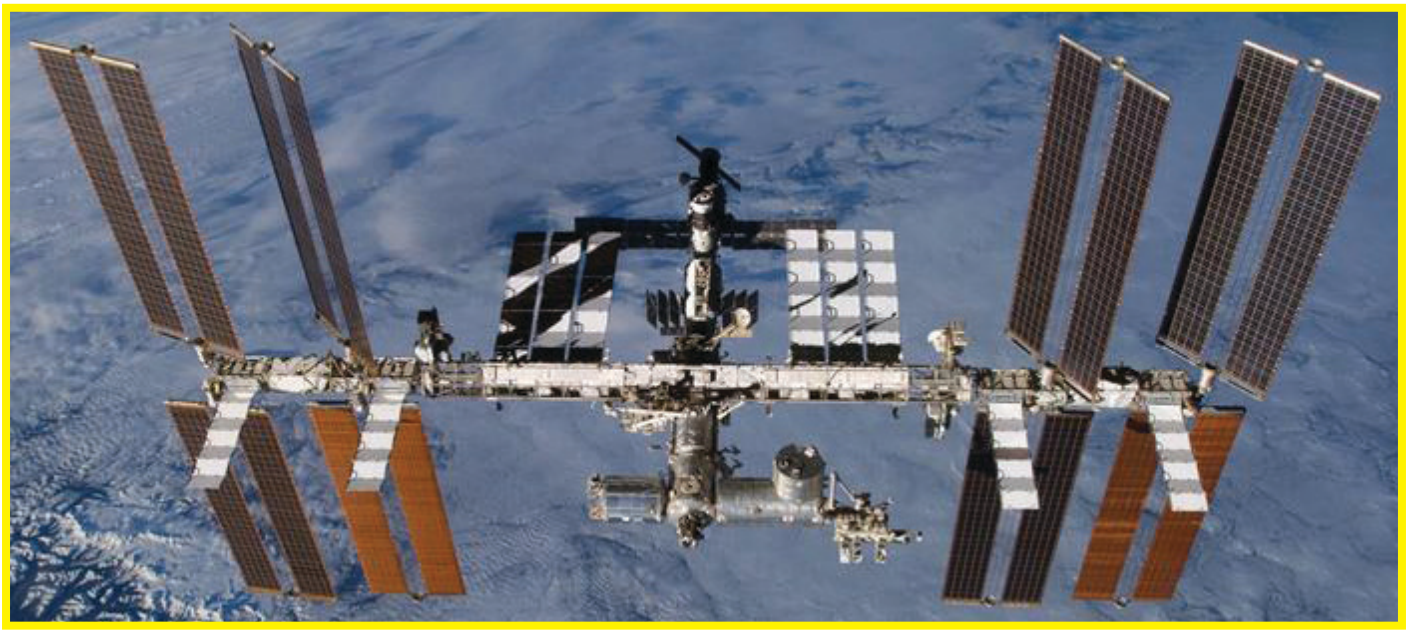


Figure 1 : *The International Space Station.*

Satellites are objects in space that revolve around a larger object. In this case, the satellites are orbiting around a planet. There are two types of satellites; natural and artificial. A moon orbiting the Earth is an example of a natural satellite and the international space station orbiting The Earth is an example of an artificial satellite. Satellites are used for a variety of purposes that enable us to live a comfortable life on Earth. Some of its uses include television signals, telephone facilities, navigation, weather, climate, and environmental monitoring. We are able to watch television with many channels because of the artificial satellites orbiting our Earth. It is due to the artificial satellites that we can communicate all across the globe. This form of communication is the fastest and the most cost-effective way that covers vast areas compared to cables.

In addition, satellites are used to explore the space that we know so little about. In the past, Astrophysicists were limited to ground telescopes to learn about space. However, with technological advancements, we can explore more by launching satellite telescopes into space. Satellite telescopes have been critical in learning about black holes, pulsars and measuring the age of our universe.

Bhutan has officially joined this adventure to explore our space along with many other countries. It was a huge moment of pride for all the Bhutanese when our first-ever space-borne satellite called BHUTAN-1 was launched into orbit aboard the SpaceX CRS-15 mission on 29th June 2018. It was inspired by His Majesty's vision to develop Bhutan's Space and Science Technology program. This project was

Figure 2: *BHUTAN-1*

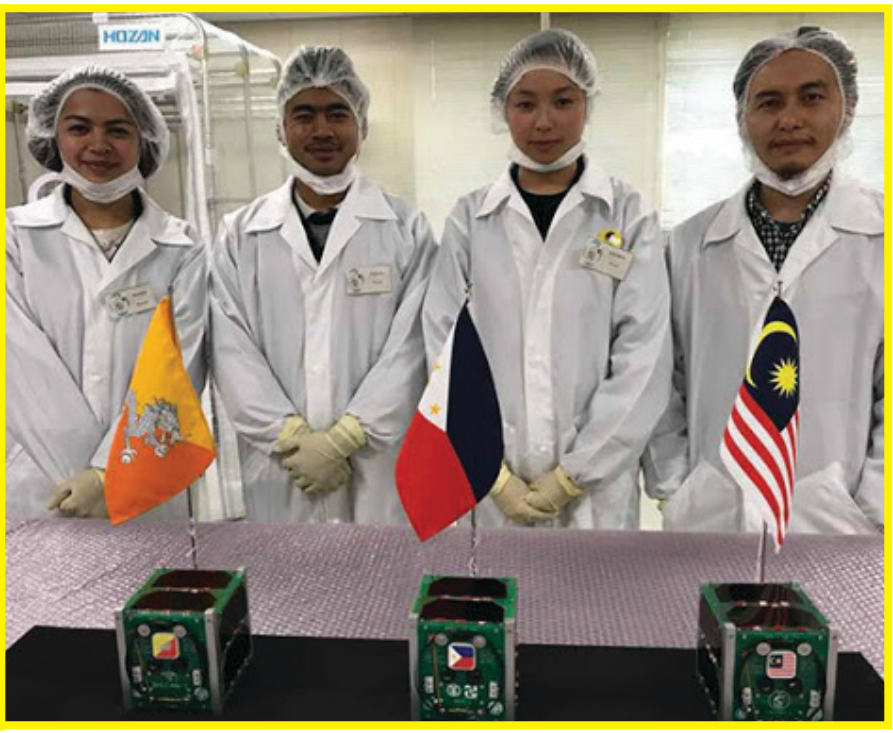


Figure 3: *Four Bhutanese Spcae Engineers behind BHUTAN-1*

very important as it marked the entry of Bhutan into space, science, and technology. BHUTAN-1 has been developed by four Bhutanese engineers as their Master's Degree Project under the BIRDS-2 project in Kyushu Institute of Technology, Japan. The BIRDS-2 project is a cross-border interdisciplinary project for countries that have not yet ventured into space by Japan.

The satellite's journey ended with it exceeding its lifespan of 6-9 months. The last contact made with the satellite was on 16th November 2020. This project was not just to enter the exploration of space but also to develop the capability of Bhutanese space engineers to develop better satellites that can be sent out into space in the future as well.

When India's Prime Minister, Mr. Narendra Modi, visited Thimphu in August 2019, a decision was made to collaborate on the development of a satellite for Bhutan that would be launched by India. This collaboration is India's way of supporting our King's plans to develop our country through advanced technology such as ICT and space technology. Following that decision, four Bhutanese space engineers left for India in December 2020 to train at the Indian Space Research Organization (ISRO). All of us are eagerly waiting to witness the historic moment when India will launch our second satellite into space. Our King and the government are aware of the importance of science and space technology in developing our country. We can look forward to more such projects where Bhutan will venture into space and hopefully one fine day, we will be able to launch our own satellite into space.

Sonam Choki Lhamo

PGDE 2021

Mitigating Climate Change

Climate change is defined as a change in temperature and weather patterns that is caused by both natural and human activities. This creates numerous threats to humans and other living things. Climate change has been a concerning issue around the world, as well as in Bhutan, because it affects not only our communities or country, but the entire world. Bhutan is regarded as highly vulnerable to the adverse effects of climate change due to its location in the Himalayan region, where the mountains are young and fragile, and Bhutan's economy is heavily reliant on climate-related sectors such as agriculture and hydropower.

Climate change is influenced by both natural and human activities, but it is largely related to human activities. It is mainly caused by greenhouse gases such as carbon dioxide, methane, nitrous oxide, sulphur, hexafluoride, perfluorocarbons, and hydrofluorocarbons, as well as global warming and emissions of harmful gases from industries and vehicles. Climate change is also caused by the import of various types of vehicles and packaged foods, the use of various pesticides and technologies, the use of fossil fuels, deforestation, overgrazing, increased pollution, waste, and many more.

Impact of climate change

Most of the world's population depend on agriculture, and climate change has adversely affected farmers. The world is already experiencing the effects of climate change, such as changes in vegetation and quality of soil, decrease in production and yield, unusual outbreaks of diseases and pests, heavy precipitation, flash floods, landslides, and unseasonal and heavy rainfall. For example, this year in October, about 793 acres of paddy fields in Paro were affected by continuous rainfall for three days. This is the result of unseasonal and intense rainfall. Cardamom cultivation is the major source of livelihood for most of the people in southern Bhutan, but climate change has greatly reduced its production. Similarly, climate change has also increased diseases and pests in the cash crop which directly affects the farmer's livelihood.

Figure 1: *Heavy rains in October 2021 destroyed harvested paddies in many parts of the country.*

With increasing temperatures, our glaciers are melting and snowfall is comparatively less than before, leading to glacial lake outburst floods (GLOF), causing great destruction to the people as well as the economy. Climate change has impacted human health, such as increased injury and death caused by extreme weather events, waterborne diseases, communicable diseases, and other respiratory illnesses, lead-

ing to a decrease in human productivity, unemployment, and poverty. An increasing number of diseases and pests, unpredictable weather, and poor quality soil caused by climate change have resulted in the reduction of the livelihoods of farmers. In addition, it has created an economic crisis in the world.

Figure 2: *GLOF causes an increase in river water level.*

Natural disasters have become more common as a result of climate change, as have unpredictable changes in weather patterns and perspiration, glacial melting and sea-level rise, and biodiversity loss. The world is facing a water scarcity crisis; perennial springs are drying up, and birds, insects, and wild animals are migrating to colder areas as temperatures rise. Human and ecosystem devastation would result from glacial melting and rising sea levels. Bhutan is at risk of GLOF, drying water sources, forest fires, landslides damaging most roads, and prolonged droughts that endanger biodiversity loss. To summarize, climate change has disrupted the entire ecosystem, but most people are unaware of its impact on their daily lives.

Mitigating climate change

Our future generations will be roasted, toasted, fried, and grilled unless we take action to mitigate climate change. Climate change is real, and we are experiencing it on a daily basis, so it is time for us to take action to mitigate climate change. Climate change can be mitigated by using renewable energy sources, reducing the use of plastics and managing waste through the Reduce, Reuse, and Recycle (3Rs) approach, and planting trees. To combat climate change, the government and relevant agencies should enact laws, policies, and acts. At the same time, these laws, policies, and acts must be implemented and monitored, because action speaks louder than words.

As a future social worker, I believe that through advocacy and awareness programs, cleaning campaigns, tree planting, and building resilience to climate change, social workers can play an important role in mitigating climate change. Nobody on this planet will be immune to the effects of climate change, so let us all work together to combat climate change for a better future, and let us not punish future generations for our actions today.

Sonam Wangchuk

B.A. in Social Work

Astronomy Club at Samtse College of Education: Thinking Beyond Earth

The Astronomy Club at Samtse College of Education was formally established on 22nd September 2020 and includes students and faculty who are interested in exploring the universe. Thhe primary aim of the club is to disseminate hands-on astronomy outreach activities in Bhutanese schools and colleges.

The Astronomy Club at Samtse College of Education was established with the following objectives:

- raise astronomical awareness and interest in space science among Bhutanese students and children of all educational levels;
- instill a scientific temperament and a love of astronomy in students and teachers;
- use telescope or a mobile app to observe various celestial bodies such as stars, constellations, and planets in the real night sky;
- establish links with international partners for knowledge exchange through astronomy and space science research;
- participate in scholarly and intellectual discourses on astronomy and space science in the context of school-based STEM education;
- invite national and international guest speakers with relevant background and expertise in astronomy and space science to inspire young minds; and
- observe international events on space science.

A glimpse at the astronomy club's activities

Visit SCE Astronomy Club: Thinking Beyond Earth | Facebook

Figure 1: *Created a Facebook page to facilitate communication with astronomers and astronomy enthusiasts.*

Figure 2: *Students observed the Blue Full Moon in September-October 2020 using a telescope.*

Figure 3: *Ms. Sonal Thorve and Mr.Samir Dhurde, astronomers at the Inter-University Center for Astronomy and Astrophysics (IUCAA) in Pune, India, resourced an online workshop for astronomy club members on making toys to teach astronomy.*

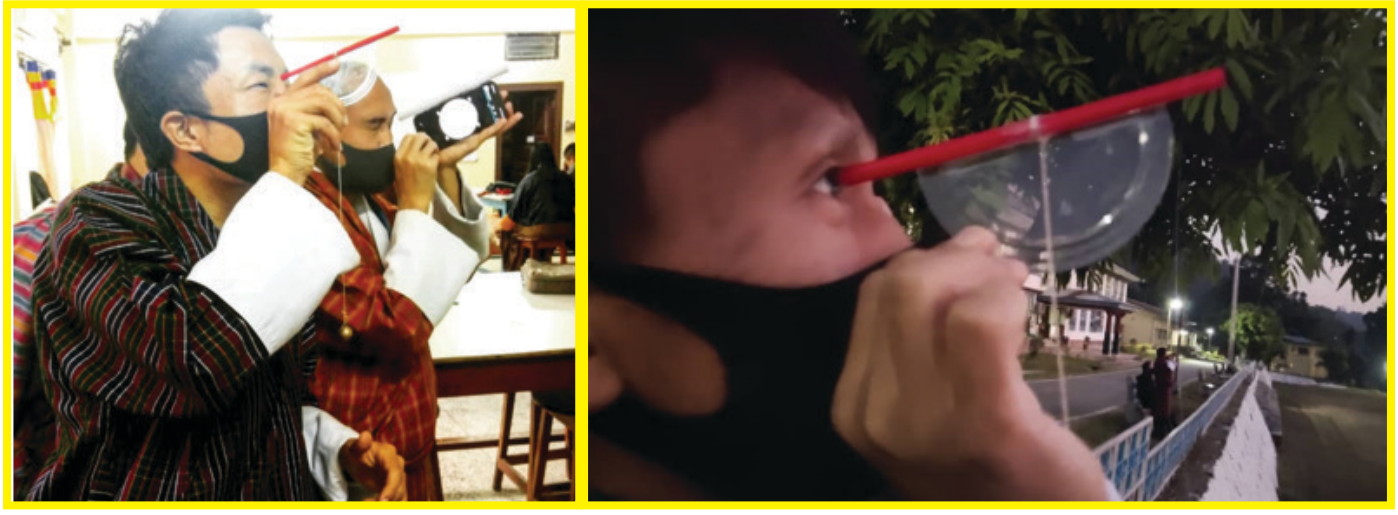
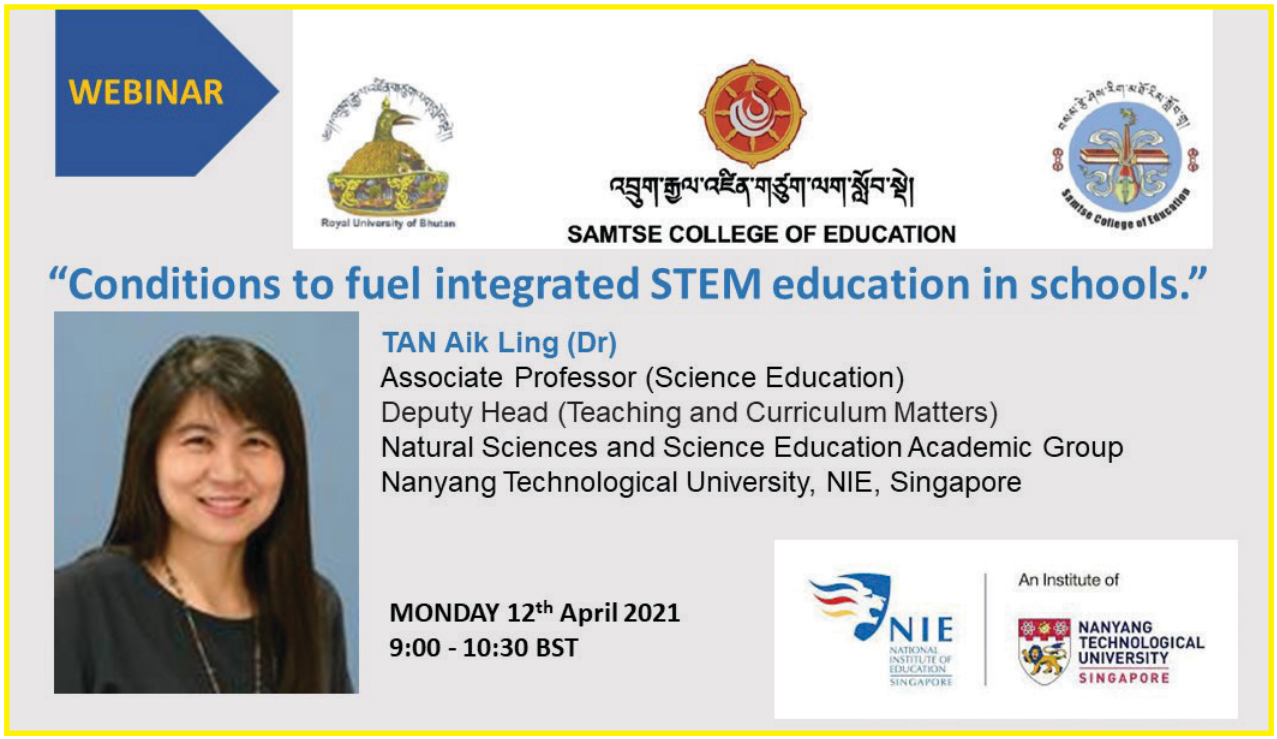


Figure 4: *Club members used an improvised inclinometer and inclinometer apps to measure the latitude of Jupiter and Saturn's conjunction on December 21st, 2020.*

Conditions for Fueling Integrated STEM Education in Schools



Introduction

On April 12, 2020, the President of the College, along with faculty members from Math, Science, and Information Technology, attended a webinar titled "Conditions to Fuel Integrated STEM Education in Schools" resourced by Dr. Tan Aik Ling, Associate Professor in the Natural Sciences and Science Education at Nanyang Institute of Education (NIE), Nanyang Technological University (NTU), Singapore. Dr. Teo Tang Wee, Associate Professor in the Natural Sciences and Science Education (Academic Group), NIE, NTU, Singapore, was also present to complement the responses of Dr. Aik Ling to the questions from the participants.

The primary objective of the webinar was to enable STEM teacher educators in the College to learn about some of the good practices of STEM Education in the Singaporean school system. Dr. Tan Aik Ling began her presentation with a brief history of how the Singaporean Government emphasized the importance of STEM education for specific purposes. She stated that after gaining independence in 1965, the government considered supporting technical welfare through STEM education and that the government was focused on supplying a technical workforce to the industries. The second revision in STEM education in Singapore, according to the Guest Speaker was guided by the knowledge-based economy in 1980, and the current emphasis is on problem-solving through innovation and enterprise. She shared that the slogan for the revised Science Curriculum Framework (2019) in Singapore is Science for Life and Society. With this, Dr. Tan Aik Ling reminded the participants to think about what the purpose of STEM education in Bhutan should be. Then, using an activity, she introduced the participants to the concept of STEM education and the disadvantages of offering Science, Technology, Engineering, and Math education in silos. Good STEM education is regarded as the solution for producing innovative thinkers for STEM-related industries that will help the global economy. She emphasized that, in addition to preparing students for the future workforce, STEM education is critical for individual students' personal

development, allowing them to make sense of a world increasingly powered by science and technological innovations. She further said that, despite the focus on STEM education, there is little agreement on what constitutes STEM, how STEM outcomes can be measured and disparities in STEM educators' understanding of STEM education. She stated that to address the aforementioned issues, the integration of two or more STEM disciplines or lessons based on connections between the subjects and real-world problems is recommended, which will also improve scientific content understanding and solve social issues. Hence, an integrated STEM education could be focused on either content integration or context integration. She described the STEM QUARTET Model (Figure 1), an instructional framework for STEM integration based on the theoretical concepts of disciplinarity and problem-centered learning. The Multi-centric Education, Research, and Industry STEM Centre (meriSTEM) at NIE Singapore use this model to train teacher trainees and teach STEM education in schools.

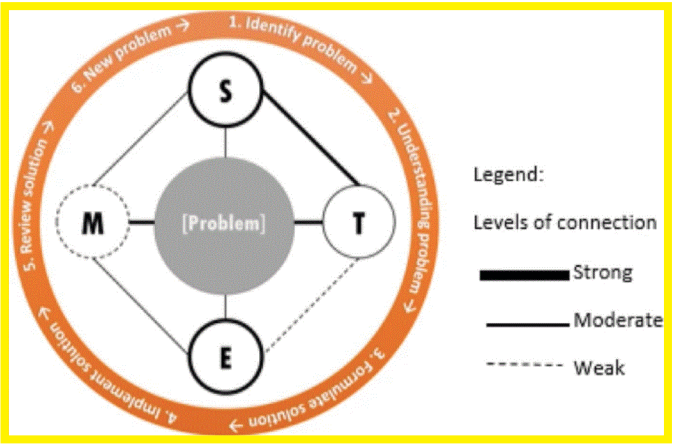


Figure 1: *S-T-E-M Quartet instructional framework*

This integrated STEM instructional framework is based on the fundamental perspective of solving complex, persistent, and deep real-world problems using practices unique to the four disciplines, while also drawing on connections within and between disciplines. She also said that making connections across disciplines is difficult and that teachers must handle STEM content deliberately and explicitly so that students can describe the connections when applying knowledge to solve real-world problems. Hence, the S-T-E-M Quartet is an instructional framework that aims to make the connections between disciplines more explicit. The framework's four main characteristics are as follows:

1. Problem-solving as the overarching process,

2. Complex, persistent and extended real-world problem at its core,

3. A focus on connections between the disciplines (i.e. horizontal connections), and

4. S-T-E-M as the four disciplinary domains (i.e. vertical learning) with a lead discipline.

She demonstrated the use of the Quartet Model to design an integrated STEM lesson for a high school biology lesson.

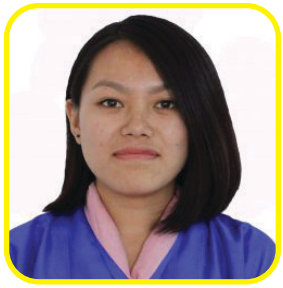
Following Dr. Tan Aik Ling's presentation, one of the participants asked whether Bhutan's current science education could be classified as STEM education because STEM subjects are taught in silos. To this Dr.Teo Tang Wee replied that STEM education has always been confusing from the start of the Act of STEM Education and it remains, though the original idea is to integrate all the subjects, yet the actual implementation is difficult. But as a teacher, if we implement at least two out of the four STEM disciplines in our class, we can say it is STEM education.

Another question was on the practice of integrating Biology, Chemistry, and Physics in the Singaporean education system. Here Dr. Teo Tang Wee replied that some schools in Sin-

gapore offer an Applied Learning Programme (ALP) in which more than 50% are for STEM ALP. These schools provide double periods in a week for the students to learn and experience STEM ALP lessons of integrated STEM education. Similarly, other interactions focused on designing STEM lessons, the challenges of integrating STEM subjects, and teacher subject backgrounds that may impede the implementation of integrated STEM education in schools.

With this, the session came to an end with the last note from the President. The President appreciated and thanked the two resource persons for sharing some good STEM education practices, and he asked the science faculty of the College to review and reflect on their STEM education practices, as well as consider how we can contribute to raising the country's STEM education standards. He further added that STEM has become the language of education and stated the importance to make concerted efforts to make our education and society progressive and dynamic, as STEM education will be the solution to the majority of the problems we will face in the new century. The President and the STEM Research Center Coordinator thanked the resource persons and requested similar interactions and future collaborations in STEM education and research.

Dr. Reeta Rai and Ms. Sapna Thapa



Designing e-Brochures by Bachelor of Arts in Social Work (BASW) Students

Social workers need to be equipped with various skills to be able to communicate, assess, diagnose, and provide the best solutions for their client's issues. At this time when technology integration is imperative, building their ICT skills is prioritized. Thus, during the Spring Semester, 2021, the second cohort of BASW students were thoroughly trained on using application-based technology. As a result, and partial fulfillment for the module Functional Information Technology (FIT102), students developed twelve e-brochures for various clubs that are active in Samtse College of Education.

The e-brochures were designed and developed after multiple procedures of data collection, analysis, design, and development using MS Publisher. This project allowed them to nurture their creativity, collaboration, communication, and technical skills. Furthermore, they were able to hone their social skills when completing the project which they have been theoretically learning in other modules from the past semester. They can now comfortably integrate technology in their practice of social working at present and in the future.

e-brochure for TARAYANA Club

The club provides social platform for the young volunteers who learn the importance of service and the Art of Giving

Tarayana foundation have touched thousands of lives and created conditions for the achievement of individual goals and dreams in many far flung rural communities

Helping hands are better than praying lips

Outdoor Activities

Cleaning Campaign in and around Samtse town

- Paper picking and drain unclogging
- White washing of religious shrines
- Contributes in construction activities

Services to beneficiaries

- The club has some beneficiaries that they have been looking after and they often visit them.
- Provide rations and clothing
- Maintenance and cleaning of houses and surrounding.

Render services to the economically disadvantaged students

- Supply school uniforms (shoes, casual dresses, slippers)
- Financial support (school fees)

Bhutan Happiness

Tarayana Club

www.tarayanafoundation.org

Aims and Objectives of Tarayana

" The spirit of volunteerism through meaningful social services in the communities".

Vision: Happy and prosperous Bhutan.

Mission: Tarayana foundation believes in maximizing happiness and harmony among all Bhutanese people by providing opportunities for life improvement. By helping community members learn and integrate new skills, Tarayana foundation promotes self-empowerment and the importance of serving each other.

Motto: Service from the heart

Volunteers do not necessarily have the time, they just have the HEART

General Background

Tarayana is a public benefit organization, registered with the Civil Society Organization Authority of Bhutan. it was founded by her Majesty the queen mother Ashi Dorji Wangmo Wangchuck and formally launched on 4th May 2003, by his Majesty the king Jigme Singye Wangchuk. Tarayana strives to improve rural livelihood by promoting participation in mainstream development initiatives and enhancing income generating activities. Tarayana foundations goals of contributing to a prosperous Bhutan have resulted in the urbanization delving deep into remote, rural communities where services had not reached.

In 2003, the teachers who graduated from Paro College and Samtse College started Tarayana clubs in the college with the hope to promote one of the objectives of the foundation, "The spirit of volunteerism through meaningful social services in the communities". The main activities of the club are awareness program, cleaning campaign, helping senior citizens an d donating clothes and rations. The activities that the club implement are very innovative and focused to help the needy ones . Since its inception, the club has been found to be very active and supportive. Today the Tarayana club has recruited 92 members. They strive to render services from the heart.

In Campus Activities

Cleaning campaign in and around the college campus

- Paper picking
- Cleaning of water reservoir tank of the college
- Grass cutting
- Footpath maintenance

Fund raising activities

- Cultural shows (singing and dancing)
- Sports competition among classes (indoor and outdoor games)

Creates awareness programs in international days observed in the college in

e-brochure for SDG Club

Samtse College Of Education

Sustainable Development Goal (SDG) CLUB

AIMS

- To promote sustainable environment.
- To protect the planet.
- Ensure that all students enjoy peace and prosperity.

OBJECTIVES

- To gear college towards sustainable development via main objectives:
- Improve access to primary education.
- Promote gender equality.
- Combat major diseases.
- Preserve the environment.

VISION

- No one left behind by 2030
- Sustainable development.
- The promotion and protection of human rights and social progress.

MISSION

- To solve some of humanity's biggest challenges.
- Increase access to education.
- Address climate change.
- Reduce inequality among trainees

BENEFITS OF THE CLUB

- Promote sustainable environment by following measures like;

1. Training our youths to have sustainable environment through many strategies.
2. Most importantly we focus on goal no. 3 (good health and wellbeing) and goal no. 6(clean water and sanitization)

ACHIEVEMENTS

- Clean the water source for the college
- Manage the college waste
- Works for campus beautification

BACKGROUND HISTORY

- Club was started in the year 2016 by Mr. Tashi Dawa.
- Mr. Tashi Dawa is a ambassador of Youth. He introduced the club in our college to bring changes.

Compiled by Ms. Sapna Thapa, Lecturer

Dr. TEO is an Associate Professor in the Natural Sciences and Science Education Academic Group at National Institute of Education, Nanyang Technological University, Singapore. She also serves as the Co-Head of the Multi-Centric Education, Research and Industry STEM Centre (meriSTEM@NIE). She hosted two webinars for STEM faculty and students at Samtse College of Education. The webinars were also attended by some school teachers, university academics, policymakers, and curriculum developers with expertise in STEM subjects. The webinars' titles were: How Can I Prepare to Teach STEM Lessons in the Future? and Manifestations of STEM Education Rhetoric on The Global Landscape.

The first issue of STEM Education Newsletter is pleased to feature Dr. TEO Tang Wee's Perspectives on STEM Education, notable achievements of Singapore in STEM Education, and some recommendations to educators for implementing STEM education with a humanistic focus. She shares her views on STEM education in the following sections.

The "STEM Way": STEM education should really be integrated, otherwise it would defeat the purpose of going the "STEM way". Clearly, research in the STEM fields has become interdisciplinary and humankind has the answers to most of what is deemed today as relatively less complex natural phenomena. The (un) natural phenomena that humankind has to deal with today are much more complex, not only in terms of the scientific principles undergirding the evolving changes but also in terms of the inter-relations between humans, society, cultures, politics, and the environment. The implication for our present and future generations is that we have to adapt, or be left behind.

Adaptation is the natural process in which living things adjust to changes in order to survive. Education is not self-serving and should also continually evolve to address changes in the larger ecosystem to which it belongs. My imagery of the "STEM way" is like rhizomatic veins running through the systems and structures, resulting in

connectivity. STEM education that is purposeful in its intent, driven by knowledgeable teams of teachers, and supported by visionary school leaders can support students in making such cognitive connections while being grounded in disciplinary knowledge and practices. It is a win-win and not an either-or situation in introducing integrated STEM education to the school curriculum.

Something comes, something goes: The school curriculum is always packed to the brim with content delivery and assessment. If STEM education were to be added to the school curriculum, what would need to make way for STEM education? Teaching and learning according to topics is easier than learning in a thematic way because the former offers a definitive scope that makes accountability more visible. While such approaches have worked well for centuries, I wonder if such approaches will continue to serve our students well given that real world problems, issues, and challenges are not compartmentalised. If anything needs to go, I would recommend the archaic ways of topical teaching and testing. As educators, we all know that assessment drives learning. For transformative changes like STEM education to take root in the school curriculum, assessment must change.

Learning with our neighbours: In a recent BBC interview, I mentioned that Singaporean children have indeed shone at international benchmark assessments such as TIMSS and PISA. However, I underscored the point that STEM literacy is more than just the cognitive competencies to understand new knowledge or engage in the normative practices of the respective disciplines. What STEM literacy also entails is the ability to make informed decisions that would benefit oneself and others. In other words, STEM literacy embodies morality, ethics, empathy, cultural awareness, and so on, such that when you engage in the humanistic way of thinking, it could mediate decisions based on knowledge and meta-knowledge. The world will probably benefit from having smarter people, but certainly not smart people who choose to create a new order that could potentially result in greater messiness and inequities that the world is already confronting.

Last but not least, I think that Singapore educators are still working hard to understand what "STEM education" is and how best to enact STEM lessons in the classrooms. What I am more certain about is that Singapore has done well in making sure that the conditions for successful STEM education are available. Specifically, the quality of the teachers is good in terms of their content knowledge and dispositions. Budgetary resources, as well as access to teacher professional development opportunities, such as teacher work attachments at industries, are available. The narrative of STEM education is consistent with the macro narratives related to the digital transformation of Singapore. Consistency and alignment of initiatives across sectors of a society can help its citizens understand the broader goals and work in tandem.

Phub Lham, the only female in the M.Ed. Biology 2021 cohort, was awarded the Certificate of Excellence in Academic Proficiency in Biology.

Ms. Phub Lhamo, of Nimaling village in Chuzagang geog, Sarpang Dzongkhag, graduated from Samtse College of Education (SCE) in December 2021. She has been a teacher for 20 years and taught at Motithang Higher Secondary School in Thimphu before enrolling into the Masters Degree study at SCE. She was well-known as a dedicated teacher at the school, and she used to teach subjects such as Biology, Chemistry, and Information Technology. Recently, she excelled in M.Ed Biology with a score of 80.06 percent and was one of the female recipients of the Merit Award as a result of her hard work and perseverance. Mr. Kinley Wangchuk, on behalf of The STEMERC Editorial Team, interacted with her to better understand her academic achievement perspectives as the only female in the M.Ed. Biology 2021 cohort.

Ms. Phub Lham was awarded the Certificate of Excellence in Academic Proficiency in Biology.

Kinley Wangchuk (KW): How did you feel receiving a merit certificate from the 2021 biology cohort as a female?

Phub Lham (PL): I am delighted and honored to be one of the recipients of such an honor.

KW: Did the two-year M.Ed. program help you advance your pedagogical, content, and research knowledge and skills?

PL: Yes, definitely, I've gained a lot of knowledge and skills that will help me improve my students' learning even more, but I can't say I've become an expert. My passion for students drove me to pursue this program at SCE, and I am confident that my qualification enhancement will act as a catalyst for the school's effective teaching and learning processes.

KW: What challenges did you face as a female while undergoing this course?

PL: Being a lone female was difficult, especially at the start of the academic session when I needed to move around more and had no female friends to ask for assistance. Furthermore, I felt somewhat lost when I had to participate in some group projects. But, over time, I discovered that all of my male colleagues were friendly and helpful.

KW: What are your thoughts on the status of women and girls in STEM education in Bhutan?

PL: As a female STEM teacher, I believe female students lag behind male students in STEM skills and education, which could be attributed to social norms and expectations. However, I am seeing more girls in schools than ever before, and more girls are interested in science, which is very encouraging.

KW: How would you like to encourage school girls to pursue STEM education so that they do not fall behind?

PL: We, as educators, can help our school girls develop a positive attitude toward STEM education by providing equal opportunities for both boys and girls, resulting in more girls participating. For example, the activities we design or any tasks we assign should be doable by both boys and girls and should make the classroom conducive to learning. We can encourage more female participation in any activity by providing the necessary guidance and demonstrating our concern. We must instill in female students a sense of pride in their ability to compete with male students and dream big. If they put their minds to it, there is nothing they cannot accomplish.

Phuntsho Dorji was awarded the Certificate of Merit Excellence in Academic Proficiency in M.Ed Science and Mathematics (79.98%) and the Certificate of Excellence in Academic Proficiency in Chemistry (81.10%).

Mr. Phuntsho Dorji is from Martsala village in Pemagatshel's Dechheling geog. He worked as a chemistry teacher at Drukjegang Central School in Dagaga Dzongkhag for six years before being enrolled in the M.Ed course. At the auspicious award ceremony held on December 2, 2021 he was awarded the Certificate of Merit Excellence in Academic Proficiency in M.Ed Science and Mathematics (79.98%) and the Certificate of Excellence in Academic Proficiency in Chemistry (81.10%).

Mr. Kinley Wangchuk, on behalf of The STEM-ERC Editorial Team, interacted with him to better understand his perspectives on academic achievement and STEM education.

Mr. Phuntsho Dorji receiving the Certificate of Merit Excellence in Academic Proficiency in M.Ed Science and Mathematics and the Certificate of Excellence in Academic Proficiency in Chemistry.

Kinley Wangchuk (KW): How do you feel receiving a Merit Excellence certificate from the entire M.Ed Science and Mathematics 2021 cohort?

Phuntsho Dorji (PD): I feel happy because my hard work has led to the fruition of this special award. Having said that, it was all because of the guidance and effort of my tutors. Therefore, I offer my deepest gratitude to all of them. My appreciation also goes to my family for their prayers and blessings throughout this learning journey.

KW: Did the two-year M.Ed program help you advance your pedagogical, content, and research knowledge and skills?

PD: Yes, the two-year M.Ed program has allowed me to advance my knowledge in terms of pedagogical adaptation, content knowledge, and research skills. For instance, from the Assessment module, I have learned about pedagogical approaches such as place-based learning, design thinking, and inquiry-based learning that are very useful for teaching scientific concepts to students. Similarly, in terms of content knowledge, the advanced studies module assisted me in improving my understanding of chemistry. In addition, one of the most enriching modules in the M.Ed program was the research module. Through this module, I have learned a lot about research and its components. I can admit that I am confident in doing research by myself.

KW: In what ways do you believe school students will benefit from your qualification advancement?

PD: The pedagogies that were learned through this course will help trigger students' interest in learning. By applying various pedagogies and strategies, students will experience different tastes in the process of learning. The other aspect is, assessment practices in the school will be improved. In addition, I would be able to determine the misconception of Chemistry among students through investigative study that I learned through the misconception module. Furthermore, for higher secondary schools science students, the research knowledge that I gained from this course will be handy for the students while carrying out the project works.

KW: How will you support the Royal Kasho's vision for STEM education?

PD: As a Chemistry teacher, my only wish is to support the agency in fulfilling the objective of producing globally competent individuals. The rapidly changing world due to technological advancement, requires future citizens to be endowed with scientific knowledge and skills. The scenario in which the development paradigms unfold their dynamism would be completely different from today. It is going to be more challenging, and the best solution to this end is to prepare future citizens by giving them the right tools, the right insights, the right methods, and the right direction, which ultimately aligns with the Royal Kasho. Therefore, I aspire to put in my best effort to inspire my students to do exceptionally better in science in general and chemistry in particular.

KW: Is there anything else you'd like to say about STEM education?

PD: STEM education is very crucial for students to be successful in today's rapidly changing world. Students with sound knowledge of STEM subjects are expected to solve any issues that arise due to natural phenomena or anthropogenic activities. Students with sound STEM knowledge should aspire to become successful entrepreneurs, inventors, scientists, and productive citizens regardless of their career goals. However, in Bhutan, the majority of science students aspire to become engineers, doctors, or teachers after their studies. And it seems that none of our young minds prepare for the unseen challenges that they are likely to encounter on their way. The reality is that our education system has produced mediocre science graduates.Therefore, as educators, we need to change this mindset among the students and provide them with the right tools and direction to become globally competent individuals. One of the ways we can encourage our students to learn STEM subjects is through the use of laboratory work. Through laboratory work, students become critical and develop scientific attitudes by investigating problems.

Interviewed by

Kinley Wangchuk

M.Ed I Chemitry

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