SEAAIR 2022

The 22nd ANNUAL CONFERENCE

Annual SEAAIR Conference Proceedings

Volume 2

(November 2022-November 2023)

ISSN 2774-0773(Online)

Annual SEAAIR Conference Proceedings

Volume 2
(November 2022-November 2023)

SEAAIR 2022: New Normal Education: Transitioning, Transforming, and Technologies Agenda
September 28-30, 2022

Published by:
SEAAIR (South East Asian Association for Institutional Research)
Indexed by EBSCO Academic Databases
Website: http://www.seaairweb.info/Conference/

Cover Design:
Jang Wan Ko, Ph.D. & Jihoe Park, Ph.D.
Sungkyunkwan University & Chungwoon University

ISSN 2774-0773 (Online)

MESSAGE FROM PRESIDENT OF SEAAIR

SEAAIR greets you and warmly welcomes you all with great pleasure to our SEAAIR 22nd Annual Conference in Seoul, South Korea. We thank our distinguished speakers and participants for joining us this year, and to many of our participants and presenters, we say "for joining us again." Indeed, we are very grateful to Sungkyunkwan University (SKKU) with the Korean Association for Adult and Continuing Education (KACE) for accepting the enormous task as this year's Local Organizing Committee (LOC) and in making this scholarly event happen.

For more than two decades, SEAAIR remains steadfastly committed to its purpose. That is, "to benefit, assist and advance research leading to improved understanding, planning, and operations of HEIs in the South East Asia." We firmly believed that SEAAIR has flourished through the years because of its unrelenting focus on its reason for being and for consistently upholding the wisdom and history established by the founding members. It has become a conduit of academic and cultural platforms.

As a maturing organization, SEAAIR has advanced in its desire to become more inclusive …. into SEAAIR Plus through partnerships with other countries like China, Korea, and Taiwan, with key participations from Japan and Australia, and other frequent nationalities' involvements.

This year's theme "New Normal Education: Transitioning, Transforming, and Technologies Agenda" is not only appropriate but very timely when practically HEIs all over the globe continue to grapple with digitization in transitioning from the pandemic era that created for us the aftermath of what we call now as the New Normal.

We received a total of 99 abstracts, with 75 full papers submitted for review and , 73 or 78% of which were accepted. However, to be presented in this year's conference are 44 papers or more than 58%, which are spread quite well in the four sub-themes.

Joining a face-to-face conference after the pandemic proved to be very challenging. But many of us made possible what seemed impossible…we were willing to go through the hurdles, notwithstanding the paper refinement, ….but for most of us, we can't believe we are finally here, after the entry challenges of uncertainties.

The new normal has painted a more convoluted travel landscape that can be very dispiriting, but yes…we were able to put up with the complexities. Is this not one good reason to cheer that our being here is more of a personal victory? Let's claim our personal victory! Cheers!

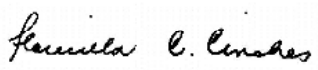
We sincerely commend our LOC headed by Prof. Jang Wan Ko with his dynamic team. The very fast responses to additional participants/presenters' document requests were catalysts to have found many of us here now joining.

We thank our Keynote Speakers for setting the tone of our Conference. Likewise, we are also very grateful to our Plenary Speakers, whose inputs greatly widened our perspective on our conference Theme.

Our LOC took to the task of creating for all of us, not only this academic experience but also enjoyably meaningful and memorable experience through their warm hospitality and the rich traditions and cultures of Seoul. Let's join the tour of what they have prepared for us.

Thus, we look forward for everyone to enjoy the conference as a conduit of both academic and cultural platform in addition to your life's journey, that is not only memorable but a rich experience.

We reiterate our sincere gratitude to SKKU, the LOC members and team for taking up meaningfully the 22nd SEAAIR Annual Conference. We also thank everyone for your interests in joining the Conference. Thank you.



Prof. Ma. Florecilla C. Cinches, PhD
President

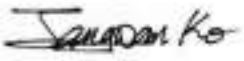
WELCOME MESSAGE FROM ORGANIZER

Welcome to the SEAAIR2022 annual conference in Seoul, Korea. It is our pleasure to meet all the distinguished Professors, Speakers, Presenters and also experts and scholars in this SEAAIR Conference.

The SEAAIR2022 Conference is hosted by Institute of Educational Research at Sungkyunkwan University and Korean Association for Adult and Continuing Education, jointly by South East Asian Association for Institutional Research (SEAAIR). Also we would like to thank Sungkyunkwan University for its generous support.

The SEAAIR conference aims to facilitate international exchange in IR, to transform the wisdom in IR research into action in order to advance the development of teaching and learning in higher education. This year's conference is particularly meaningful in two ways. This is the first on-site conference after outbreak of pandemic. The theme of the conference is "New Normal Education: Transitioning, Transforming, and Technologies Agenda". Hence, the main theme of the conference is indeed a timely one. We are sure that this conference will deeply discuss a way to adapt and succeed in the new normal. In addition, discourse of institutional research in Korea started here at Sungkyunkwan University. The first official IR office in Korea was Center for Institutional Effectiveness established in 2010 at Sungkyunkwan University. Since then higher education communities in Korea have adapted IR functions to support decision-making processes.

We would like to thank the keynote speakers, all presenters, session chairs, and participants for their active involvement, and personally thank the staff and members of local organization committee for their hard work. Wish to meet you again on the next conference. Thank you!



Jang Wan Ko, Ph.D.
Chair, SEAAIR2022 Local Organization Committee
President, Institute of Educational Research, SKKU
President, Korean Association for Adult and Continuing Education

SEAAIR COMMITTEE

President:	Dr. Ma. Florecilla C. Cinches
Hon. Secretary:	Dr. Koh Yit Yan
Head, SEAAIR Secretariat:	Dr. Krisada Tanchaisak
Editor, JIRSEA:	Dr. Teay Shawyun
Members-at-large:	Dr. Rajendra Sharma
	Dr. Dennis V. Madrigal
	Dr. Leenawaty Limantara
	Dr. Sophia Shi-Huei Ho
	Dr. Tajularipin Sulaiman
	Dr. Sutee Sujitparapitaya
	Dr. Manika Wisessathorn

SEAAIR 2022 LOCAL ORGANIZATION COMMITTEE

Chair	Dr. Jang Wan Ko
Secretary	Dr. Jiye Hong
	Ms. Dain Lee
	Ms. Liu Ting
Coordinator of Conference	Dr. Jihoe Park
	Ms. Jiwoo Park
Paper Reviewers	Dr. Dongho Kim
	Dr. Donghun Lee
	Dr. Hyosun Kim
	Dr. Youngsook Song
	Dr. Byung-Jun Yi
Administrator	Dr. Heayoung Oh
	Dr. Jung-Won Suh
	Ms. Yae Jee Lee
	Ms. Luxing Huang
	Ms. Zhang Yuningjing

SEAAIR 2022 22nd Conference Schedule

28-30 September, 2022

DAY1 Wednesday, 28th September, 2022

Time	Activities			
9:00-9:30	Registration			
9:30-9:50	Welcome performance			
9:50-10:00	Break			
10:00-10:30	**Opening Session** *Opening Remarks*: Dr. Ma. Florecilla C. Cinches, President of SEAAIR *Welcome messages:* Dr. Dong Ryeol Shin, President of SKKU Dr. Jang Wan Ko, President of KACE Dr. Byoung-Joo Kim, President of KAIR Exchange of tokens: **20th Anniversary Celebration of SEAAIR**			
10:30-11:00	Group Photo Taking / Coffee Break			
11:00-12:00	**Keynote Speech I** **Creating new & better normal of future higher education in the transforming era: Digitization and data-centric innovation** **Dr. Jong Chul Jung, Chair Professor** Seoul National University of Science & Technology, Former Vice Minister of Education)			
12:00-13:15	Lunch Break			
13:15-13:30	Coffee Break			
13:30-15:00	**Parallel Session I**			
	Session I-1 Room A	**Session I-2** Room B	**Session I-3** Room C	**Session I-4** Room D
15:00-15:15	**Coffee Break**			
15:15-16:45	**Parallel Session II**			
	Session II-1 Room A	**Session II-2** Room B	**Session II-3** Room C	**Session II-4** Room D

DAY2 Thursday, 29th September, 2022

Time	Activities		
9:00-9:30	Registration		
9:30-9:45	Coffee Break		
9:45-10:45	**Panel Session** **Institutional Research in New Normal Education** **SEAAIR**: Dr. Teay Shawyun **Korea**: Dr. Giljae Lee **Taiwan**: Dr. Sophia Shi-Huei Ho **Moderator:** Dr. Seon Joo Kim(Pukyong National University)		
10:45-11:00	Coffee Break		
11:00-12:30	**Parallel Session III**		
	Session III-1 Room A	**Session III-2** Room B	**Session III-3** Room C
12:30-13:30	Lunch Break		
13:30-14:45	**Parallel Session IV**		
	Session IV-1 Room A	**Session IV-2** Room B	**Session IV-3** Room C
14:45-15:00	Coffee Break		
15:00-16:00	**Keynote Speech II** **The challenge and prospect of Asian university in the digital age** **Dr. Seyeoung Chun, Emeritus professor of Education,** (Chungnam National University, Former President of KERIS)		
16:00-17:00	**Poster session**	**General Meeting**	
17:00-17:30	**Old Campus Tour**		
17:30-18:00	**Break**		
18:00-20:00	**Cultural Night & Dinner**		

DAY3 Friday, 30th September, 2022

Time	Activities
10:00-15:00	City Tour

Oral Presentation Program

DAY1 Wednesday, 28th September, 2022

Parallel Session I 13:30-15:00			
Session I-1 **Room 9B320** **(Dr. Jung-Won Suh)**	**Session I-2** **Room 9B321** **(Dr. Dongho Kim)**	**Session I-3** **Room 9B316** **(Dr. Jiye Hong)**	**Session I-4** **Room 9B318** **(Dr. JeongA Yang)**
Self Efficacy and Supervision Practices among Guidance Directors in Higher Education Institutions (Calvin Dave Ganub)	A sustainable human capital process of Rajamangala University of Technology in Thailand (Krisda Tanchaisak, Rungnapa Lokessathian, Siriphun Thongsai and Duangduen Chancharoen)	The Teaching and Learning Outcomes of Singapore Polytechnic Media, Arts & Design Students From Common Foundation(CFP) Studies (Yanzo Pang and Clarice Sim)	Conversion from physical assessment to online assessment: A Case Study at the Newcastle Australia Institute of Higher Education (Yit Yan Koh and Yaw Long Chua)
New Normal Education: Designing a preferred transformation Jay Somasundaram, Patrick Danaher and Mohammad G Rasul	An examination of the essential competencies among support personnel of an international private university in Bangkok (Krisda Tanchaisak, Pannapat Puvanont and Duangduen Chancharoen)	The Human Capital Empowerment of Lao Krang Ethnic in Suphanburi Province for Cultural Tourism (Chiranuch Sopha, Kanjanarat Rattanasonthi, Rungroj Yenchaipruck, Rugsiri Chunhaphantarak and Proudteema Srirathu)	Problem-Based Online Learning Through Multidisciplinary Studies To Enhance Chemistry Literacy and Improve Environmental Awareness (Familia Novita Simanjuntak and Riska Septia Wahyuningtyas)
Does Institutional Governance Matter in Academics' Job Attitudes? A Comparative Study in Taiwan, Japan, and Korea (Sophia Shi-Huei Ho, Robin Jung-Cheng Chen and Ying-Yan Lu)	An investigation of the human resource management practices at Rajamangala University of Technology in Thailand (Narat Wattanapanit, Rungnapa Lokessathian and Busara Niyomves)	The Assessment of Non-Formal and Informal Educational Standard (Staporn Tavornativat and Pattaraporn Kitchainukoon)	Correlates of Pre-Service Teachers' 21st Century Skills and Mentoring Practices of Supervising Instructors in the New Normal Education (Anally Villanca)
	Essential competencies of support staff in private universities in Thailand: A factor analysis study (Narat Wattanapanit, Pannapat Puvanont and Bongkoch Thongciam)		Analysis of Technological and Pedagogical Knowledge (TPK) on Prospective Biology Teachers to Welcome the Era of Society 5.0 (Riska Septia Wahyuningtyas, Janed Lauren and Familia Novita Simanjuntak)

Parallel Session II 15:15-16:45			
Session II-1 **Room 9B320** **(Dr. Jung-Won Suh)**	**Session II-2** **Room 9B321** **(Dr. Hyunyoung Choi)**	**Session II-3** **Room 9B316** **(Dr. Jiye Hong)**	**Session II-4** **Room 9B318** **(Dr. JeongA Yang)**
Artivism, Art for Social Transformation (Visual Analysis of Student Curated Artworks) (Ma. Cecilia Alimen, Rolando Alimen and Rowena Vargas-Isidro)	Developing the Process of Standardized English Proficiency Test and Mapping onto the Common European Framework of Reference (CEFR) (Kwanhathai Choedchoo, Nutthaporn Owatnupat and Sudsawad Chandum)	The Extent Implementation of the Community Outreach Programs and Activities (Medania Malagsic, Mylene Jainga and Jeffrey Ledesma Jr.)	Guidelines for Development of Graduate Curriculum in Early Childhood Education Management (Bongkoch Thongeiam, Krittrin Tumat and Narat Wattanapanit)
Learning Development for Early Childhood by 5-STEPs learning process following King Rama IX's Philosophy regarding Early Childhood Inclusive Education (Chadtharawadee Boonthanom)	The Result of Cooperative Learning Approach Emphasizing on Team-Pairs-Solo Teaching Method for the English-speaking Skill (Saowapan Palasuwan)	Tertiary Education Readiness Assessment of the Pioneering Senior High School Graduates of the Philippine K-12 Program (Jo Niza Mortiz and Jayson Digamon)	The development of the STIs & HIV and contraception virtual classroom (SHCVC) program on early childhood pre-service teachers (Chitraporn Boonthanom, Thitinun Teravecharoenchai and Junthanee Teravecharoenchai)
Re-Discovering Online Learning Situation and Teaching-Engagement toward Institutional Development of Private Maritime University in the Philippines (Rolando Alimen and Ma. Agnes Regina Torres)	Do I know as much as I think I know?: The effect of the test on Thai EFL undergraduate students' perceived grammatical knowledge (Ekamorn Iamsirirak and Pariwat Imsa-Ard)	A Pathway Toward Happiness for Thai Undergraduate Students during the COVID-19 Outbreak: The Role of Perceived COVID-19 Stressors and Cognitive Flexibility (Manika Wisessathorn, Sawian Kaewwongsa, Kamonrat Thirapong and Ekamorn Iamsirirak)	Weathering the Pandemic: The 'What If' Experience in Scenario Planning (Ma. Florecilla C. Cinches)
	Various Online Learning in Academic Reading Class as the Efforts to Increase Students' Motivation (Masda Surti Simatupang and Ramot Peter)	Measurement Of Psychometric Trait Of Athletic Identity, Mental Health and Perceived Social Support On Career Planning Among Student-Athletes (Kai Yan Wong, Tajularipin Sulaiman and Wan Marzuki Wan Jaafar)	SEAAIR 20/20: A Review of SEAAIR Annual Conferences 2000 – 2020 (Koh Yit Yan and Chua Yaw Long)

DAY2 Thursday, 29th September, 2022

Parallel Session Ⅲ 11:00-12:30		
Session Ⅲ-1 **Room 9B318** **(Dr. Hyunyoung Choi)**	**Session Ⅲ-2** **Room 9B316** **(Dr. Jiye Hong)**	**Session Ⅲ-3** **Room 9B215** **(Dr. Jang Wan Ko)**
Assessment of Professional Learning Teams: The College of Education Experience (Ma. Cecilia Alimen and Ma. Delsa Gange)	Risk Analysis and Mitigation Learning from Home During the COVID-19 Pandemic: An Effort to Transform the Quality of Education (Imeldha Putrianti and Ktut Silvanita Mangani)	A Causal Model of Organizational Culture, Psychological Attributes, School Environment and Performance of Faculty in Higher Education Institutions (Albert Villanca)
Teachers' Psychological Factors And Teachers' Work Motivation During Movement Control Order (MCO) (Abdul Aziz Ismail, Kai Yan Wong and Tajularipin Sulaiman)	Analysis of University's Globalization Discourse Using News Big Data Focusing on Topic Modeling Analysis Methods (Jiwoo Park and Jang Wan Ko)	Children of Ofws and Overseas Parents: An Assessment of the USLS GEC-Chipa Support Group Program (Lota Largavista, Rowena Bañes, Mary Grace Bañares and Joyce Benedicto)
Creating a Research Culture in a Dominican University: Perspectives and Productivity of University of Santo Tomas-Legazpi Faculty (Jet Guerrero, Christine Grace Azul and Jason Carmona)	The Lifelong Learning Management Model for Good Agricultural Practice (GAP) Skills based on the Intelligence Agricultural Demonstration Farm for Farmers and Students at Suan Dusit University, Thailand (Nuttabodee Viriyawattana, Tipawan Wannakan and Surachat Sinworn)	A Study of Adult Learners in Taiwan Community Universities on Grit and Learning Engagement: Psychological Capital and Learning Empowerment as a Mediator (Po-Lin Chen)
Connectedness Matters: Exploring Psychological Distance in Online Education (Angelica Panique and Coolen Joy Nebreja)		A social critical analysis on Philippine higher education in the time of covid-19 pandemic towards a framework on flexible learning (Alvin Sario)

Parallel Session IV 13:30–14:45		
Session IV-1 **Room 9B313** **(Dr. Hyunyoung Choi)**	**Session IV-2** **Room 9B316** **(Dr. Jiye Hong)**	**Session IV-3** **Room 9B321** **(Dr. Tajularipin Sulaiman)**
Political Education Design with the Penta Helix Model in the New Normal Era (Putri Hergianasari and Rizki Amalia Yanuartha)	Digital Inclusion among educators: An examination of salience in Public and Private Schools within Metro Manila (Mateo Borbon, Maria Loida Faye Borbon and Evelyn Lagang)	Ambidextrous Chair: Design Solution For Both Right And Left Handed Persons Mary Grace Sabadisto
Transforming Education: Utilization of New Media as a Means of Political Participation of Beginner Voters in Indonesia (Rizki Amalia Yanuartha and Putri Hergianasari)	A Scientometric Analysis on Chinese Higher Education Informatics (Ting Liu and Jang Wan Ko)	Promoting Tourism Using Digital Technology at Archaeological Sites for Students with Disabilities (Keyoon Wongkorm)
Use of Technology-Enabled Teaching-Learning among Library and Information Science (LIS) Faculty in a Private University (Cozette Gregorios and Ma. Cecilia Alimen)	Conducting Research: Experiences, Challenges, and Benefits towards Institutional Development Activities in the Private Maritime University, Philippines (Rolando A. Alimen and Marie Bella N. Estores)	Digital Technology for Learning Vocabulary for Students with Disabilities (Kanvipa Hongngam and Sucheera Polrachom)
Flexible Learning in CASE UST Legazpi in the time of COVID-19 Pandemic (Alvin Sario, Lalaine Valladolid, Patrick Joseph Seeillano)		

Table of Contents

Theme IV: Digitization & Educational Technology Innovations ····· 363

Theme II: Re-Discovering Teaching & Learning Practices & Protocols

Problem-Based Online Learning through Multidisciplinary Studies to Enhance Chemistry Literacy and Improve Environmental Awareness

Familia Novita Simanjuntak[1] and Riska Septia Wahyuningtyas[2]

[1]*Christian University of Indonesia,* Indonesia *(familia.simanjuntak@uki.ac.id)*
[2]*Christian University of Indonesia,* Indonesia (*riska.wahyuningtyas@uki.ac.id*)

ABSTRACT

Chemistry learning struggled with its biggest barriers during the Covid-19 pandemic which only can be executed online. The barriers are distance and quality of internet connection. They increase students' anxiety about chemistry learning that requires critical and scientific thinking to solve the problems. Further, online learning is still the best practice for new normal education. On the other side, distance education should be able to encourage students actively participate in pandemic survival by following the health protocols based on their environmental awareness. The research aims to describe multidisciplinary studies as fundamental for problem-based online learning to enhance chemistry literacy and improve environmental awareness. Purposive sampling defines the respondents, they are the students who followed 4 months full course of online general chemistry learning. Data is qualitative from students' answer sheets of structured interviews and be analyzed descriptively according to the literature reviews. Data also includes video assessment to analyze the students' ability of chemistry content creation to describe their scientific thinking. The findings describe that multidisciplinary studies enrich students' knowledge and perspective to explore the chemicals surrounding them. They develop much wider and deeper learning experiences which drive students to become more aware of the quality of their living environment. The research concludes that problem-based online chemistry learning needs to be supported by multidisciplinary studies to draw attention wider and deeper so students can enhance chemistry literacy and improve their environmental awareness.

Keywords: New Normal Education, Problem-Based Online Learning, Crititical and Scientific Thinking

Introduction

Chemistry education has its complexity which is commonly assumed by students as the conceptualization of their experiences of the physical world (Taber, 1998). It is related to distinguishing the representations of aspects of an individual's cognitive structure, and general models which are intended to reflect commonalities from the representations derived from several individuals (Lakoff & Johnson,1980). For example, when the teacher describes an atom as the smallest thing in any matter and made up of protons, neutrons, and electrons, then students should define it in the same way. But, in fact, some students still perceive it as the basic atom that can be divided into three parts named proton, neutron, and electron. The situation requires chemistry teachers to manage the disparity so students can make an explanation of the common framework of chemistry by driving the individual's cognitive structure through their mental organization (Driver & Erickson, 1983)

Taber (1998) describes the individual's cognitive structure as a composite picture based on ideas shared by a number of students, generalized non-individual descriptions, and thematic interpretations of data, stylized, mild caricatures of the response made by students'. The description of Taber (1998) is based on Driver and Erickson (1983) who briefly explains science as the creation of the human mind with its freely invented ideas and concepts. That is why chemistry should give wider space to students in conceptualizing their experiences of the physical world, especially related to chemicals existences in their daily life.

Limited mobilization to control the Covid-19 pandemic caused the disparity of students' framework of chemistry to become wider where students can only learn online. Online learning makes students struggle to learn because of the distance and quality of internet connection (Muilenburg & Berge, 2005) which worst the interaction quality inter students and also between teacher and students (Bacow *et al.*, 2012). Though Huang (2020) found that online learning gives the most significant benefit, lecture recordings via online software. The lecture recordings provide the capture of the teacher's presentation, class discussions, and participation as they occur, so the students can further grasp the knowledge. Another benefit of online learning is supporting the students to reduce their difficulties in mastering the subjects by watching the playback.

However, the benefit of online learning can only occur if the teachers always improve their teacher-student interaction and maintain students' interest by engaging them during online teaching. Problem-based learning is one learning approach to maximize the benefit of online learning for improving the teacher-student interaction by maintaining students' interests and engaging the students. As Savin-Baden (2007) explained that problem-based learning is characterized by situations such as organizing the focus for learning which provides the complex, real-world situations that have no 'right' answer, so students need to work in teams to confront the problem, identify learning gaps, and develop viable solutions. In the end, problem-based learning drives students to gain new information through self-directed learning.

Referring to Overton and Randles (2015) problem-based learning needs to be dynamically executed by focus enrichment such as chemistry for sustainable development. Dynamic problem-based learning enhances the students' experiences in real-life problem-solving, communication, and group working skills. Belt *et al.* (2002) emphasizes that effective problem development should be able to encourage the student's enthusiasm and interest by providing a rich source of real-life contexts so the students can create various scenarios or case study.

Multidisciplinary studies will effectively implement dynamic problem-based learning because they apply different perspectives to common topics without significant integration of those perspectives. So that interdisciplinary studies occur that increase creativity and help to foster innovation (Rasmussen, 2022). Furthermore, Rajabzadeh, Mehrtash, and Srinivasan (2022) explain that multidisciplinary studies improve students' understanding of the concepts and develop meta-skills focused on developing

deep content knowledge, fostering critical thinking, engaging in collaboration, and promoting creativity and communication skills.

The targets of this research are the first-year chemistry education students who attend distance learning from some remote (disadvantaged, leading, and outermost) areas of Indonesia. Sari *et al.* (2022) identified the condition of learning in some remote areas of Indonesia as parents' low awareness of the importance of their children's education, local teachers' low motivation, limited teaching resources at school, pupils' absenteeism, pupils' poor numeracy, and literacy skills, the principal's low responsibility, natural hazard factors, pupils' low ability to understand Indonesian, and local conflicts between different communities. The condition as Sari *et al.* (2022) identified is similar to Zaharah's (2022) findings that generally, learning did not run smoothly in Indonesia during Covid19 pandemic, because some students have difficulty participating in distance learning caused to unstable internet connections and lack of funds to purchase internet quotas, and teachers lack expertise in learning technology, especially in using learning applications.

This article aims to describe multidisciplinary studies as fundamental for problem-based online learning to enhance chemistry literacy and improve environmental awareness. The problem-based online learning applies daily-life activities and surroundings as the context of knowledge for multidisciplinary studies.

Literature Reviews

Multidisciplinary Studies for Chemistry Education

Rasmussen (2022) defined multidisciplinary studies as studies which are combining or involving more than one discipline or field of study by applying different disciplinary perspectives to a common topic but without causing significant integration of those perspectives. Furthermore, multidisciplinary studies appear to have a stronger connection to innovation because attributed to the ideas and methods that are most often transformational than when drawn from outside the discipline that developed them. Multidisciplinary studies for chemistry education increase complex problems of the realm so its effective application requires suitable training in multiple disciplines or effective collaboration between various practitioners of different disciplines.

Multidisciplinary studies for chemistry education, according to Rajabzadeh, Mehrtash, and Srinivasan (2022), provide deep content knowledge, foster critical thinking, engage in collaboration, and promote creativity and communication skills. Deep content knowledge of chemistry from multidisciplinary studies implementation achieved by involving the history and archeology of chemistry, so it develops a fosters critical thinking, and gradually, engages students in collaboration. Engaging students in collaboration which is supported by students' teaching and learning from various backgrounds' interests and motivations will promote creativity and communication skills (Srinivasan, 2022).

Further, Jones, Jordan, and Stillings (2005) stated that multidisciplinary studies for chemistry education produce a variety of knowledge products, including new evaluation instruments, websites for research or dissemination, digital videos of chemical demonstrations and experiments, a set of animations, instructional software programs, paper instructional materials, and two annotated bibliographies. Hendarwati *et al.* (2021) described multidisciplinary studies as collaborative problem-based learning that improves students' collaborative and problem-solving skills. In detail, Hendarwati *et al.* (2021) explained that the objective of multidisciplinary studies in chemistry education is constructing knowledge, looking for resolution strategies, and evaluating solutions in collaboration. Al-Thani *et al.* (2022) also found that multidisciplinary studies implementation in chemistry education develops students' research self-efficacy and fosters their research competencies based on multidisciplinary science.

Chemistry Literacy

Chemistry literacy is defined by Holbrook (2005) as knowledge and understanding gained from learning outcomes through chemistry. Simanjuntak (2020) states that chemical literacy plays a role in individual awareness and promotion of biodiversity conservation efforts to achieve sustainable development goals. Chemistry literacy is vital to enhance the capability of problem-solving in the chemical world by fully utilizing the chemical information to inform decisions that describe the development of several skills sets including gathering information, sifting and refining knowledge, aligning information with prior experience, and applying information within the context of the problem (Shultz and Zemke, 2019).

According to Parlan *et al.* (2022) findings, chemistry literacy means the ability to provide scientific explanations on related topics. This research discusses biotic and abiotic factors in an ecosystem; irritability; adaptation; evolution; food chain, webs, and pyramid; biogeochemical cycle; biodiversity; and sustainability. Chemistry literacy that has to be achieved by this research should be able to explain the chemicals' roles within those topics and synthesize the relevant knowledge to solve the problems provided by the researcher in class. So, during the course, students can solve the problems by chemistry literacy that describe the relevant context, knowledge, and competency. Furthermore, the findings of Putica and Ralević (2022) state that chemistry literacy significantly influences the achievement in chemistry learning among students, especially the reasoning capability.

Moreover, Bunce and Phelps (2006) deeply asses chemistry literacy as the applicative knowledge or practical real-chemistry related to students' interest and motivation in chemistry learning, such as finding the empirical formula of a compound or balancing an equation of the chemical reaction. They identify chemistry literacy as described by the skills of looking for information, formulating questions, organizing knowledge, classifying, relating to various representations, noticing regularity, initiating hypotheses, and conducting an inquiry.

Environmental Awareness

Wong (2003) expressed environmental awareness as opinions on environmental protection efforts and policies. Students' environmental awareness can be developed, based on Wahyuningtyas and Simanjuntak's (2020) findings, by applying the local wisdom-based learning module. Environmental awareness refers to the tendencies of feelings, values, and concerns that will motivate individuals against environmental protection and conservation, which consists of environmental sensitivity, behaviors, attention, motivation, and intention to act on environmental problems (Febriasari and Supriatna, 2017).

Budimansyah and Sopandi (2016) find that problem-based learning can improve environmental awareness by engaging students to reflect on the learning as the process of knowledge harvesting. There are three indicators of environmental awareness, based on Perkasa, Agrippina, and Wiraningtyas (2017), described as (1) contextual knowledge of environmental issues and sensitivity to related problems; (2) competence to perceive and be concerned about environmental issues and problems; and (3) organizing the relevant knowledge to solve environmental problems and contributing to environmental improvement. This research defines environmental awareness as the tendencies of feelings, values, and concerns identified by environmental sensitivity, contextual knowledge of environmental issues, and organizing the relevant knowledge to solve environmental problems or contribute to environmental improvement.

Method

The research was conducted as an environmental education course that occurred over 3 months. The research involved first-year seven students in a Chemistry Education Study Program at the Christian University of Indonesia. The students were learning from their homes located in Bekasi Region-West Java, West Nias, Bengkayang-West Borneo, East Timor, Tanah Karo-North Sumatra, and the densely populated housing of West Jakarta. In the beginning, the state of students' condition and learning motivation was similar such as lack of chemistry knowledge, low communication skill though using the Indonesian language, and average learning motivation.

The researcher is the lecturer of the course who plays some roles as the class facilitator, mentor, and learner. The course implemented problem-based online learning to explain chemicals' role within the connection between some topics related to biotic and abiotic factors in an ecosystem; irritability; adaptation; evolution; food chain, webs, and pyramid; biogeochemical cycle; biodiversity; and sustainability. The course's outcome is encouraging students to decide on some scenarios based on their identified problems to improve or preserve the environment quality. The process of problem-based online learning was executed as follows:

Step 1—Identify and clarify unfamiliar terms presented in the scenario; scribe lists those that remain unexplained after discussion. For the first step, the researcher used two pictures to show two conditions of environment quality that describe the researcher's surroundings, as shown in Figure 1 and Figure 2. Other than that, the researcher also used one picture to explain the chemicals' role that influences the environment quality. During the session, the researcher implemented multidisciplinary studies to explain the pictures by facilitating the intense discussion through various questions inter alia "How do you feel about the pictures of two environment conditions?"; "Have you ever been in those two environment conditions?"; "Can you explain the differences between living things' interactions occurred inside the two environment conditions?"; "What do you suggest to preserve the quality of the city forest or improve the quality of the slum area, referring to the situations inside the pictures?".

Step 2—Define the problem or problems to be discussed; students may have different views on the issues, but all should be considered; the scribe records a list of agreed problems. During the session of step 2, the researcher roles a play as a learner, the same position as the students to improve the quality of the problems discussed.

Step 3—"Brainstorming" session to discuss the problem(s), suggesting possible explanations on basis of prior knowledge; students draw on each other's knowledge and identify areas of incomplete knowledge; scribe records all discussion. In this session, the researcher plays two roles. First, the researcher plays a mentor to suggest possible explanations on basis of students' prior knowledge. The second role is to become a facilitator to manage the discussion so all students actively express their opinions and views so the transfer of knowledge between the students occurs during the learning progress.

Figure 1: Two conditions of environment quality

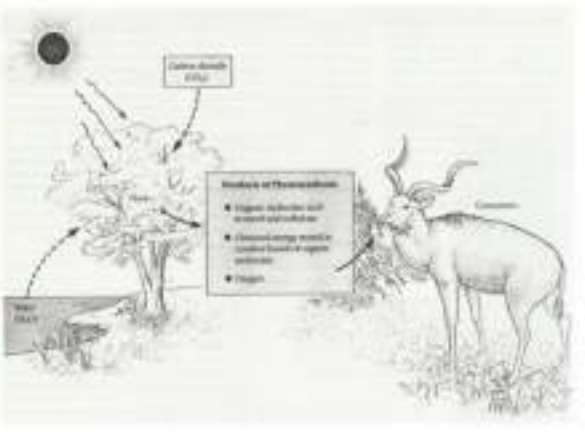


Figure 2: Interaction between chemicals and living things

Step 4—Review steps 2 and 3 and arrange explanations into tentative solutions; the scribe organizes the explanations and restructures if necessary. Continue to Step 5—Formulate learning objectives; nine students as a learning group reaches consensus on the learning objectives; tutor ensures learning objectives are focused, achievable, comprehensive, and appropriate. Step 4 and Step 5 were gradually executed for each student one at a time. They play two roles as speakers and facilitators to explain their topics related to biotic and abiotic factors in an ecosystem; irritability; adaptation; evolution; food chain, webs, and pyramid; biogeochemical cycle; biodiversity; and sustainability. During the sessions of Step 4 and Step 5, the researcher plays a mentor and a learner at the same time.

Step 6—Private study (all students gather information related to each learning objective). This session is the moment for students to write and reflect on the topics that they already presented in Step 4 and Step 5. The reflection moment was supported by each session record so the students can replay the record to deeper comprehend the discussion. At the end of the course, Step 7—Students identify their learning resources and share their results then recap their written reflections as a book series of environmental education based on a chemistry perspective. In this final step, the researcher checks learning and may assess the worksheet.

Result and Discussion

In the beginning, it was not easy to conduct problem-based online learning because the students cannot find the importance of learning environmental education, since they want to be chemistry teachers after finishing their studies in the Chemistry Education Study Program. This is why the starting point began with some reflective questions to frame the basis of students' prior knowledge related to chemistry learning. Each student gave the expected answers but they still struggled to frame the knowledge to explain the chemicals' role in influencing the quality of the environment.

However, the students cannot give the expected answers to suggest actions to preserve the quality of the city forest or improve the quality of the slum area. The researcher found that the picture cannot describe the students' surroundings so the distance between students and the problems is too far. Immediately, the researcher realized the situation and then change the question with a direction to ask students to show a picture that describes their surroundings as described in Figure 3 and Figure 4. The decision of changing the question with direction is referring to Overton and Randles (2015) that

problem-based learning needs to be dynamically executed by focus enrichment, so it can enhance students' experiences in real-life problem-solving, communication, and group working skills. During the problem-based online learning, the researcher engages students to reflect on the learning as the process of knowledge harvesting to improve environmental awareness (Budimansyah and Sopandi, 2016; Febriasari and Supriatna, 2017).

Continuation of Overton and Randles' (2015) findings, Belt *et al.* (2002) emphasize that effective problem development should be able to encourage the student's enthusiasm and interest by providing a rich source of real-life contexts so the students can create various scenarios or case studies. The decision of changing the question with direction in Step 1 affects the students' interests and enthusiasm in Step 2 and Step 3.

The result of Step 2 and Step 3 shows that the student who presents Figure 3 can explain that Nias' traditional house is constructed without nails, and is earthquake resistant. She was able to explain the chemicals' role in influencing the quality of the traditional house, especially the kinds of woods that are used in the construction. They have to use special kinds of wood to build one traditional house and need 4 years to finish it. She even can give a satisfactory answer to her friend's question "Can we use a machine to short the time of building a traditional house?" She answered that the machine will damage the contours of the land which is a coastal area and also waste a lot of money to handle the machine. This explanation is in line with Budimansyah and Sopandi, 2016; Febriasari and Supriatna, 2017; and Perkasa, Agrippina, and Wiraningtyas (2017) that the student expresses her tendencies of feelings, values, and concerns that motivate her against environmental protection and conservation, which consists of environmental sensitivity, behaviors, attention, motivation, and intention to act on environmental problems.

The same condition with the student who proposes Figure 4. She is used to the phenomenon and believes that the eruption will increase the fertility of the land so they can harvest higher in the next season. Even though they are very afraid of the eruption and experienced very sad situations for a long time before the eruption ended. From generation to generation told that the eruption means nature is trying to heal herself to balance human activities and become healthier to afford living things' needs. Further, she also explained the synthetic fertilizers used for farming should be balanced with the organic ones to prevent another disaster. These situations emphasize the findings of Jones, Jordan, and Stillings (2005) who stated that multidisciplinary studies for chemistry education produce a variety of knowledge products. The variety of knowledge products describes chemistry literacy as explained by the findings of Shultz and Zemke, 2019; Parlan et al. (2022); Putica and Ralević (2022).

Figure 3: Traditional House of North Nias

Figure 4: The Eruption of Sinabung Mountain, Tanah Karo-North Sumatra

Result for Step 4 and Step 5 show all students' proficiency in describing the chemicals' roles within the connection between the topics related to biotic and abiotic factors in an ecosystem; irritability; adaptation; evolution; food chain, webs, and pyramid; biogeochemical cycle; biodiversity; and sustainability. They explained that machines using fossil fuels can contaminate the land and the coastal area which bad influence on living things and the noise will disturb and harm birds as well. Deeper, they understand that a traditional house-building ceremony takes a long duration to give time for other living things to adapt to human activities so that harmony can exist gradually.

For the last step, Step 6 and Step 7, all students perform similar ability to synthesize the information from online media as their paper works in describing and explaining the chemicals' roles in influencing the environment related to biotic and abiotic factors in an ecosystem; irritability; adaptation; evolution; food chain, webs, and pyramid; biogeochemical cycle; biodiversity; and sustainability. An example of the synthesis such as "Adaptation will occur if biotic factors respond to changes in abiotic factors, so it can be interpreted that the conditions that affect the occurrence of adaptation are irritability and change". As Rajabzadeh, Mehrtash, and Srinivasan (2022) explained that multidisciplinary studies improve students' understanding of the concepts and develop meta-skills focused on developing deep content knowledge, fostering critical thinking, engaging in collaboration, and promoting creativity and communication skills.

Overall, each student is happy with their achievements during the problem-based online learning. Even though the works are individual assignments, they can work as a team to result better and comprehend deeper (Hendarwati *et al.*, 2021). Further, they also criticize the information they get from online media or the researcher's statement during the discussion. They can accept the different points of view though they can agree on one condition that a sustainable environment is our common responsibility. Before closing the course, the researcher asks students' opinions to conclude the topics, and they express the same impression that everything we have done to the environment will directly affect our quality of life (Simanjuntak, 2020; Al-Thani *et al.*, 2022).

Apparently, a higher quality of students' achievements from the implementation of multidisciplinary studies as the fundamental for problem-based online learning in chemistry education mostly depends on the proficiency of the educators in role-playing along each step. The situation is in line with Ramussen's (2022) statements that effective application of multidisciplinary studies requires suitable training in multiple disciplines or effective collaboration between various practitioners of different disciplines.

Conclusion

Generally, the implementation of multidisciplinary studies as the fundamental for problem-based online learning in chemistry education requires a high-quality of teacher's or lecturer's proficiency in role-playing to gain students' higher achievement. The minimum requirement that should be done by the teacher or lecturer is fluently communicating with a wider perspective and interdisciplinary thinking. The focus of problem-based online learning is strighly on student-centered learning for better achievement, especially in students' ability to critically think, and synthesize information which drives active discussion, and proficiency in presentation skills.

Overall, each student is happy with their achievements during the problem-based online learning. Even though the works are individual assignments, they can work as a team to result better and comprehend deeper. Further, they also criticize the information they get from online media or the researcher's statement during the discussion. They can accept the different points of view though they can agree on

one condition that a sustainable environment is our common responsibility. Before closing the course, the researcher asks students' opinions to conclude the topics, and they express the same impression that everything we have done to the environment will directly affect our quality of life.

References

Al-Thani, N. J., Saad, A., Siby, N., Bhadra, J., & Ahmad, Z. (2022). The Role of Multidisciplinary Chemistry Informal Research Programs in Building Research Competencies and Attitudes. *Journal of Chemical Education*, *99*(5), 1957-1970.

Bacow, L. S., Bowen, W. G., Guthrie, K. M., Long, M. P., & Lack, K. A. (2012). *Barriers to adoption of online learning systems in US higher education* (pp. 39-51). New York, NY: Ithaka.

Belt, S. T., Evans, E. H., McCreedy, T., Overton, T. L., & Summerfield, S. (2002). A problem based learning approach to analytical and applied chemistry. *University Chemistry Education*, *6*(2), 65-72.

Budimansyah, D., & Sopandi, W. (2016, April). Implementing Value Clarification Technique to Improve Environmental Awareness among Pre-Service Chemistry Teacher. In *1st UPI International Conference on Sociology Education* (pp. 190-193). Atlantis Press.

Bunce, D. M., & Phelps, A. J. (2006). Chemical Literacy: What Does This Mean to Scientists and School Teachers? W. *Journal of Chemical Education*, *83*(10).

Driver, R., & Erickson, G. (1983). Theories-in-action: Some theoretical and empirical issues in the study of students' conceptual frameworks in science.

Febriasari, L. K., & Supriatna, N. (2017, September). Enhance environmental literacy through problem based learning. In *Journal of physics: conference series* (Vol. 895, No. 1, p. 012163). IOP Publishing.

Hendarwati, E., Nurlaela, L., Bachri, B., & Sa'ida, N. (2021). Collaborative Problem based learning integrated with online learning. *International Journal of Emerging Technologies in Learning (iJET)*, *16*(13), 29-39.

Huang, J. (2020). Successes and challenges: online teaching and learning of chemistry in higher education in China in the time of COVID-19. *Journal of Chemical Education*, *97*(9), 2810-2814.

Jones, L. L., Jordan, K. D., & Stillings, N. A. (2005). Molecular visualization in chemistry education: the role of multidisciplinary collaboration. *Chemistry Education Research and Practice*, *6*(3), 136-149.

Lakoff, G., & Johnson, M. (1980). The metaphorical structure of the human conceptual system. *Cognitive science*, *4*(2), 195-208.

Muilenburg, L. Y., & Berge, Z. L. (2005). Student barriers to online learning: A factor analytic study. *Distance education*, *26*(1), 29-48.

Overton, T. L., & Randles, C. A. (2015). Beyond problem-based learning: using dynamic PBL in chemistry. *Chemistry Education Research and Practice*, *16*(2), 251-259.

Parlan, P., Minata, Z. S., Suryadharma, I. B., Sulistina, O., & Marfu'ah, S. (2022). The Effect of Triangulation-Based Metacognitive Learning Strategy on Students' Chemistry Literacy and Learning Achievement. *JTK (Jurnal Tadris Kimiya)*, *7*(1), 14-24.

Perkasa, M., Agrippina, A., & Wiraningtyas, W. (2017). Sustainable chemistry oriented on chemistry learning to increase student awareness to the environment. *Sainsmat: Jurnal Ilmiah Ilmu Pengetahuan Alam*, *6*(2), 169-178.

Putica, K. B., & Ralević, L. R. (2022). Improving Elementary School Pupils' Chemical Literacy Using Context-Based Approach in Teaching the Unit Alkanes2.

Rajabzadeh, A. R., Mehrtash, M., & Srinivasan, S. (2022). Multidisciplinary Problem-Based Learning (MPBL) approach in undergraduate programs. In *Interactive Mobile Communication, Technologies and Learning* (pp. 454-463). Springer, Cham.

Rasmussen, S. C. (2022). Moving beyond the intersection of chemistry and history: Evolving multidisciplinary approaches to the historical study of chemistry. *Bull. Hist. Chem*, *47*(1).

Sari, L. K., Thomas, V., De Backer, F., & Lombaerts, K. (2022). Pre-service teachers' teaching challenges and the transformative learning opportunities during teaching practice in Indonesian remote areas. *European Journal of Teacher Education*, 1-18.

Savin-Baden, M. (2007). *A practical guide to problem-based learning online*. Routledge.

Shultz, G. V., & Zemke, J. M. (2019). "I Wanna Just Google It and Find the Answer": Student Information Searching in a Problem-Based Inorganic Chemistry Laboratory Experiment. *Journal of chemical education*, *96*(4), 618-628.

Simanjuntak, F. N. (2020). Literasi kimia dalam konsumsi pangan bergizi, beragam dan berimbang menuju kehidupan sehat dan sejahtera. *EduMatSains: Jurnal Pendidikan, Matematika dan Sains*, *5*(1), 65-82.

Srinivasan, S. (2022). Multidisciplinary Problem-Based Learning (MPBL) Approach in Undergraduate Programs. *New Realities, Mobile Systems And Applications: Proceedings of the 14th*, *411*, 454.

Taber, K. S. (1998). An alternative conceptual framework from chemistry education. *International Journal of Science Education*, *20*(5), 597-608.

Wahyuningtyas, R. S., & Simanjuntak, F. N. (2020). Pengembangan Modul Pembelajaran Berbasis Kearifan Lokal Untuk Meningkatkan Kemampuan Berpikir Kritis. *Jurnal Pro-Life*, *7*(3), 275-287.

Wong, K. K. (2003). The environmental awareness of university students in Beijing, China. *Journal of Contemporary China*, *12*(36), 519-536.

Wood, D. F. (2003). Problem based learning. *Bmj*, *326*(7384), 328-330.

Zaharah, Z. (2022). Analysis of Distance Learning During Covid-19 Pandemic in Indonesia. *SALAM: Jurnal Sosial dan Budaya Syar-i*, *9*(2).