LAPORAN

EASE WINTER SCHOOL 2023

14th - 20th January 2024

ANISA PUTRI
NPM. 072623009

PRODI PENDIDIKAN IPA
SEKOLAH PASCASARJANA
UNIVERSITAS PAKUAN
2024

KATA PENGANTAR

Puji dan syukur selalu terpanjatkan kepada zat Yang Maha Suci Allah SWT, serta shalawat dan salam selalu tercurah kepada junjungan kita Nabi Muhammad SAW yang dalam setiap langkahnya menjadi panutan bagi kita untuk senantiasa bergerak menuju pencerahan. Atas berkat rahmat Allah SWT saya, peserta Winter School EASE tahun 2024 dapat menyelesaikan kegiatan Winter School EASE 2024 di Thailand serta pembuatan laporan perjalanan Program Winter School EASE 2024. Laporan ini dibuat sebagai pertanggung jawaban atas terlaksananya kegiatan ini yang dilakukan selama 6 hari, pada tanggal 14 Januari – 20 Januari 2024 bertempat di Thailand.

Pertama, sudah sepatutnya kami bersyukur kepada Allah Yang Maha Agung, atas keanggungan-Nya kami diberikan kesempatan bisa berkunjung ke negeri orang lain yaitu Thailand, yang tidak pernah kami bayangkan sebelumnya. Kedua, kepada orang tua kami. Terimakasih yang sebanyak-banyaknya kami ucapkan atas dukungan kalian, dukungan materi, motivasi dan doa yang selalu tercurahkan kepada kami. Selanjutnya kepada Universitas Pakuan, juga teman-teman delegasi Indonesia yang telah menemani selama satu minggu disana, dan kepada segenap pihak yang telah membantu dan melancarkan kegiatan Winter School EASE 2024 ini, baik secara langsung maupun tidak langsung, kami mengucapkan terima kasih yang sebanyak-banyaknya.

Kami menginsafi dan sadar banyak sekali kekurangan dalam pelaksanaan kegiatan Student Exchange hingga tahap penulisan laporan ini. Tiada gading yang tak retak, maka dari itu dalam satu helaan nafas yang sama kami memohon maaf atas kekurangan dan kesalahan yang masih menyertai, serta terus mengharapkan kritik dan saran yang membangun untuk penulis jadikan bahan refleksi guna menghasilkan karya yang lebih baik.

3 Februari 2024

Anisa Puteri

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LAMPIRAN

BAB I

PENDAHULUAN

A. Latar Belakang

Dalam era globalisasi ini, pemahaman mendalam terhadap ilmu pengetahuan, terutama dalam bidang ilmu pengetahuan alam (IPA), sangatlah penting untuk pengembangan manusia dan masyarakat. Menyadari pentingnya hal tersebut, Magister Pendidikan IPA memiliki keinginan kuat untuk memperluas wawasan dan pengetahuannya melalui partisipasi mahasiswa dalam kegiatan Winter School EASE (East Asian Science Education) 2024.

Winter School ini menjadi platform ideal untuk mahasiswa Magister Pendidikan IPA memperdalam pemahaman mereka terhadap Science, Technology, Engineering, and Mathematics (STEM) serta pendidikan berkelanjutan (Education Sustainable Development/ESD). Keikutsertaan dalam kegiatan ini memberikan kesempatan unik untuk terlibat langsung dengan diseminasi penelitian yang dilakukan oleh para profesor dari enam negara Asia. Pada program ini mahasiswa dapat memperoleh wawasan mendalam mengenai tren terkini dalam STEM dan bagaimana pendidikan berkelanjutan dapat diintegrasikan secara efektif dalam kurikulum pendidikan IPA.

Selama Winter School, mahasiswa tidak hanya menjadi peserta pasif, tetapi juga memiliki kesempatan untuk mengikuti seminar riset individu yang didampingi oleh para profesor dari berbagai negara. Hal ini memungkinkan mereka mendapatkan masukan berharga dan perspektif baru terkait dengan penelitian yang mereka lakukan. Kolaborasi riset dengan sesama mahasiswa Magister dan Doktoral dari enam negara yang berbeda akan membuka peluang untuk pertukaran ide dan pengalaman yang kaya.

Selain itu, kunjungan ke beberapa universitas yang menerapkan pendekatan Education Sustainable Development (ESD) memberikan gambaran langsung tentang implementasi konsep ini dalam konteks pendidikan sains. Mahasiswa dapat belajar dari praktik terbaik yang diterapkan oleh lembaga-lembaga tersebut dan membawa inspirasi kembali ke negara asal mereka.

Tidak hanya fokus pada aspek akademis, Winter School juga menyediakan waktu untuk kunjungan budaya di Thailand. Ini bukan hanya sebuah perjalanan wisata, tetapi juga kesempatan untuk memahami dan menghargai keanekaragaman budaya serta menerapkannya dalam pendekatan pendidikan sains yang inklusif dan berkelanjutan.

Melalui partisipasi dalam Winter School East Asian Science Education, mahasiswa Magister Pendidikan IPA berharap dapat membawa pulang pengetahuan, keterampilan, dan wawasan baru yang dapat diterapkan dalam pengajaran mereka sendiri, sekaligus menjadi agen perubahan untuk memajukan pendidikan sains dan STEM di tingkat lokal maupun global.

Berdasarkan perjalanan kegiatan ini, maka penulis akan melaporkan seluruh kegiatan dan *insight* positif yang didapatkan selama mengikuti kegiatan ini untuk menjadi pertanggungjawaban penulis sebagai peserta terhadap Prodi yang telah memberi kesempatan baik ini dengan harapan Prodi akan tetap melanjutkan kegiatan positif ini di tahun tahun akademik berikutnya.

B. Tujuan Mengikuti Winter School EASE 2024

Adapun beberapa tujuan mengikuti program ini adalah sebagai berikut :

1) Memperdalam pemahaman tentang ilmu pengetahuan alam, teknologi, rekayasa, dan matematika (STEM) melalui diseminasi penelitian oleh para professor dari enam negara Asia.
2) Mengikuti seminar riset individu dengan mendampingi dan menerima masukan dari profesor-prosesor ahli, sehingga dapat meningkatkan keterampilan riset mahasiswa.
3) Berpartisipasi dalam kolaborasi riset dengan sesama mahasiswa magister dan doktoral dari enam negara, membangun jejaring internasional, serta bertukar ide dan pengalaman dalam konteks pendidikan sains.
4) Memahami konsep dan penerapan pendekatan Education Sustainable Development (ESD) dalam kurikulum pendidikan sains, dengan fokus pada aspek berkelanjutan dan inklusif.
5) Melakukan kunjungan ke beberapa universitas yang telah berhasil menerapkan ESD, untuk memahami praktik terbaik dan merinci implementasi konsep tersebut di tingkat lembaga pendidikan.

6) Mengalami dan memahami keanekaragaman budaya melalui kunjungan budaya di Thailand, dengan harapan dapat mengintegrasikan aspek-aspek budaya ini dalam pendekatan pendidikan sains yang inklusif.
7) Mengimplementasikan hasil pembelajaran dan pengalaman dari program ini ke dalam praktik pengajaran mahasiswa, dengan fokus pada pengembangan metode pengajaran yang inovatif dan berkelanjutan.

8) Membangun kapasitas kepemimpinan di bidang pendidikan sains dan STEM, dengan harapan dapat menjadi agen perubahan di tingkat lokal dan berkontribusi pada pembaruan kurikulum pendidikan.
9) Meningkatkan kualifikasi dan profil akademis mahasiswa, membuka peluang bagi pengembangan karir di bidang pendidikan, penelitian, dan pengembangan kurikulum di tingkat nasional maupun internasional.
10) Meningkatkan kapasitas pribadi dalam hal kepemimpinan, keterampilan interkultural, dan kemampuan beradaptasi, sejalan dengan pengembangan diri sebagai individu yang komprehensif dan berkontribusi pada masyarakat global.

C. Manfaat mengikuti Winter School EASE 2024

Setelah menjalani program Winter School EASE 2024 manfaat yang didapatkan antara lain:

1) Memperoleh pemahaman yang lebih mendalam tentang ilmu pengetahuan alam, teknologi, rekayasa, dan matematika (STEM) melalui paparan penelitian dan pengalaman langsung dengan para profesor dari enam negara Asia.
2) Meningkatkan keterampilan riset melalui partisipasi dalam seminar riset individu, didampingi oleh para ahli di bidang pendidikan sains.
3) Membangun jejaring internasional dengan sesama mahasiswa magister dan doktoral dari enam negara, membuka peluang untuk kolaborasi riset jangka panjang dan pertukaran pengalaman.
4) Mempelajari konsep dan penerapan pendekatan Education Sustainable Development (ESD) dalam pendidikan sains, memungkinkan penerapan praktik berkelanjutan dalam kurikulum dan pengajaran.
5) Mengetahui praktik terbaik dalam penerapan ESD melalui kunjungan ke universitas-universitas yang telah berhasil menerapkannya, dengan tujuan meningkatkan kualitas pendidikan sains.

6) Memperluas pemahaman tentang keanekaragaman budaya melalui kunjungan budaya di Thailand, dan menerapkan aspek-aspek budaya ini dalam pengajaran sains yang lebih inklusif.
7) Meningkatkan keterampilan pengajaran dengan mengintegrasikan hasil pembelajaran dari program ini ke dalam praktik pengajaran, memperkaya metode pengajaran dan pengalaman pembelajaran mahasiswa.

8) Membangun kapasitas kepemimpinan mahasiswa dalam bidang pendidikan sains dan STEM, memberikan mereka peran aktif dalam perubahan dan pengembangan pendidikan di tingkat lokal.
9) Meningkatkan profil akademis dan profesional, membuka peluang untuk berkembang dalam karir pendidikan, penelitian, dan pengembangan kurikulum di tingkat nasional dan internasional.
10) Menjadi agen perubahan dalam pendidikan sains yang berkelanjutan, berkontribusi pada pembangunan berkelanjutan melalui implementasi ESD dan penyebaran pengetahuan STEM yang berkelanjutan.

BAB II

PELAKSANAAN WINTER SCHOOL EASE 2024

A. Persiapan

Untuk mencoba pengalaman baru ke luar negeri melalui program pertukaran pelajar (student exchange) Winter School EASE 2024 ke Thailand yang diikuti oleh 8 peserta yang terdiri dari mahasiswa magister dan doktoral pendidikan IPA dan didampingi 3 profesor dari 5 Universitas sebagai delegasi Indonesia yaitu ; Prof.Dr.Hj. Anna Permanasari, M.Si (Universitas Pakuan), Prof. Dr. Riandi, M.Pd, Dr. Irma Rahma Suwarma, Ph.D (UPI), Jaka Afriana dan Anisa Puteri (Universitas Pakuan), Eliyawati, M. Taufiq dan Vivi Mardiana (UPI), Nur Ahmad (UNEJ), Ardiani Mustika Sari (UNNES) dan Ananta Ardyansyah (UM). Program ini dilaksanakan selama 6 hari, peserta harus bergabung terlebih dahulu dengan cara registrasi. Pada awalnya, peserta harus mengisi formulir pendaftaran dan *application form*, serta mengumpulkan berkas-berkas yang diminta seperti paspor dan KTP. Setelah itu, peserta membuat *proposal research* yang berkaitan dengan pembelajaran sains. Program Studi Magister Pendidikan IPA memutuskan 1 mahasiswa yang bersedia mengikuti dalam program Winter School EASE 2024 ke Thailand.

Sebelum keberangkatan tepatnya pada tanggal 12 Januari diadakan pembekalan dan pelepasan oleh Dekan Sekolah Pascasarjana Prof Dr. Ing. Soewarto Hardhienata dan juga Wakil Dekan Bidang Kemahasiswaan dan Keuangan Dr. Dadang Jaenudin untuk memberikan penguatan dan dukungan moral dan material kepada peserta.

Pada tanggal 9 Januari diadakan *technical meeting* yang dipimpin oleh Penanggungjawab delegasi Indonesia yaitu Dr, Irma Rahma Suwarma, Ph.D (UPI) guna membahas apa saja yang harus dipersiapkan sebelum keberangkatan yang belum sempat dibahas dalam pembekalan beberapa hari yang lalu, dari hal yang bersifat kelompok sampai hal yang bersifat individual, semua dipersiapkan dengan matang untuk meminimalisir hal yang tidak diinginka

B. Perjalanan Keberangkatan

Seperti yang sudah dijadwalkan, tanggal 14 Januari 20 peserta berangkat ke Thailand. Semua peserta berkumpul di Bandara Seokarno Hatta jam 06.00 WIB dengan jadwal penerbangan 09.00 WIB. Sesampainya di bandara prosedur-prosedur itu telah menanti para peserta mulai pemeriksaan keamanan, pengecekan barang bawaan melalui metal detector, check in di loket, boarding pass kemudian menunggu di ruang tunggu. Pesawat Malaysia Airlines tujuan Jakarta-Kuala Lumpur dijadwalkan take off pada pukul 11.30 WIB,.

Kemudian kami menuju Gate Q7 melakukan transit selama 1 jam untuk menuju ke Suvarnabhumi International Airport dengan jadwal 13.00 dan sampai 14.30 waktu setempat. Setelah sampai di bandara kami melanjutkan perjalanan menuju Bangkok dengan menggunakan kereta dan dilanjutkan dengan taxi menuju hotel.

Gambar 1. Keberangkatan di Bandara Soetta

Gambar 2. Perjalanan menuju Hotel dengan Kereta

C. Kegiatan di Thailand

Winter School East Asian Science Education (EASE) adalah pengalaman pendidikan yang mendalam dan beragam bagi para mahasiswa Magister dan Doktoral Pendidikan IPA yang berpartisipasi. Berikut adalah deskripsi kegiatan utama yang melibatkan para peserta dalam pembangunan pengetahuan, keterampilan, dan kolaborasi internasional:

1) Kuliah atau Lokakarya oleh Profesor dari berbagai negara Asia

   Kami mendapatkan kuliah dan lokakarya yang dipandu oleh para profesor senior dari berbagai wilayah. Profesor ini akan membagikan karya dan pengalaman mereka dalam bidang sains atau pendidikan STEM yang terkait dengan pendidikan untuk pembangunan berkelanjutan. Kuliah dan lokakarya ini bertujuan untuk memberikan wawasan mendalam mengenai perkembangan terbaru dalam ilmu pengetahuan dan teknologi serta pendekatan pendidikan yang berkelanjutan.

   Berikut adalah daftar lokakarya dari para professor :

Day	Lecture	Professors	Topics
1	1	Prof. Bing Wei, China Macao	Practical Work in Science Education: Conceptual Analyses and Empirical Studies
1	2	Prof. Hiroki Fujiii, Japan	Trends and Perspectives of Climate Change Education in the Asia-Pacific: For Consideration in Science Education
2	3	Prof. Hyoung-Yong Park, Korea	Science Education in the Age of AI
2	4	Prof. Zhihong Wan, Hong Kong	Integration & Creativity in School STEM Education
2	5	Prof. Chockchai Yuenyong, Thailand	Students' Computational Thinking Competency in STEM Education
3	6	Prof. Silvia Wen-Yu Lee, Taiwan	Exploring New Dimensions: The Role of Virtual Reality in Science Learning
3	7	Prof. Riandi, Indonesia	Develop Technology Engineering Literacy Learning (TELL) to Improve STEM Teachers' Assessing Skills

Gambar 3. Lokakarya Prof Bing Wei

Gambar 4. Lokakarya Prof. Park Hyoung Yong

Gambar 5. Lokakarya Prof. Zhihong Wan

Gambar 6. Lokakarya Prof. Chokchai Yuenyong

2) Sesi Presentasi Riset

Peserta memiliki kesempatan untuk mempresentasikan dan mendiskusikan studi mereka dalam kelompok kecil. Dalam lingkungan yang mendukung, mereka akan secara aktif menganalisis dan mendiskusikan studi lain. Profesor dan pelatih akan mengawasi diskusi, memberikan saran, dan memastikan bahwa diskusi berjalan produktif. Setiap presentasi dan diskusi akan memakan waktu sekitar 30 menit, memungkinkan para peserta untuk mendalami topik penelitian mereka.

Gambar 7. Peserta Presentasi Riset

3) Proposal Penelitian Kolaboratif

Peserta akan terlibat dalam kelompok kecil untuk mendiskusikan dan mengembangkan proposal penelitian kolaboratif lintas wilayah. Proposal ini akan berkaitan dengan sains atau pendidikan STEM yang terkait dengan isu-isu pembangunan berkelanjutan di Asia. Setiap kelompok akan mempresentasikan proposal mereka di depan kelas, dan satu proposal terbaik akan dipilih pada akhir sekolah musim dingin. Hal ini mendorong kolaborasi antarwilayah dan pemikiran inovatif dalam mengatasi tantangan pembangunan berkelanjutan.

Gambar 8. Diskusi Riset Kolaborasi

Gambar 9. Presentasi Riset Kolaborasi

Gambar 10. Tim Riset Kolaborasi

4) Kunjungan Budaya

Winter School EASE 2024 juga menyediakan waktu untuk kunjungan budaya yang mencakup Grand Shadow Play, Pok Pan Temple dan Amphawa Pasar Terapung. Ini tidak hanya merupakan pengalaman wisata, tetapi juga kesempatan untuk memahami dan mengapresiasi warisan budaya Thailand.

Kunjungan ini memberikan dimensi tambahan pada pengalaman belajar, memperkaya pemahaman peserta terkait budaya setempat.

Gambar 11. Grand Shadow Play

Gambar 12. Pok Pan Temple

Gambar 12. Grand Shadow Collection Art

Gambar 13. Kunjungan Art Centre Silapkorn University

BAB III

PENUTUP

A. Kesimpulan

Winter School EASE 2024 telah menjadi suatu perjalanan intelektual yang menginspirasi dan membuka mata bagi peserta yang berpartisipasi. Melalui kegiatan-kegiatan yang beragam, kami telah memperoleh pemahaman mendalam tentang ilmu pengetahuan alam, teknologi, rekayasa, dan matematika (STEM), sekaligus meresapi esensi pendidikan berkelanjutan (ESD) dalam konteks Asia.

Kuliah dan lokakarya oleh para profesor senior telah membuka pintu wawasan terbaru dan membimbing kami menuju pemahaman mendalam akan dinamika STEM dalam pendidikan untuk pembangunan berkelanjutan. Sesi presentasi disertasi memperkaya pengalaman pribadi dan memungkinkan kami untuk berbagi pengetahuan serta menerima umpan balik yang konstruktif dari sesama mahasiswa dan pembimbing.

Partisipasi dalam pengembangan proposal penelitian kolaboratif lintas wilayah mengajarkan kami arti sejati dari kolaborasi global. Diskusi dan perdebatan yang dilakukan dalam kelompok kecil memberikan kesempatan untuk mendengar berbagai perspektif dan mengasah kemampuan berpikir kritis kami. Hasilnya adalah proposal penelitian yang mencerminkan pemahaman mendalam kami terhadap isu-isu pembangunan berkelanjutan di Asia.

Kunjungan budaya ke Grand Shadow Play, Art Centre Silapkorn University, dan Amphawa Pasar Terapung memberikan sentuhan kemanusiaan pada perjalanan kami. Pengalaman ini tidak hanya melibatkan diri dalam kekayaan budaya Thailand, tetapi juga meresapi nilai-nilai lokal yang dapat memperkaya pendekatan pendidikan sains kami di masa mendatang.

Dengan demikian, kami melangkah keluar dari EASE sebagai agen perubahan yang siap mengintegrasikan konsep STEM dan ESD dalam praktik pendidikan kami. Pengalaman ini bukan hanya meningkatkan kapasitas akademis kami, tetapi juga membentuk kami menjadi pemimpin yang peduli, kolaboratif, dan berkomitmen pada pembangunan berkelanjutan di wilayah masing-masing.

Terima kasih kepada semua pihak yang telah mendukung dan melibatkan diri dalam kesuksesan Winter School EASE 2024. Semoga pengalaman ini tidak hanya memberi warna pada perjalanan akademis kami, tetapi juga menjadi tonggak awal bagi transformasi positif dalam dunia pendidikan dan ilmu pengetahuan. Kami yakin bahwa jejak EASE akan terus membimbing langkah-langkah kami menuju masa depan pendidikan yang berkelanjutan dan inklusif.

E·A·S·E
East-Asian Association for Science Education

EASE WINTER SCHOOL 2023

14th - 20th January 2024

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President

Anna Permanasari
EASE President 2023 – 2024

Dear all EASE members, all winter school participants, all professors, and coaches. First of all, we are very grateful because finally this annual EASE activity was carried out offline again after the Covid-19 pandemic ended. For some reasons, this activity was postponed from mid of 2023 to early 2024. This activity aims to bring young scientists and young science educators closer together to collaborate and share experiences related to science education in their respective countries. It is also hoped that through the activities, all of participants those are postgraduate students from all regions of EASE, will share views and thoughts regarding science education. Innitially by the lecture of some professors from all EASE regions, at the end of the course participants will hopely create a research proposal that can be implemented collaboratively. Considering its usefulness, EASE considers to ensure the sustainability of the program.

We convey our deepest appreciation to Thailand team as an EASE member who was willing to host the winter course. Our appreciation also goes to the universities in Thailand (Srinakharinwirot University , Kasesart University, Khon Kaen University), and Science Education Association who have become co-hosts. Special thanks to Dr. Chanyah Dahsah with the team who has organized the program very satisfactorily.

Once again, to all of participants, use this opportunity as a means to gain experience and knowledge, as well as an opportunity to collaborate between countries.

Hopefully this activity will run smoothly and be successful.

Thank you very much

EASE WINTER SCHOOL 2023
Thailand

Overview

EASE Summers Schools proposes to provide valuable opportunities for Ph.D. science education students from EASE constituent regions to gain experiences from senior professors, share their research experiences, and develop future research collaboration among the Ph.D. students. The 5-day school includes seven lectures or workshops from senior professors, 35 dissertation presentations and discussions from each individual student, five cross-region collaborative research proposals development, and presentations from a group of students. A group of students will include seven students from each region. One senior professor and one coach will supervise each group of students.

Our EASE EM Thailand will provide accommodation, lunch, coffee breaks, dinner, transportation from hotel to university, university to university, cultural tours during the stay, and from hotel to Bangkok or airport. The participants (students, professors , and coach) should be responsible for their traveling to Thailand and Taipan Hotel on the Arrival Date, two dinners, and other expenses needed.

Activities

1. Lecture or workshops: senior professors from each region will share their works and experiences in science or STEM education related to education for sustainable development.

2. Dissertation presentation session: students present and discuss their studies in a small group. In addition, students are expected to actively analyze and discuss other students' studies in a supportive environment. A professor and coach will supervise the discussion and provide suggestions to improve their ongoing study. Each presentation and discussion will take about 45 minutes.

3. Collaborative research proposal: students in a small group discuss and develop a cross-region collaborative research proposal. The proposal should be related to science or STEM education related to education for sustainable development issues in Asia and be plausible and valuable in all regions. The proposal should clarify the issue, research questions, literature review, research design and method, and study benefit. Each group will present their proposal to the whole class. One best proposal will be selected by the end of the summer school.

4. Cultural visit: Damnoen Saduak Floating Market; Grand Shadow Play, Art Center Silpakorn University, and Ezy Farm Learning Center.

Participants

Each region will include
- One senior professor
- One coach
- Two to eight Ph.D. or Master's students

Application

- All participants must submit a personal information form.
- Senior professors must submit an abstract (250-500 words) related to the lecture or workshop topic.
- Students must submit a 2-page proposal briefly explaining the topic, objectives, background, methods, and expected outcomes.
- All documents will be submitted to the regional coordinator and submitted to chanyah@g.swu.ac.th.

Important Date:

- Application due date: 15 December 2023
- Arrival and Departure Time: 14 January – 20 January 2024

Regional Coordinator:

- Indonesia
- Japan
- Mainland China
- South Korea
- Hong Kong
- Taiwan
- Thailand

Host Organizing Committee:

- Coordinator: Chanyah Dahsah, Assist. Prof. (chanyah@g.swu.ac.th), Srinakharinwirot Unviversity
- Secretary: Tussatrin Wannaketsiri, Associate Prof. (tussatrin.k@ku.th), Kasetsart University (Kamphaeng Saen)
- Chair: Chokchai Yuenyong, Associate Prof. (ychok@kku.ac.th), Khon Kaen University
- Committee: Pattamaporn Pimthong, Associate Prof. (fedupppi@ku.ac.th), Kasetsart University

Schedule

<table>
<tr><th rowspan="2">Time/Day</th><th>Arriving Day</th><th>Day 1</th><th>Day 2</th><th>Day 3</th><th>Day 4</th><th>Day 5</th><th>Departure Day</th></tr>
<tr><th>Sunday 14 Jan 24</th><th>Monday 15 Jan 24</th><th>Tuesday 16 Jan 24</th><th>Wednesday 17 Jan 24</th><th>Thursday 18 Jan 24</th><th>Friday 19 Jan 24</th><th>Saturday 20 Jan 24</th></tr>
<tr><td>9:00 – 10:00</td><td rowspan="5">Check in 14:00 (Taipan Hotel)</td><td>Opening Session</td><td>Lecture 3
Prof. Park, Hyoung-Yong, South Korea</td><td>Lecture 6
Prof. Silvia Wen-Yu Lee, Taiwan</td><td rowspan="4">Damnoen Saduak Floating Market

Grand Shadow Play (Asia/Pacific Cultural Centre for UNESCO)</td><td>Collaborative Proposal (Group Work)</td><td rowspan="5">Airport Shuttle from Hotel to Airport</td></tr>
<tr><td>10:00 – 10:20</td><td colspan="3">Coffee break</td><td></td></tr>
<tr><td>10:20 – 11:20</td><td>Lecture 1
Prof. WEI Bing, China (Macao)</td><td>Lecture 4
Prof. Wan Zhihong, Hongkong</td><td>Lecture 7
Prof. Riandi, M.Si, Indonesi</td><td>Proposal Presentation 1 – 2 (30 mins each)</td></tr>
<tr><td>11:20 – 12:20</td><td>Lecture 2
Prof. Hiroki Fujii, Japan</td><td>Lecture 5
Prof. Chockchai Yuenyong, Thailand</td><td>Collaborative Proposal (Group Work)</td><td>Proposal Presentation 3 – 4 (30 mins each)</td></tr>
<tr><td>12:20 – 13:15</td><td colspan="4">Lunch</td><td></td></tr>
</table>

<table>
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<tr><td>13:15 – 14:00</td><td rowspan="5"></td><td>Dissertation Presentation 1</td><td>Dissertation Presentation 6</td><td rowspan="3">Collaborative Proposal (Group Work)</td><td rowspan="6">Art Center Silpakorn Unviersity

Eazy Farm Learning Center</td><td>Proposal Presentation 5 (13:15 – 13:45)</td><td rowspan="7"></td></tr>
<tr><td>14:00 – 14:45</td><td>Dissertation Presentation 2</td><td>Dissertation Presentation 7</td><td>Reflection/Reward (Professor & Coach)</td></tr>
<tr><td>14:45 – 15:30</td><td>Dissertation Presentation 3</td><td>Coffee break</td><td>Coffee break</td></tr>
<tr><td>15:30 – 15:45</td><td>Coffee break</td><td rowspan="4">Bus Pick Up to Nakorn Pathom Provinces (Visit Pra Pathom Chedi)

Self - Dinner</td><td>Coffee break</td><td rowspan="4">Bus Pick Up to MIRACLE SUVANABHUMI AIRPORT HOTEL</td></tr>
<tr><td>15:45 – 16:30</td><td>Dissertation Presentation 4</td><td rowspan="2">Collaborative Proposal (Group Work)</td></tr>
<tr><td>16:30 – 17:15</td><td>Professor and Coach Meeting</td><td>Dissertation Presentation 5</td></tr>
<tr><td>18:00 – 20:00</td><td>Welcome dinner</td><td>Leisure Time Self-Dinner</td><td>Dinner at Hotel</td><td>Farewell Dinner</td></tr>
</table>

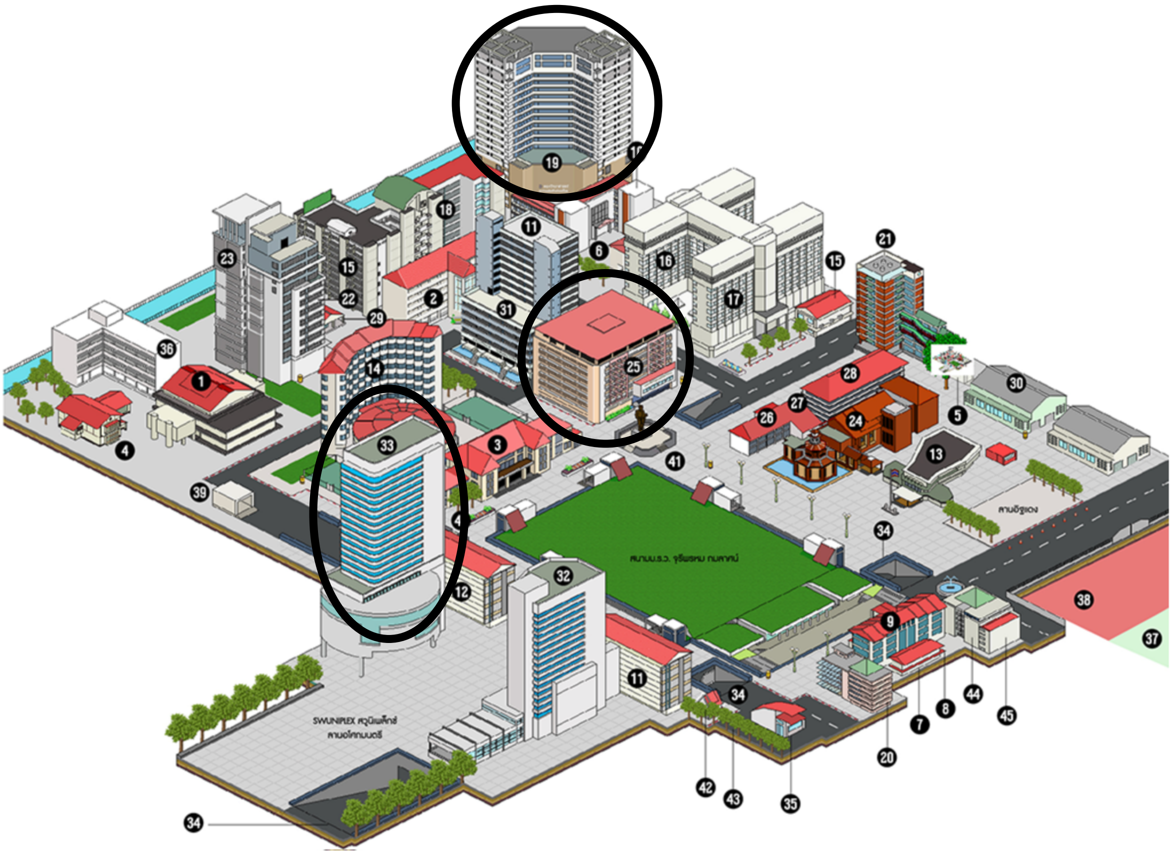
Program Detail

Arrival Day: January 14, 2024

- Check in at Taipan Hotel Bangkok https://www.taipanhotel.com/
- Professor and Coach Meeting (16:30)
- Welcome Dinner at Taipan Hotel (18:00)

Day 1: January 15, 2024

- Breakfast at Taipan Hotel
- Meet at Lobby 8:15 walk to Srinakharinwirot University about 15 minutes
- Opening Session/ Special Lecture 1-2, Room 502 Building 19 Faculty of Science, Srinakharinwirot University
- Dissertation Presentation 1-5 at Room 305, 306, 403, 404, 505 Building 25 Central Library Srinakharinwirot University



Day 2: January 16, 2024

- Check Out/Breakfast at Taipan Hotel
- Meet at Lobby 8:15, leave the luggages at Hotel Lobby, Walk to Srinakharinwirot University
- Special Lecture 3 – 5, Floor 19, Building 33 SWU Innovation Building, Srinakharinwirot University
- Dissertation Presentation 6 - 7 at Room 305, 306, 403, 404, 505 Building 25 Central Library Srinakharinwirot University
- Bus Pick Up to Nakorn Pathom Province, visit Pra Pathom Chedi https://en.wikipedia.org/wiki/Phra_Pathommachedi
- Leisure Time and Dinner until 19:00, Check in at the Saenpalm Training Home (http://www.saenpalmtraininghome.com) and International Dormitory

Day 3: January 17, 2024

- Saenpalm Training Home, breakfast 7:00 – 8:15 and Meet at Lobby 8:30, Shuttle Pick Up to Kasetsart University (Kamphaeng Saen)
  International Dormitory, Meet at Lobby 7:45, Shuttle Pick Up for Breakfast
- Lecture 6 - 7 / Collaborative Group Work at Kasetsart University (Kamphaeng Saen)

Day 4: January 18, 2024

- 7.00 Bus pick up at the hotel
- 8.00 – 09.00 Damnoen saduak Floating Market
- 10.00- 11.00 Grand Shadow Play at Wat Khanon (Asia/Pacific Cultural Centre for UNESCO)
- 11.30- 12.30 Lunch at Muang Ratchaburi, Kuai Tieu Khai
- 13.00 - 14.00 Art Centre Silpakorn University
- 14.30- 16.30 Ezy Farm Learning Center

Day 5: January 19, 2024

- Check Out
- Saenpalm Training Home, breakfast 7:00 – 8:00 and Meet at Lobby 8:30, Shuttle Pick Up to Kasetsart University (Kamphaeng Saen)
  International Dormitory, Meet at Lobby 7:45, Shuttle Pick Up for Breakfast
- Collaborative Group Work and Presentation, Certificate and Reward
- Bus Pick Up to MIRACLE SUVANABHUMI AIRPORT HOTEL

Departure Day: January 20, 2024

- Check out

Activities

Lecture or workshops

Senior professors from each region will share their works and experiences in science or STEM education related to education for sustainable development.

Day	Lecture	Professors	Topics
1	1	Prof. Bing Wei, China Macao	Practical Work in Science Education: Conceptual Analyses and Empirical Studies
1	2	Prof. Hiroki Fujiii, Japan	Trends and Perspectives of Climate Change Education in the Asia-Pacific: For Consideration in Science Education
2	3	Prof. Hyoung-Yong Park, Korea	Science Education in the Age of AI
2	4	Prof. Zhihong Wan, Hong Kong	Integration & Creativity in School STEM Education
2	5	Prof. Chockchai Yuenyong, Thailand	Students' Computational Thinking Competency in STEM Education
3	6	Prof. Silvia Wen-Yu Lee, Taiwan	Exploring New Dimensions: The Role of Virtual Reality in Science Learning
3	7	Prof. Riandi, Indonesia	Develop Technology Engineering Literacy Learning (TELL) to Improve STEM Teachers' Assessing Skills

Professor Bing Wei

University of Macau
Macao

BIOGRAPHY

Dr. Bing Wei obtained his Master of Education (chemistry teaching) from Beijing Normal University in 1992 and PhD (science education) from the University of Hong Kong in 2003. Currently, Dr. Wei is a full professor in Faculty of Education (FED), University of Macau (UM). Also, he serve as the coordinator of the integrated science program in FED, a non-residential fellow in Shiu Pong College, and a member of the Senate of UM. Prior to joining UM, Dr. Wei had worked in Guangzhou University for years. Dr. Wei's research interest mainly lies in three areas: science curriculum development, science teacher development, and the nature of science. Up to now, Dr. Wei has published more than one hundred peer-reviewed articles in both Chinese and English academic journals, among which 40 are SSCI indexed. Dr. Wei serves as an editorial board member and an advisor in several academic journals and professional organizations in China and beyond. Dr. Wei has rendered many consultancy and training services to the community of education in Macau. Between 2012 and 2017, as the coordinator, he led the project of designing the Requirements of Basic Academic Attainments (RBAAs) of Natural Sciences for junior and senior secondary schools in Macau.

TITLE

Practical Work in Science Education: Conceptual Analyses and Empirical Studies

ABSTRACT

The term 'practical work' is not limited to its literal meaning; it can also refer to various experiences in school settings whereby students interact with equipment and materials or secondary sources of data to observe and understand the natural world. Practical work is commonly recognized by science teachers, science educators, and science curriculum developers as having a distinctive and central role in science education as a means of making sense of the natural world. Due to its origin with scientific experiment, practical work is often seen as identical to experimentation. For instance, the Chinese characters 实验 (s*hiyan*) literally means experiment but broadly refers to practical work in oral as well as written discourses of science education. The purposes, definitions, meanings of practical work in the English literature and its close associations with scientific experiment, laboratory work, scientific inquiry, and scientific practice are shared in this talk. In view of academic research, it is suggested the meanings of *shiyan* can be explored as an issue of science curriculum development, science teacher development, and science textbook research. Based on his research work, Dr. Wei will share three of his empirical studies on practical work in the context of China. The first is about the meanings of 'experiment' in the intended chemistry curriculum in China over the period from 1952 to 2018 (Wei & Chen, 2020). The second is about science teachers' perceptions of experimentation (Wei & Li, 2017). The third is an exploration of the nature of practical work in school science textbooks (Wei et al., 2022). The rationales, methodologies, main findings of these three empirical studies will be reported and their implications for school practice and academic research will be discussed. Finally, the future directions and focuses of research work on practical work are recommended.

Professor Hiroki Fujii

Okayama University
Japan

BIOGRAPHY

Prof. Dr. Hiroki Fujii is a professor of science education in the Graduate School of Education at Okayama University and the director in Okayama University ESD Promotion Centre at the UNESCO Chair in Research and Education for Sustainable Development, Japan. His major area of work is design and development of school science curricula and lessons to promote students' scientific literacy. He has served on a vice president of the Society of Japan Science Teaching since 2019, as well as a vice president of the East-Asian Association for Science Education since 2021. Fujii is currently interested in researching science lessons and science teacher training incorporating education for sustainable development (ESD). He organizes a joint research project on teacher education for ESD with European countries and its advanced project on teacher education for climate change education (CCE) in Asia, supported by the Japan Society for the Promotion of Science (JSPS) and UNESCO (http://ceteesd.ed.okayama-u.ac.jp/).

TITLE

Trends and Perspectives of Climate Change Education in the Asia-Pacific: For Consideration in Science Education

ABSTRACT

Incorporating climate change education (CCE) into school education and teacher training is an urgent and challenging task. This study presents the trends and perspectives of school education and teacher education with regard to CCE, especially in countries of East Asia, Southeast Asia, and the Pacific islands. The basis for this attempt is discussions under the followings: 1) global calls to accelerate CCE; 2) development of CCE in schools – leading projects and educational policies, curricula, and pedagogy; and 3) implementation of CCE in teacher education – educational programs and courses and an innovative project through collaboration in the Asia-Pacific. In conclusion, in order to mainstream CCE in schools and teacher education institutions, the first requirement is to develop a school education policy and guidelines on CCE and to promote the incorporation of CCE into the curricula not only in science and social science subjects but also in the humanities. Additionally, new curricula should be flexible enough to be adaptable to local contexts. Second, pedagogical approaches that encourage behavioral changes in learners, such as learner-centered, inquiry-based, experiential, participative and collaborative, and inter- and transdisciplinary approaches, should be further disseminated. They must take into account the characteristics of climate change including its inevitable unknowns and uncertainties, scientific complexity, and the difficulty in being recognizing it from personal experience. Finally, despite various obstacles to integrate CCE into existing teacher training, teacher education institutions should implement CCE strategies and develop educational programs and courses that would allow teachers to gain competencies as sustainability citizens as well as professional competencies for CCE. These requirements will be crucial in considering CCE in science education.

KEYWORDS

Climate Change Education; Education for Sustainable Development; School Education; Teacher Education

Professor Hyoung-Yong Park

Gyeongin National University of Education
South Korea

BIOGRAPHY

Hyoung-Yong Park is an associate professor at Gyeongin National University of Education, South Korea. He is researching science education, STEAM and artificial intelligence convergence education, Education for Sustainable Development (ESD), gifted science education, and teacher professional development.

TITLE

Science Education in the Age of AI

ABSTRACT

Artificial intelligence (AI) has become increasingly influential in our daily lives and professional fields with the rapid development of related technologies in recent years. AI has penetrated deeply into the lives of humans surrounded by smart devices, and the coexistence of humans and AI is no longer a future but a reality. It is hard to say how much this rapid development and adoption of technology will transform human civilization. The emergence of generative artificial intelligence represented by 'ChatGPT' is further accelerating the digital transformation of our civilization. In this process, the education gap between countries and social groups is wider than ever before. Therefore, digital empowerment in education is essential to prevent a future of educational inequality. What role can science education play in addressing these needs? In the era of digital transformation, how can we foster the analytical and critical thinking, creative thinking, and lifelong learning skills that science education has been pursuing? In this lecture, we remind ourselves of the values of science education amidst the flood of digital tools and information. In particular, from the perspective of science education through the deconstruction and reconstruction of black-boxed technologies, we will explore how the new era of science education can promote the transition to a problem-solving process that is connected to real life and based on live data, focusing on the case of physical computing. We will discuss new directions in science education to help students become future citizens who can take ownership of and participate in the interplay of science, technology, and society rather than becoming technology-dependent consumers who need help understanding how it works.

Professor Wan, Zhihong

The Education University of Hong Kong
Hong Kong

BIOGRAPHY

Dr Wan is an Associate Professor at The Education University of Hong Kong. He is serving as the Vice President of the East-Asian Association for Science Education. Cultivating STEM talent is his long-standing research interest with an emphasis on interdisciplinary STEM learning. Extensive topics about STEM education have been investigated in his projects, including the relationship between STEM learning and STEM career aspiration, the impacts of designed-based STEM learning, understanding the integration in STEM, and cultivating students with ADHD through STEM robotics. A series of STEM robotics textbooks have been published. His research works have been widely published in top international journals, including Computer & Education, Science Education, Studies in Science Education, International Journal of Science Education, Thinking Skills & Creativity, and etc.

TITLE

Integration & Creativity in School STEM Education

ABSTRACT

STEM education has been the focus of curriculum development and reform in many countries. Although the acronym STEM represents the four disciplines of science, technology, engineering, and mathematics, within the context of education policy and school curriculum, STEM is considered an integrated approach to teaching and learning. Meanwhile, STEM creativity, which refers to an individual's ability to apply the knowledge and skills of the STEM disciplines to make an original product that has social or personal value and is designed with a purpose, is considered one of the most significant goals of STEM education and has been repeatedly highlighted in various government documents concerning STEM education. This presentation will introduce the theoretical background of these two key issues in STEM education (i.e., STEM integration and creativity). After that, two studies will be shared about how STEM integration and STEM creativity can be investigated in school contexts. The 1st study designed and validated a scale for integrative STEM teaching practice that comprises the three dimensions of content infusion (CI), pedagogy expansion (PE), and subject orchestration (SO). The participants were 278 primary teachers from 36 schools in Hong Kong. The three-dimensional structure of integrative STEM teaching practice was supported by multi-group confirmatory factor analyses, indicating its consistency across teachers of different genders and differing levels of teaching experience. The 2nd investigated the effects of a 6-month design-based STEM learning event (in which the application of information technologies was required) on 155 upper primary students' STEM creativity and epistemic beliefs. The results showed (i) a significant improvement in the fluency and flexibility dimensions of STEM creativity, (ii) a significant decrease in the source, certainty, and justification dimensions of epistemic beliefs, and (iii) no statistically significant change in the originality dimension of STEM creativity or the complexity dimension of epistemic beliefs. Based on these findings, a framework will be generated to illustrate how integrated STEM education can be systematically implemented to facilitate the creativity of school students.

Professor Chockchai Yuenyong

Khon Kaen University
Thailand

BIOGRAPHY

Chokchai Yuenyong is associate professor in science education program, Faculty of Education, Khon Kaen University, Thailand. He graduated Ph.D. in science education from Kasetsart University, Thailand, cooperation with the University of Waikato, New Zealand with supporting by scholarship of the Institute for the Promotion of Science and Technology (IPST). Currently, He is working in the science education program of Khon Kaen University, Thailand. He also works as President of Science Education Association of Thailand (SEAT). He was ranked as the world top 2% scientists 2022 by Stanford University. His interesting research include Student learning in physics, Science teaching based on constructivism, Scientific literacy, Science teacher education, STEM Education, Cultural issues in science education. His current project is PLC STEM academy for enhancing STEM teacher competencies. He published around 130 indexed SCOPUS papers and 47 indexed Web of science papers.

Chokchai Yuenyong
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Fax: (66) 43 343454
Email: ychok@kku.ac.th

TITLE

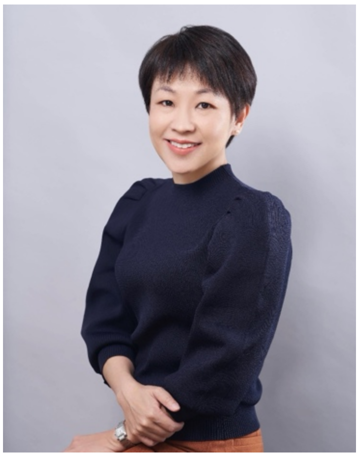
Students' Computational Thinking Competency in STEM Education

ABSTRACT

Computation and analytical methods have created powerful tools for understanding phenomena across all spectra of human inquiry. Computational thinking practices have been not only integrated into science and mathematics but also included in history, art and language arts. The literatures suggested that the ability to effectively use computer simulations and interactive visualizations is an important aspect of computational thinking, particularly as it relates to the STEM fields. This paper clarify examining students' computational thinking competency in STEM education. Two studies about STEM education were highlighted in order to provide scenario of examining students' computational thinking competency in STEM education. The first study was about promoting students' computational thinking competency on the acid-base STEM education unit. Another one is about promoting students' computational thinking competency on satellite and spacecraft STEM education unit. The paper highlighted students' designing prototypes with aiming to understand their competency on computational thinking based on 4 categories of computational thinking taxonomy. These categories included data practices, modeling and simulation practices, computational problem solving practices, and systems thinking practices.

KEYSWORD

STEM education, computational thinking, acid-base, satellite, spacecraft



Professor Silvia Wen-Yu Lee

National Taiwan Normal University
Taiwan

BIOLOGRAPHY

I am currently a Distinguished Professor of the Graduate Institute of Information and Computer Education and Associate Dean of College of Education at National Taiwan Normal University (NTNU) in Taiwan. Before joining NTNU, I was a Director and Distinguished Professor in the Graduate Institute of Science Education at the National Changhua University of Education. I received my PhD degree from the Learning Technology program, University of Michigan, Ann Arbor. My expertise is interdisciplinary research in educational technologies and science learning. My recent research interest is designing virtual reality learning materials and building models of how students learn when using VR; and facilitating students' computational thinking through STEM activities. Past research topics include enhancing students' competence in scientific models and modeling through curriculum design and computer simulations. I have had opportunities to work on the editorial teams in major journals including the Journal of Research in Science Teaching (JRST) and the Chinese Journal of Science Education.

TITLE

Exploring New Dimensions: The Role of Virtual Reality in Science Learning

ABSTRACT

In this session, Professor Silvia Wen-Yu Lee from the National Taiwan Normal University will delve into the transformative potential of Augmented Reality (AR) and Virtual Reality (VR) in science education. The presentation will explore review studies and empirical studies that demonstrate how virtual technologies creates immersive, interactive learning environments, fostering a deeper understanding of scientific concepts. Key areas of focus include the impact of advanced organizers, the intricate roles of affective factors in VR settings, and the design and development of effective VR instructional materials. Attendees will gain insights into recent findings showcasing how VR influences cognitive, affective, and behavioral aspects of learning, offering a new dimension to science education.

Professor Riandi

Universitas Pendidikan Indonesia
Indonesia

BIOGRAPHY

Riandi is a professor in science education at the Faculty of Mathematics and Sciences Education, Universitas Pendidikan Indonesia (UPI). Born in Tasikmalaya on May 1, 1963. He obtained a bachelor's degree in biology education from the Bandung Institute of Teacher Training and Education, a master's degree in biology from Gadjah Mada University, and a Ph.D. in science education obtained from Universitas Pendidikan Indonesia. Currently he is a lecturer in undergraduate, master's and doctoral programs for courses in genetics, laboratory techniques, biology learning media, science learning innovation and science education for sustainable development. Areas of research and publications in teacher professional development related to TPACK, STEM, and ESD.

TITLE

Develop Technology Engineering Literacy Learning (TELL) to Improve STEM Teachers' Assessing Skills

ABSTRACT

The increased demand of human resources with required literacies in 21st century, have been triggering reformation in many sectors of life. Most of reformation was targeting on science and technology development, including education. Japan and Indonesia are realizing it; therefore, we need collaboration research even though each country has its own issues. In education sectors, Science, Technology, Engineering, and Mathematic (STEM) approach implementations are becoming a major solution to create the required human resources. Japan and Indonesia start to investigate the STEM education implementation in 2013 through several research activities that impacted to teachers and students. The recent research focus on developing Technology Engineering Literacy Learning (TELL) for STEM teachers. We identified that teachers are able to develop STEM learning very well, but they can't develop the assessment. We found that they are able to develop scientific and mathematic literacy items, but they face difficulties in developing technology and engineering literacy. We design sixteen meeting courses for them. It is including: technology development in IR 4.0, technology literacy concept, design technology, technology and engineering domain, technology and engineering in STEM learning, and technology and engineering literacy assessment. This is mixed method research that invite quantitative and qualitative method. The quantitative collected from teachers' TEL profile, and qualitative data collected from TELL course activities observation. The results showed that before the course, teacher got low score in understanding technology and engineering design system domain. After the courses, they understand the concept of technology and can create varied assessment TEL design.

KEYWORDS

STEM teachers, Technology and Engineering Literacy, assessment, mixed method design

Coach

Prof. Jian-Xin Yao
Beijing Normal University
China

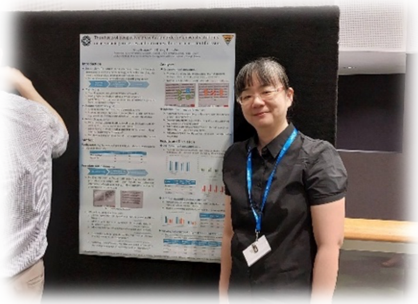
Prof. Tomotaka Kuroda
Shizuoka University
Japan

Prof. Heesoo Ha
Seoul National University
South Korea

Prof. Xiaojing Weng
The Education University of Hong Kong
Hong Kong

Coach

Prof. Irma Rahma Suwarma
Universitas Pendidikan Indonesia
Indonesia



Prof. Miao Hsuan Yen
National Taiwan Normal University
Taiwan

Prof. Chaninan Pruekpramool
Srinakharinwirot University
Thailand

Dissertation Presentation and Collaborative Research Proposal Session

Dissertation Presentation

Students present and discuss their studies in a small group. In addition, students are expected to actively analyze and discuss other students' studies in a supportive environment. A professor and coach will supervise the discussion and provide suggestions to improve their ongoing study. Each presentation and discussion will take about 45 minutes.

Collaborative Research Proposal

Students in a small group discuss and develop a cross-region collaborative research proposal. The proposal should be related to science or STEM education related to education for sustainable development issues in Asia and be plausible and valuable in all regions. The proposal should clarify the issue, research questions, literature review, research design and method, and study benefit. Each group will present their proposal to the whole class. One best proposal will be selected by the end of the summer school.

Region	Indonesia	Japan	Mainland China	South Korea	Hong Kong	Taiwan	Thailand
Number of students	8	6	5	4	2	2	8

Student Groups

Group	Professor	Coach	Group member	Title
1	Prof. Bing Wei (China (Macao))	Prof. Heesoo Ha (South Korea) Prof. Chaninan Pruekpramool (Thailand)	1. Japan: Mr Yusei Nomura	The Role and Influence of Inquiry in the Upper Secondary School Curriculum
			2. Japan: Mr Kousuke Shimada	The meaning of acquiring scientific knowledge in Japan: From a historical perspective
			3. China: Ms Yi-Xuan Liu	A Framework for Learning Progression of Metamodeling and Modeling Practice: a Systematic Review
			4. Indonesia: Mr Ardiani Mustikasari	Improving the Quality of Integrated Science Learning Through Ethno-STEAM Approach Base on Digital Platform
			5. Taiwan: Mr Jhuo-Syun Sie	High School Biology Teacher to Promote Students' Conceptual Understanding through the Scientific Explanation
			6. Thailand: Ms Sunisa Thapseang	Development of Problem-based Learning Model in Chemistry to Enhance the System Thinking Ability for Secondary School Students
			7. Thailand: Mr Parinya Mutcha	Enhancing cross-cutting concepts in chemistry for high school students in through construct map-driven formative assessment

Group	Professor	Coach	Group member	Title
2	Prof. Hyoung-Yong Park (South Korea)	Prof. Xiaojing Weng (Hong Kong)	1. Indonesia: Mr Jaka Apriana	Increasing Science Teacher Skills in Laboratory Management Through The Training Model Based On Standard Of Indonesian National Competency Work (SKKNI)
			2. Japan: Ms Gerelkhuu Shinetsetseg	Interview Survey on Children and Teachers in Mongolian Primary Schools: A Comparative Study of capital and rural areas
			3. China: Ms Shan Lin	Development of a program for improving high school biology teachers' pedagogical content knowledge (PCK) of argumentation
			4. China: Mr Kuerbanjiang Jielili	A Study on Hierarchical Teaching Practice Based on Cognitive Diagnosis Theory
			5. South Korea: Ms Haejung Ahn	Design Study on the Development of Pre-service Science Teachers' Teaching Professionalism in the Educational Internship Semester System
			6. Taiwan: Ms Pei-Wan Liu	Developing The Observation Instrument for Teacher's Mathematical Teaching Knowledge
			7. Thailand: Ms Kusumar Ubonmoung	Development of Students' Empathetic Problem-Solving Ability in 8th grade Students through Design-based Learning

Group	Professor	Coach	Group member	Title
3	Prof. Zhihong Wan (Hong Kong) Prof. Riandi (Indonesia)	Prof. Jian-Xin Yao (Mainland China)	1. Indonesia: Ms Vivi Mardian	Development of STEM-Worksheet to Improve Students' Problem-Solving and Collaboration Skills on Static Fluid Concepts
			2. Indonesia: Mr Nur Ahmad	Applying Project Based Learning PBL-STEM to Support the Merdeka Curriculum in Indonesia
			3. Thailand: Ms Angkana Langkawong	Development of STEM Methods Course by Integrated Culturally Responsive to Promote STEM Teaching Competency of Elementary Preservice Teachers
			4. Thailand: Ms Chantia Butrattana	The BCG-battery STEM education for Enhancing Students Computational Thinking
			5. China: Mr Lihua Tan	How Science Teachers Deal with STEM Education: An Explorative Study from the Lens Of Curriculum Ideology
			6. Japan: Mr Tetsuya Ida	Teaching Invasive Alien Species through Drawing
			7. South Korea: Ms Yang Jiyun	The Impact of Experiential Learning Program for Advanced Science on the Students' Science Academic Passion

Group	Professor	Coach	Group member	Title
4	Prof. Silvia Wen-Yu Lee (Taiwan)	Prof. Irma Rahma Suwarma (Indonesia) Prof. Tomotaka Kuroda (Japan)	1. Indonesia: Ms Anisa Puteri	Development of STEM Learning Media Virtual Reality Based on Self Paced Learning to Improve Metacognitive Skills
			2. Indonesia: Mr Muhamad Taufiq	Development of STEM-Coding Team-Based Project Using Scratch to Increase Students' Creative Thinking and Collaboration Skills on Mechanics Concepts
			3. South Korea: Ms So Yoon Bang	The Development and Application of SWH performance evaluation using AI and data-Focusing on Middle School ‘Motion and Energy’ Part
			4. Thailand: Dr. Rames Kaewmanee	Development of DIY Metal Air Battery to Enhance High School Science Students’ Conceptual Understanding in Electrochemistry through Inquiry-based Learning
			5. Hong Kong: Ms Jing Zhang	A Three-Year Longitudinal Study on Online Graphical Programming Learning: Investigating the Effects of Self-Regulated Learning and Autonomous Motivation
			6. China: Ms Xiaowan Jin	Professional Learning in a Web-based Community of Practice of, by, and for Chinese elementary science teachers: A Narrative Inquiry
			7. Japan: Mr Hiroaki Okada	An Analysis of Physics Textbooks from Different Cultures: Revealing unique Characteristics in Japanese and Chinese Educational Tradition to Improve Curriculum Design.

Group	Professor	Coach	Group member	Title
5	Prof. Hiroki Fujiii (Japan) Prof. Chockchai Yuenyong (Thailand)	Prof. Miao Hsuan Yen (Taiwan)	1. Indonesia: Ms Eliyawati	Identifying Science Teacher Competencies to Teach Education for Sustainable Development (ESD) in East Asian Countries: A Survey Research
			2. Indonesia: Mr Ananta Adriansyah	Investigating Students' Metacognition and Problem Solving Skills through GPT-Assisted Learning: Combining SSI-Contextualized Chemistry Teaching
			3. Thailand: Mr Korakoch Tangcharoenlap	The Development of a Learning Model to Enhance Scientific Media Literacy Skills for Grade 8 Students
			4. Thailand: Mr Witsanu Suttiwan	Science Teacher's Competencies in Transformative Learning for Sustainable Development in the School Context
			5. Japan: Mr Junye Gao	Examining Educational Transformations: An Analysis of Global Influences and Local Dynamics in STEM Education in Japan and China
			6. South Korea: Ms Seongwoo Kim	Cross-country Curriculum Analysis and Comparison of the Detailed Goals of Sustainable Development Goals (SDGs)
			7. Hong Kong: Ms Khadeza Yasmin	Human Health Risk Assessment, Rice Safety Threshold and Remediation by Modified Bone Biochar from A Multi Metal Industrial Paddy Areas

Students' Abstract

Research Proposal EASE Winter School 2024

Group 1

Japan: Mr Yusei Nomura, Hiroshima University

Title:

The Role and Influence of Inquiry in the Upper Secondary School Curriculum

Objectives:

This study aims to examine the characteristics of inquiry in Course of Study (CoS), as a national curriculum standard for upper secondary schools in Japan.

Background:

In the context of science education, the term "inquiry" encompasses multiple meanings with two major perspectives commonly recognized as "inquiry as ends" and "inquiry as means." The former refers to instructional outcomes in the curricula, while the latter denotes an instructional approach (Rutherford, 1964; Abd-El-Khalick et al., 2004). In addition, Anderson (2006) pointed out that the desired inquiry orientation must include attention to both means and ends.

In Japan, the term "process of inquiry" has been integral to the CoS since the 1960s. According to Nozoe and Isozaki (2014), previous versions of the CoS emphasized the significance of inquiry in helping students develop scientific methods and knowledge. In the recent version of CoS, inquiry has been placed as a keyword, reaffirming its significance in science education (MEXT, 2018). Specifically, two subjects were created: "Inquiry-based Study of Science and Mathematics" and "Period for Inquiry-based Cross-disciplinary Study," both of which emphasize "inquiry."

This study aims to answer research questions (RQ).

RQ1. What are the differences in the activities and aims of "inquiry" in these subjects?

RQ2. What is the meaning of the "process of inquiry" in science?

Method:

I analyzed two sets of data: i) CoS for upper secondary school (MEXT, 2018); in Science, “Inquiry-based Study of Science and Mathematics,” and “Period for Inquiry-based Cross-disciplinary Study,” and ii) literatures by science education researchers and curriculum developers in this period.

Expected Outcome:

I clarified that the differences between them are in the process that students employ in their learning. First, in learning science, students are intended to learn through scientific inquiry to help them acquire procedural knowledge, and develop skills related to practical work and scientific attitudes. Second, as articulated in the “Inquiry-based Study of Science and Mathematics,” students combine scientific inquiry and mathematical activities. This subject emphasizes that students show mathematical evidence to support results from practical work, followed by preparation for reports and presentations. Third, in “Period for Inquiry-based Cross-disciplinary Study,” students use various learning approaches, including scientific inquiry, mathematical activities, and other learning approaches, such as design processes, to find solutions for themselves. While the aims of “inquiry” in each subject focus on the real-world issues surrounding students, there are differences in their emphasis.

The position of inquiry in the recent version of CoS encompassed both “inquiry as ends” and “inquiry as means.” “Inquiry as ends” intended for students to perform inquiry in the context of science content (excluding epistemological understanding). On the other hand, “process of inquiry (as means)” was intended for students to learn science through exchange of ideas and discussions along with collaboration with other students to validate ideas and solve problems. Japanese science education researchers and curriculum developers have analyzed the “process of inquiry,” focusing on two aspects: a) the “process” that students use while doing inquiry, and b) the competencies that students are expected to acquire. I argued that the “process of inquiry” has emphasized process “as means” when students focus on doing inquiry, and they mainly acquire competencies.

References:

Note

Above findings of this study will be a part of ISEC Conference 2024.

Main Reference

Abd-El-Khalick, F., BouJaoude, S., Duschl, R. A., Hofstein, A., Lederman, N. G., Mamlok, R., Niaz, M., Treagust, D., and Tuan, H. (2004). Inquiry in science education: International perspectives. *Science Education, 88*(3), 397-419.

Ministry of Education, Culture, Sports, Science and Technology [MEXT]. (2018). *Kotogakkou gakusyu shidouyouryou kaisetsu rika hen* [The Course of Study for upper secondary science: Guideline]. [in Japanese] Retrieved from https://www.mext.go.jp/content/20211102-mxt_kyoiku02-100002620_06.pdf (Accessed December 26, 2023).

Nozoe, S., and Isozaki, T. (2014). A study on the background of the Course of Study for Elementary and Junior High School Science classes: Focusing on problem-solving and inquiry from the forties of the Showa era, *The Bulletin of Japanese Curriculum Research and Development*, *37*(1), 95-108. [in Japanese] https://doi.org/10.18993/jcrdajp.37.1_95.

Rutherford, F. J. (1964). The role of inquiry in science teaching. *Journal of Research in Science Teaching*, *2*(2), 80-84.

Japan: Mr Kousuke Shimada, Hiroshima University

Title The meaning of acquiring scientific knowledge in Japan: From a historical perspective
Objectives: This study aims to examine the meaning of acquiring scientific knowledge in science education (*rika*) in Japan. Based on the aims, the research questions are settled on as follows: a) How the acquisition of scientific knowledge had been perceived in wartime Japan?; and b) Whose ideas and views were affected in science education at that time?
Background Historically, the ideals and ideologies of science have defined the character of science education. Science curriculum tends to include new contents in response to new social demands and scientific research results. Currently, science school curriculum emphasizes "Competence–Based curriculum", which is also the case in Japan. On the other hand, some educators have tried to restore the position of "science content" such as "powerful knowledge" (e.g., Young, 2013). Given this situation, science curriculum needs to consider the relationship between competence and content. In Japan, there was a similar debate in the 1930s–1940s. it was the debate between "*Kagakuteki seishin* (the scientific spirit)" and "*Chishiki hencho-ron* (overlearning argument)". The former aimed to develop the scientific skills and interest in science, while the latter argued that scientific knowledge in the school curriculum was useless. According to this position, there was no need to remember scientific knowledge. However, educators and intellectuals have argued for the educational value of acquiring scientific knowledge.
Method: This study utilized critical discourse analysis. This study analyzes the textbooks, the articles and essays published in educational periodicals in the 1930s–1940s, focusing on the ideas of Kunihiko Hashida (1882–1945), a former professor of Tokyo Imperial University and the 56th Minister of Education. His ideas and views influenced in science curriculum at that time.

Expected Outcome:

Hashida thought that science must be carried out as an activity in life. Therefore, people could learn more about nature and recognize themselves by doing science (Hashida, 1939). Accordingly, Hashida tried to resolve the relationship between intellectual and moral education by paying attention to human independence in all scientific processes, entailing scientific knowledge creation, acquisition, and use (Shimizu, 1982). Hashida's ideas were based on Eastern and Japanese traditional thought, the unity of a subject and object (Hashida, 1939). In short, acquiring scientific knowledge was inseparable from forming an identity, which Hashida considered moral education.

Although Hashida considered science education from a perspective of its educational value, he needed to also consider the science content itself. Consequently, Hashida's ideas were not authentically understood, and the ideas were interpreted as developing the attitude of teachers and students toward imperialism. However, one important thing to know is that Hashida's idea does not show any attitude of worshipping the Japanese Emperor (Okamoto, 2021).

The expected outcome of this study may be useful in two ways. Firstly, the current science curriculum needs to consider competence and what science contents should be selected in contemporary contexts. Secondly, for effective and meaningful learning of science, it is important for curriculum designers to acknowledge unique cultural or historical views of nature in their own country. In Eastern countries where Western modern 'science' has been introduced, and science curriculum were implemented into the school curriculum, they may need to recognize their view of nature such as Japanese one, which is the unity of the subject and the object.

References:

Note

Some findings of this study have already been presented at the Focal Meeting of World Education Research Association in Singapore in 2023.

Reference

Hashida, K. (1939). *Gyō toshite no kagaku* (*Science as practice*) [in Japanese]. Iwanami Shoten.

Okamoto, T. (2021). *Kindai nihon no kagaku: Meijiishin kara haisen made* (*Modern Japanese science studies: From the Meiji Restoration to Defeat*) [in Japanese]. The University of Nagoya Press.

Shimizu, Y. (1982). Science and the Idea of Education in Kunihiko Hashida: A Perspective on the Study of Educational Thought during the War [in Japanese], *Japan Society for the Historical Studies of Education*, *25*, 32–52.

Young, M. (2013). Overcoming the crisis in curriculum theory: A knowledge-based approach. *Journal of Curriculum Studies*, *45*, 101–118.

China: Ms Yi-Xuan Liu, Beijing Normal University

Title:

A Framework for Learning Progression of Metamodeling and Modeling Practice: A Systematic Review

Objectives:

This study first explores the components of metamodeling and the internal mechanism of modeling practice, based on research in philosophy of science. Second, we will construct a hypothetical framework for learning progression of metamodeling and modeling practice, by conducting a systematic review on studies about epistemological foundation, practical processes, assessment tools, and the instructional strategies that can promote students' understanding of metamodeling and develop their capability of modeling.

Background:

Models and modeling are the core elements of scientific thinking and key tools for scientific research. In the new round of curriculum reform, metamodeling and modeling practice are important elements of core literacy in all disciplines. Inheriting the understanding of model and modeling in the philosophy of science, a series of research on model cognition and practice in science education have emerged since the 1980s.

The systematic discussion of the nature of the scientific model had its genesis in the process of establishing a normalized structure for scientific theories by philosophers during the period of logical positivism (Gilbert & Justi, 2016). According to logical positivism, a theory is a syntactic structure, and a model is a specific example to interpret this theory (Knuuttila, 2005; Adúriz - Bravo, 2013). A syntactic view of the model is derived. However, the difficulty of axiomatizing scientific theories in practice, among other things, calls for a new perspective to coordinate models and theories and to revisit the nature of scientific models (Frigg & Hartmann, 2009). In the 1960s, the semantic view of the model became dominant. Semantic philosophers thought that models made up scientific theory, which are intended examples of theory (Adúriz -Bravo, 2013). It is generally agreed that the model is the representation of reality.

In the two perspectives above, models both play a subsidiary role to theories, although in different ways (Frigg & Hartmann, 2009). These views of the model have been challenged in many ways. Some researchers thought that the model is independent of theory (Frigg & Hartmann, 2009), while others thought the model is a means to explore theory or a complement of theory (Morgan & Morrison 1999; Harré, 2004). The mediator view of the model is one of these challenging views (Morgan & Morrison 1999). In this view, Models are "autonomous agents", and the independence allows models to mediate between the theories and target systems (Frigg & Hartmann, 2009). Based on the mediator view of the model, and granting models an individual status as epistemic artefacts, the artefactual view of the model was proposed (Knuuttila, 2005). This view emphasized the materiality of the model, and it extended the epistemic practices involved in the model - no longer just representation.

Method:

We plan to use systematic review to explore the internal mechanism of metamodeling and modeling practice in the artefactual view of models. The systematic review involved three steps of "identification-screening-included" (Petticrew & Roberts, 2006).

Databases and literature search terms

We plan to use Web of Science, ERIC, Springer Link, and Wily Online library as databases. The search term will be a combination of "metamodeling", "scientific model", and "modeling" in the title, abstract, or keyword.

Inclusion process and quality check

We are going to use "Rayyan" for eligibility screening, a web-based tool that helps research teams screen and select studies for systematic reviews (Lee et al., 2022). All authors will read the titles, abstracts, and keywords of retrieved articles to check if these meet the inclusion criteria. Then we are going to discuss the discrepancies and review the eligibility criteria. Next, we will read the full-text of qualified articles to confirm the final articles for review.

Content analysis

We will code the articles from the aspects of study design, the aim of the study, instructional strategies, assessment tools, key conclusion, etc. All authors will code independently, when the results are inconsistent, we will agree through discussion.

Expected Outcome:

1. Based on a systematic review, we will construct the hypothetical framework for learning progression of metamodeling and modeling practice.
2. According to the results of the systematic review, we will develop an item bank of metamodeling and modeling practice for K–12 students.
3. Analysis of existing instructional strategies of modeling based on the hypothesis framework

Refference:

Adúriz -Bravo, A. (2013). A 'Semantic' View of Scientific Models for Science Education. *Science & Education, 22*(7), 1593–1611. https://doi.org/10.1007/s11191-011-9431-7

Frigg, R., & Hartmann, S. (2009). Models in science. In E. N. Zalta (Ed.), Stanford encyclopedia of philosophy. Stanford, CA: Stanford University.

Gilbert, J. K., & Justi, R. (2016). *Modelling-based Teaching in Science Education* (Vol. 9, pp. 17-40).

Springer International Publishing. https://doi.org/10.1007/978-3-319-29039-3 Knuuttila, T. (2005). Models as epistemic artefacts: Toward a non-representation list account of scientific representation. Helsinki, Finland: University of Helsinki.

Lee, S. J., Francom, G. M., & Nuatomue, J. (2022). Computer science education and K-12 students' computational thinking: A systematic review. *International Journal of Educational Research*, *114*, 102008. https://doi.org/10.1016/j.ijer.2022.102008

Morrison, M., & Morgan, M. S. (1999). Models as mediating instruments. In M. S. Morgan & M. Morrison (Eds.), Models as mediators: Perspectives on natural and social science (pp. 10–37). Cambridge, MA: Cambridge University Press.

Petticrew, M., & Roberts, H. (2006). *Systematic Reviews in the Social Sciences: A Practical Guide* (Vol. 1, pp.). Wiley. https://doi.org/10.1002/9780470754887

Indonesia: Ms Ardiani Mustikasari, Universitas Negeri Semarang

Title:

Improving the Quality of Integrated Science Learning Through Ethno-STEAM Approach Base on Digital Platform

Objectives:

1. Analyze the understanding and implementation of quality assurance of integrated science learning through the STEM approach so far in schools
2. Describe a model for improving the quality of integrated science learning through STEAM Approach Base on Digital Platform
3. Analyzing the validity of the model for improving the quality of integrated science learning through STEAM Approach Base on Digital Platform
4. Analyze the effectiveness of the model for improving the quality of integrated science learning through STEAM Approach Base on Digital Platform
5. Analyze the implementation of the model for improving the quality of integrated science learning through STEAM Approach Base on Digital Platform

Background:

School quality assurance is used as an important activity to improve human resources who have character and literacy competence. Quality assurance can be realized by implementing a quality management system. The current condition of education quality management models, especially primary and secondary education, is still very limited.

The Indonesian government has facilitated quality criteria and general learning guidelines. Schools need to adapt to the school context and students' learning needs, so that the learning process becomes meaningful.

The results of the 2022 Center for Educational Standards and Policy (PSKP) survey show that 82% of teachers have prepared a flow of learning objectives or syllabi and 91% of teachers have prepared teaching modules or learning implementation plans. Teachers who developed teaching modules independently referring to the school context and students' learning needs were 43%, teachers who adapted teaching modules from the Ministry of Education and Culture were 46%, teachers who used them directly were 11%.

The absence of guidance and lack of understanding of the steps is the reason why teachers have not developed their own teaching tools. Improving the quality of learning needs to be done by providing alternative steps and inspiration for working papers outlined on digital platforms.

This research is about integrated science learning with Ethno-STEM approach base on digital platform. The research products are in the form of academic texts and applications that make it easier for teachers to plan, implement and reflect on Integrated Science learning through Ethno-STEAM approach which has an impact on improving students' character and literacy. This research refers to the integrated science learning process in junior high schools which is able to improve student learning outcomes (Wiyanto, Hartono, & Nugroho, 2018) and increase student responses through integrated ethno-STEM learning (Sudarmin, et all, 2023). In addition, Integrated Science teachers need to be facilitated to improvise teaching materials with an ethno-STEM approach (Zakiyah, N. A., & Sudarmin, S. , 2022).

Method:

Research and Development

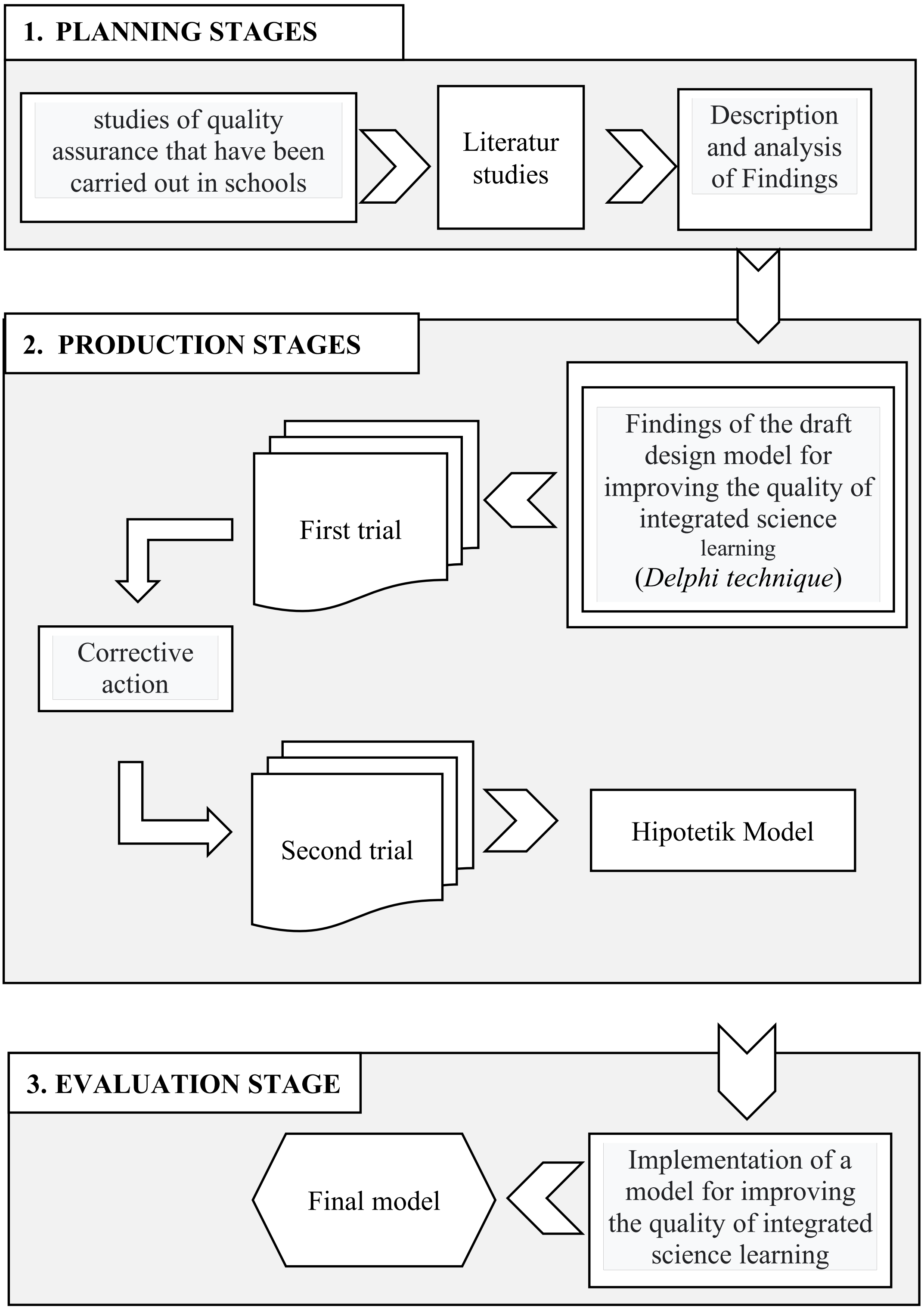


Figure 4. Research and Development Step

Expected Outcome:

The research products are in the form of academic texts and applications that make it easier for teachers to plan, implement and reflect on Integrated Science learning through Ethno-STEAM approach which has an impact on improving students' character and literacy.

References:

Fogarty, R. (2009). How to Integrated the Curricula, (October).

Raipovna, V. S. (2021). Foreign Experience in Digital Educational Technologies. *European journal of innovation in nonformal education*, *1*(2), 152-154.

Sudarmin1 et al., (2023). Analysis of Student Responses to Downstream of the Inquiry Learning Model Integrated Ethno-STEM for Aroma Compounds from Indonesian Herbal Tea to Give a Conservation Character Asian Journal of Vocational Education and Humanities Vol. 4 No. 2. p. 50-57

Wiyanto, Hartono, & Nugroho, S. E. (2018). Preparing prospective physics teachers to teach integrated science in junior high school Preparing prospective physics teachers to teach integrated science in junior high school. *IOP Conf Series: Journal of Physics*. https://doi.org/10.1088/1742-6596/983/1/012053

Zakiyah, N. A., & Sudarmin, S. (2022). Development of e-module STEM integrated ethnoscience to increase 21st century skills. *International Journal of Active Learning*, *7*(1), 49-58.

Taiwan: Mr Jhuo-Syun Sie, National Changhua University of Education

Title:

High School Biology Teacher to Promote Students' Conceptual Understanding through the Scientific Explanation

Objectives:

(1) What are the characteristics of biological words that students cannot understand before the case teacher teaches?

(2) Explore the types of explanations and explanation processes that case teachers often use in teaching.

(3) What types of scientific explanations help students understand concepts?

Background:

Science language involve in scientific terminology and conceptual relations communicate with scientist community.

It also means learning to use this specialized conceptual language in reading and writing, in reasoning and problem solving, and in guiding practical action in the laboratory and in daily life.

The lack of scientific terminology prior knowledge of learners, like a strange foreign language. Even some learners often inferred from the literal meaning of proper nouns, but misleading. On the other hands, textbooks scientific explanation is not based on prior knowledge and experience of learners, resulting in learners reading textbooks you may misinterpret the connotation of the book.

To help prior knowledge understand the concept of textbooks, science teachers on explanations key role on student learning.

Method:

The purposes of this study were to explore students' understanding of scientific terminology (including single words and compound words) in grade 10 biology textbooks before and after a teacher's instruction, and to analyze the process and types of scientific explanation applied by the teacher.

A biology teacher with 20-year teaching experience and his students (N=38) participated in this study. Eight lessons of teaching contents in the units of human circulation, immunity, and reproduction were investigated. Data was collected through the copies of the three-unit textbooks, a concept test, class observation, and semi-structured interviews before and after the instruction.

Expected Outcome:

Five types of scientific explanations were often used by the teacher in study including descriptive, functional, practical, interpretive, and causal explanations. Descriptive and functional explanations were found to be the most beneficial to high, medium, and low achievers' understanding of concepts. Practical explanation was of little benefit to low achievers' understanding of concepts. Based on the findings of the study, some suggestions regarding teaching and compiling materials were proposed.

References:

Dagher, Z. R., & Cossman, G. (1992). Verbal explanations given by science teachers: Their nature and implications. *Journal of Research in Science Teaching, 29*(4), 361-374.

Norris, S. P., Guilbert, S. M., & Smith, M. L. (2005). A theoretical framework for narrative explanation in science. *Science Education, 89*, 535-563.

Sheau-Li Chang & Chen-Yung Lin. (2001). Children's Perception of Scientific Terminology. *Chinese Journal of Science Education*, 9(3), 219-234

Thailand: Ms Sunisa Thapseang, Kasetsart University

Title:
Development of Problem-based Learning Model in Chemistry to Enhance the System Thinking Ability for Secondary School Students
Objectives: 1. To formulate an instructional framework, problem-based learning was employed to augment the systemic thinking skills of secondary school students 2. To investigate the effectiveness of an instructional model in improving systemic thinking skills among secondary school students
Background: The global landscape is replete with intricate systems, spanning from natural ecosystems, climatic patterns, and elemental cycles like water, carbon, and nitrogen, to the complexities inherent in daily human activities. Consequently, possessing cognitive abilities that enable the comprehension, analysis, and resolution of diverse challenges becomes a crucial asset for navigating both social and global systems effectively [1-3]. Systems thinking is a holistic approach to examining complex problems and systems, focusing on the interactions among system components and the patterns that emerge from those interactions [4]. Furthermore, systems thinking can help students develop higher-order thinking skills to understand and address complex, interdisciplinary, real-world problems, as well as the skills necessary to tackle important 21st-century challenges. In education, the implementation of systems thinking approaches is increasingly widespread in disciplines such as biology, engineering, and geosciences, with a growing emphasis on reorienting chemistry education [5-7]. Systems thinking in education is a student-centerer approach to teaching that allows students to appreciate the importance of constituent subsystems and how they connect to form the entire system. The integration of systems thinking into chemistry education would mean that reactions and processes would no longer be studied in isolation; instead, learners would be encouraged to think critically about factors such as the origins of any starting materials, and how they undergo transformed [8]. The systems thinking approach seeks to extend student learning beyond chemical concepts and theories to develop an understanding of interconnections among physical, biological, and environmental systems. Understanding the interdisciplinary and connective nature of these systems is crucial to solving several global problems. This study aims to develop the instructional model to enhance the system thinking ability of secondary school students and challenges in chemistry

education that help improve their conceptual understanding of chemistry and sustainable development.

Method:

The experimental research utilized an embedded research design, incorporating a one-group pretest-posttest methodology. The participants of this experimental research were 40 tenth grade students by purposive sampling. The research instruments consisted of 1) The problem-based learning model 2) Lesson plans 3) The behavior of system thinking process measurement forms 4) The system thinking ability measurement. The statistics used for data analysis were means, standard deviation, trend of efficiency, and t-test. The research methodology was divided into two phases: 1. the development of a system thinking ability measurement based on the analysis of related documents and under the approval of experts 2. to investigation of the effectiveness of the model via pretest-posttest design using the problem-based learning model (including four-step 1) Defining the complex problem 2) Construct hypothesis or model 3) Create system and 4) Implement Change/ Communicate Understanding). Additionally, interviews will be conducted to obtain insights and data seeking more into the students' experiences during the tests. The data collected will be shown by the system thinking ability measurement for quantitative assessment, the interviews and the behavior of system thinking measurement forms will provide qualitative insights.

Expected Outcome:

1. Students are able to understand and interpret complex systems and problem-solving in the analysis of complex systems or phenomena.
2. Students are able to integrate relevant chemical knowledge, practices, and ways of reasoning in the construction or application of mechanistic models to make sense of targeted problem systems or phenomena.

References:

[1] Ho, F. M. (2019). Turning Challenges into Opportunities for Promoting Systems Thinking through Chemistry Education. *Journal of Chemical Education, 96*(12), 2764-2776. doi:10.1021/acs.jchemed.9b00309

[2] Hmelo, C. E.,Holton, D. L., and Kolodner, J. L. (2000). Designing to Learn About Complex Systems. *Journal of the Learning Sciences, 9*(3), 247-298. doi:10.1207/s15327809jls0903_2

[3] Mahaffy, P. G.,Matlin, S. A.,Holme, T. A., and MacKellar, J. (2019). Systems thinking for education about the molecular basis of sustainability. *Nature Sustainability, 2*(5), 362-370. doi:10.1038/s41893-019-0285-3

[4] Jackson, A., and Hurst, G. A. (2021). Faculty perspectives regarding the integration of systems thinking into chemistry education. *Chemistry Education Research and Practice, 22*(4), 855-865. doi:10.1039/d1rp00078k

[5] York, S.,Lavi, R.,Dori, Y. J., and Orgill, M. (2019). Applications of Systems Thinking in STEM Education. *Journal of Chemical Education, 96*(12), 2742-2751. doi:10.1021/acs.jchemed.9b00261

[6] Helen Quinn, H. S., and Thomas Keller,. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*.

[7] Assaraf, O. B.-Z., and Orion, N. (2005). Development of system thinking skills in the context of earth system education. *Journal of Research in Science Teaching, 42*(5), 518-560. doi:10.1002/tea.20061

[8] Nagarajan, S., and Overton, T. (2019). Promoting Systems Thinking Using Project- and Problem-Based Learning. *Journal of Chemical Education, 96*(12), 2901-2909. doi:10.1021/acs.jchemed.9b00358

Thailand: Mr Parinya Mutcha, Kasetsart university

Title:

Enhancing cross-cutting concepts in chemistry for high school students in through construct map-driven formative assessment

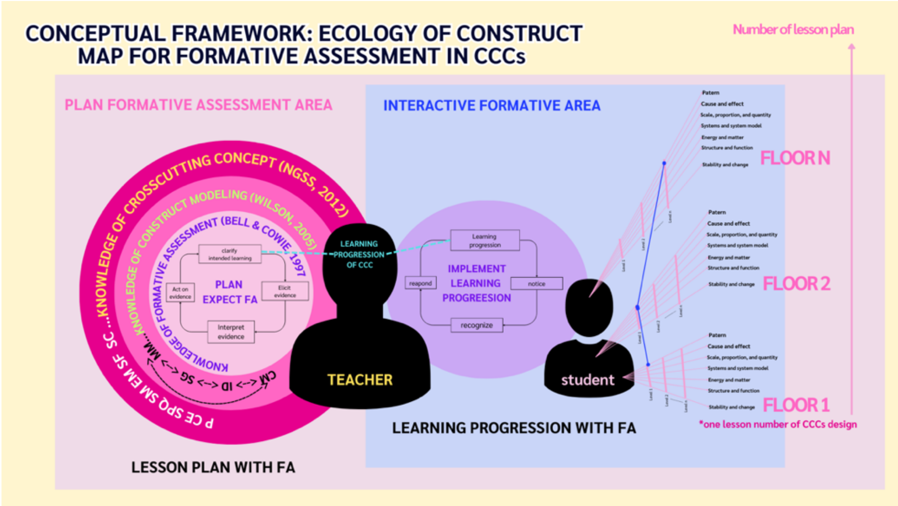
Objectives:

To study assessment approaches for learning of cross-cutting concepts driven by construct maps.

Background:

Science is an attempt to understand a phenomenon or event that occurs in the universe, in which scientists try to create a pattern of phenomena (Faikhamta, 2012). The nature of science refers to the study of scientific knowledge. How scientists acquire scientists' knowledge, work, or society and the value of science (American Association for the Advancement of Science (AAAS), 1989), however, is often defined as the epistemology of science. Science is a way of knowing. Or values and beliefs that exist in scientific knowledge and development (Lederman, 2007). Crosscutting concepts (CCCs) refer to repeated knowledge or ideas in scientific lessons, such as patterns, cause and effect, scale, proportion and quantity, energy and matter, structures and functions, stability and change, and system and system models. This framework emphasises that these concepts need to be made clear to students. However, there are not many studies on CCCs (Rivet et al., 2016). There is not much study on CCCs, although CCCs are what make students better understand and explain the phenomenon. We should promote CCCs to students in science classrooms

In a learning plan, teachers design the learning objective and conduct student assessments to provide information to improve student skills, but formative assessment (FA) can complete that process. All learning activities carried out by teachers or students, which provide information that will be used as suggestions to modify teaching and learning activities when actual evidence is used to tailor teaching to the needs of students, Learning progression (LP) should be a tool for teachers to promote students' skills in science classrooms. Teachers should incorporate LP into formative assessment to inform teachers' instructional adjustments and student competency. There is much research on LP development with 4-Building Blocks (4BB) (Wilson, 2005), but it is not yet possible to link 4BB to a lesson plan. That's why studies about enhancing cross-cutting concepts in chemistry for students in 11th grade through construct-map-driven formative assessment.



Method:

1. Documentary research: the study of cross-cutting concepts in the physical science (chemistry) curriculum of Thailand.

2. 4 Building Block: Development of construct maps of the ability to use cross-cutting concepts in chemistry

3. Action research: development and study of lessons through construct- and map-driven formative assessment

Expected Outcome:

1. Construct maps to use in science classrooms.

2. Academic Article: FA in the Science Classroom

3. Academic Article: CCCs in the Science Classroom

4. Research Article: CCCs in Thailand's Science Teaching Handbook (Document Analysis)

5. Research Article: Learning Progression of CCCs

6. Research Article: Development and study of lessons through construct-driven, map-driven formative assessment

References:

American Association for the Advancement of Science [AAAS]. (1989). Project 2061: Science for All Americans. New York: Oxford University.

Faikhamta, C. (2013). Pedagogical Content Knowledge for Teaching Nature of Science. KKU Research Journal, 2(2), 232–259.

Lederman, N. G., & Lederman, J. S. (2016). Do the ends justify the means? Good question. But what happens when the means become the ends? Journal of Science Teacher Education, 27(2), 131–135.

Rivet, A. E., Weiser, G., Lyu, X., Li, Y., & Rojas-Perilla, D. (2016). What are crosscutting concepts in science? Four metaphorical perspectives. In C. K. Looi, J. L. Polman, U. Cress, & P. Reimann (Eds.), Transforming learning, empowering learners: The International Conference of the Learning Sciences (ICLS) (pp. 970–973). International Society of the Learning Sciences.

Wilson, M. (2005). Constructing measures : An item response modeling approach (Har/Cdr edition). Routledge.

E·A·S·E
East-Asian Association for Science Education

Research Proposal EASE Winter School 2024

Group 2

Indonesia: Mr Jaka Afriana, Universitas Pakuan

Title:

Increasing Science Teacher Skills in Laboratory Management Through The Training Model Based On Standard Of Indonesian National Competency Work (SKKNI)

Subtitle:

The Profile of Science Teachers Competency In Managing Laboratory Activities At Secondary School

Objectives:

Design a model of science teacher training in laboratory management based on SKKNI

Background:

Science learning in junior high schools cannot be separated from laboratory activities. Laboratory activities are needed to concretize and clarify scientific concepts and strengthen theories. Laboratory sessions, which constitute an important component of science education, enable students to reinforce theory directly through experience and for conceptual depth to be developed (Candaş, B., & Altun, T., 2023). Whether or not there is a science laboratory at school, a science teacher should already have competence as a science laboratory administrator or manager. According to OECD (2016), competence as the application and use of skills and knowledge in real life situations rather than as having expertise or technical knowledge in a field. Countries with successful school systems are aware of the direct influence of teacher competencies on student achievement (Sever, D., & Bostancı, K., 2020).

Management of a science laboratory requires good management so that the laboratory function can run according to its objectives. Management is the process of planning, executing, directing, monitoring and evaluating (Setyaningsih, S., 2023). If it is related to science laboratory management, it means that science teachers are equipped with laboratory competencies as well as science laboratory management. Because science teachers are scientifically linear and close to laboratory activities. So far, training for laboratory heads is rarely carried out, if at all it is carried out at independent costs borne by the teacher. To address the problems faced by science teachers in Indonesia, a laboratory competency model is needed for junior high school science teachers according to national work standards. The Indonesian National Competency Work Standards (SKKNI) will be a reference in developing laboratory competencies for middle school science teachers.

By this research, the preliminary research has to conduct to portrait the real science teacher competencies in managing the laboratory activities with the SKKNI framework.

Method:

This research is development research (Research and Development/R&D) which develops a model to improve the laboratory competence of junior high school science teachers using the 4-D development model (Define, Design, Develop, Disseminate) by Thiagarajan (1974). In the preliminary study, the need analysis will be conducted through to profile the science teacher skills on managing the laboratory activity, through the survey research. By the research the portrait of teacher skills will be compared to the competency units in SKKNI those are related to the skills needed for managing science lab activities. By the preliminary research, the models of science teacher training will be recommended. The participants involved are about 200 science teachers those have at least 10 year experience in lab activity.

Expected Outcome:

It is hoped that this research will produce:

1. A model of Science teacher laboratory competency training based on SKKNI
2. Science teachers gain laboratory competency as managers or management of science laboratories
3. Recommendations for training models for science teachers as science laboratory administrators

References:

Candaş, B., & Altun, T. (2023). Investigating Flipped Laboratory Practices of Science Students Teachers. *Journal of Turkish Science Education*, *20*(1). 173-188

OECD [Organization for Economic Co-operation and Development]. (2016). The survey of adult skills: Reader's companion. Retrieved on 18 January, 2019 from https://www.oecd.org/skills/piaac/The_Survey%20_of_Adult_Skills_Reader's_companion_Second_Edition.pdf

Setyaningsih, R. (2023). Strategi Pengambilan Keputusan dalam Bidang Manajemen. Bandung: CV Alfabeta

Sever, D., & Bostancı, K. (2020). The Competencies Of Science Teacher: A Delphi Study. European Journal of Education Studies, 7(6). doi:http://dx.doi.org/10.46827/ejes.v7i6.3113

Thiagarajan, S., Semmel, D. S & Semmel, M. I. (1974). Instructional Development for Training Teachers of Expectional Children. Minneapolis. Minnesota: Leadership Training Institute/Special Education, University of Minnesota

Japan: Ms Gerelkhuu Shinetsetseg, Okayama University

Title:

Interview Survey on Children and Teachers in Mongolian Primary Schools: A Comparative Study of capital and rural areas

Objectives:

To develop more effective CCE programs and educational methods aimed to promote climate change awareness and participation among Mongolia's young learners. The objectives that follows will be implemented to that aim:

- To conduct a focus group interview with students and instructors from Mongolia's local and capital areas Primary Schools.
- To describe primary school students' and instructors' awareness of climate change.
- Based on the findings of the pilot focus groups, the curriculum design and teacher training will be developed further.

Background:

Climate Change Vulnerability in Mongolia: Emphasizing Mongolia's susceptibility to climate change and desertification. Climate change poses a formidable challenge globally, with countries such as Mongolia—largely characterized by deserts and semi-deserts—confronting substantial threats from desertification.

Desertification Watch Success: Showcasing the effective implementation and impact of the educational module. One of the notable programs is the "Desertification Watch" module (Yembuu, 2021). Available in both Mongolian and English, this module (see **Table 1**) presents a strategic educational framework aimed at mitigating desertification.

Table 1. Structure of Desertification Watch Module

No	Topic	Exemplary Activity
1	Desertification in Mongolia	Discussion about causes of desertification
2	Weather and Climate	Measurement of air temperature and humidity
3	Rocks and Minerals	Determining hardness of rocks and minerals
4	Water Supply	Measurement of water nitrate and temperature

5	Soil Cover	Determining soil texture and soil analysis
6	Plants and Animals	Measuring vegetation characteristics per area
7	Pasture degradation	Determining carrying capacity of pasture
8	Traditional Knowledge	Preparing fertilizer made of birds' dung

The desertification watch program's pilot implementation occurred in secondary schools in Uulbayan and Tumentsogt soum, both situated in Sukhbaatar aimag in eastern Mongolia.

The "Desertification Watch" program draws inspiration from the internationally acknowledged "Sandwatch" project (Cambers, 2008), an initiative originally established to study alterations in coastal environments. Both projects employ the MAST approach:

(1) Measure: by collecting data about their local environment;

(2) Analyze: data to identify issues and patterns;

(3) Share: findings to raise awareness;

(4) Take Action: by engaging in problem-solving and conservation efforts.

This approach not only educates participants about environmental issues but also empowers them with the skills and knowledge necessary to effect change (Yembuu, 2016)

Empirical research survey of pupils: Used quota sampling to select sixth-grade students from 48 primary schools in China, Japan, Mongolia, and South Korea. The final analysis included 3,984 students after excluding responses with incomplete information. Each child completed the Climate Change Awareness Scale (CAS), developed based on UNESCO’s Education for SDGs Learning Objective Framework (UNESCO, 2023).

The correlation highlighted differences and similarities among Mongolian students' perceptions on climate change. This approach also aided in determining the total effectiveness of climate change education in these various regions. This research project assesses how climate change education in East Asia aligns with its learning objectives across the three domains. The survey of Mongolian students is presented in three crucial categories, as shown below.

① Cognitive domain Pupils in Mongolia exhibit a varied yet deep understand of climate change awareness. They typically recognize the crucial role of carbon dioxide and methane in the greenhouse effect, as well as the main contributors to climate change, such as deforestation and consumption of fossil fuels. They are also aware of the consequences of climate change, such as increasing extreme temperatures, and agree on the importance of reducing CO2 emissions to combat climate change. ② Socioemotional domain In the socioemotional domain of climate change education, primary school children from the four countries exhibit diverse emotional responses to climate change. Mongolian children exhibit a unique pattern, showing heightened concern for plants, highlighting the different ways children perceive and emotionally respond to ecological changes. ③ Behavioral domain This variance in behavioral response highlights the importance of culturally modified learning methods that both inform and motivate children to act. Notably, children from Mongolia showed a readiness to volunteer with peers in efforts to support those impacted (UNESCO, 2023).
Method: **Study Design Focus group interview** To have a better understanding of the context in which the potential solution is going to be used, a focus group interview with students and panel of science teacher for sixth grade will conducting. This interview will provide insights on how teachers approach the climate change on their current practice, and what are the advantages and the shortcomings of the current learning resources. The discussion during the focus group interview will provide insights for novel ways of setting up in part ideas, leading to the development (Mina, 2021). **Why choose interview:** The purpose of qualitative interviewing is to gain a deeper understanding of your interviewees' perspectives. Researchers use interviews to structure conversations with participants to gather their insights, probe their understandings, and, sometimes in critical ethnographies, help them become more aware and reflective about issues that impact their lives. *Type of interviewing* One-on-one and focus group interviews will be discussed briefly. ① The one-on-one interview

The purpose of one-on-one interviews is to gain to understand the culture, worldview, and beliefs of participants and key informants related to the research issue. A related objective is to verify the accuracy of data collected from observations, artefacts, and previous interviews.

② Focus groups

The focus group method is a form of group interview in which there are several participants (in addition to the moderator); there is an emphasis in the questioning on a particular fairly tightly defined topic; and the accent is upon interaction within the group and the joint construction of meaning. The moderator generally tries to allow a relatively free rein to the discussion. However, there may be contexts in which it is necessary to ask fairly specific questions, especially when cross-group comparability is an issue.

Research participants:

Educators and students from various school in Mongolia will be used as participants in this study. Participants in this study will include a variety of educators from rural and capital area of Mongolian schools who teach different subjects and grades.

Methodology for organizing the interview:

The researcher will conduct the interview, create a transcript of the interview, read it carefully, code the significant ideas, and conduct with processing.

Data collection and procedure

- The research study will include students and teachers from schools in capital areas and local schools.
- The focus group interviews are going to be performed with students selected at random from the quantitative data of the short sample survey.

Expected Outcome:

Analysis of the focus group respond to matrix for each question, identification of notable themes, and construction of the final model of how teachers could enhance climate change education and awareness.

References:

Bryman, A.E. (2016). Chapter 21: Focus groups, Social Research Methods (pp. 500-521). New York: Oxford University press, 5th Edition.

Cambers, G., Chapman, G., Diamond, P., Down, L., Griffith, A. D., Wiltshire, W. (2008). Teacher's guide for education for sustainable development in Caribbean. UNESCO.

Ennis, C. D., & Chen, S. (2012). Chapter 16: Interviews and focus groups. In K. Armour & D. Macdonald (Eds.), Research methods in physical education and youth sport (pp. 217-236). New York: Routledge.

Education for Sustainable Development Goals

Education for Sustainable Development: A roadmap

Mina, M.K. (2021), The carbon cycle and systems thinking, Linköping university Press (21-34). FULLTEXT01.pdf (diva-portal.org)

UNESCO. (2023). Climate Change Awareness among Primary School Children in East Asia.

Yembuu, B., Khadbaatar, S., Getsel, U. (2016). Desertification Watch: Learning to Combat Desertification. UNESCO.

Yembuu, B., Getsel, U. (2019). Issues in teaching and learning of education for sustainability, Curriculum development on climate change adaptation Pre-service teacher training in Mongolia

China: Ms Shan Lin, Beijing Normal University

Title:

Development of a program for improving high school biology teachers' pedagogical content knowledge (PCK) of argumentation

Objectives:

1. To expend the conception for PCK of argumentation.
2. To develop an instrument for assessing high school biology teachers' PCK of argumentation.
3. To develop a program for improving high school biology teachers' PCK of argumentation.
4. To test the effect of the developed program on teachers' PCK of argumentation.

Background：

The goal of science is to produce new knowledge of the natural world through argument and critique (Osborne, 2010). Science education reform documents worldwide consider argumentation an important learning goal for students. The focus on argumentation necessitates not only a change in student learning goals but also the adoption of new roles by teachers (McNeill & Knight, 2013). Research shows that professional development programs focusing on argumentation teaching can improve teachers' argumentation teaching ability (McNeill & Knight, 2013). Against this backdrop, this study focuses on the development of a program to improve the PCK of argumentation for high school biology teachers.

Argumentation in science education

In recent years, argumentation has received attention from science education around the world. Science education reform documents consider argumentation an important learning goal for students. *K-12 Framework for Science Education* clearly emphasizes the cultivation of students' argumentation skills in science classrooms (NRC, 2012). NGSS regards argumentation as an important scientific practice (NGSS Lead States, 2013). The British curriculum emphasizes that students should be taught to make decisions based on the evaluation of evidence and arguments (Department for Education, 2014) Chinese curriculum standards also regard argumentation as a key strategy to foster scientific thinking (Ministry of Education of China, 2020). Integrating argumentation into classroom practice can support students in a variety of outcomes. Argumentation can enhance students' understanding of science content (Zohar & Nemet, 2002), increase students' epistemological understanding of science (Osborne, 2005), support students in acquiring informed perspectives on the nature of science (Khishfe, 2014), and help them develop critical thinking and scientific literacy skills (Sengul, Enderle & Schwartz, 2020).

Pedagogical Content Knowledge of argumentation

Many studies focus on two elements of PCK: knowledge of students' conceptions and knowledge of instructional strategies (McNeill & Knight, 2013, 2016; Kind, 2009; Lee & Luft, 2008; Park & Oliver, 2008). Relevant research shows that teachers have difficulty in these two aspects. For example, teachers may focus on argument language without a deeper understanding of the practice (McNeill, 2016), have difficulty in applying the reasoning and designing argumentation questions in classroom practice (McNeill & Knight, 2013), do not develop enough to support dialogic classroom interactions (Alozie, Moje, & Krajcik, 2010). However, recent research also suggests that teachers struggle with the assessment of argumentation, they lack the knowledge to measure argumentation skill or its quality (Kutluca, 2021), and have difficulty to assess argumentation because of the lack of a formal and reliable rubric (Wang & Buck, 2016). Consequently, this study focuses on three elements of PCK: (1) knowledge of students' conceptions, (2) knowledge of instructional strategies, and (3) knowledge of assessment.

Program for science teachers' PCK of argumentation

Previous research has found that professional development programs can support teachers' PCK of argumentation, teachers were able to reflect on their teaching of argumentation (Simon & Johnson, 2008), increased in constructing arguments (Crippen, 2012), and improved classroom discourse (Zembal-Saul, 2009). However, teachers still had challenges with argumentation after the professional development program in identifying reasoning in classroom discussions (McNeill & Knight, 2013), designing argumentation teaching courses, and evaluating students' argumentation ability (Yang, 2019). Professional development program is an important way to support teachers' learning, especially teachers' learning of new teaching requirements (Borko, 2004). Future work should consider the challenges teachers meet, and design a specific program for improving teachers' PCK of argumentation depending on the grade hand (McNeill & Knight, 2013).

Based on the above background, the purpose of this study is to address two questions:

(1) Which content should be included in the professional development program?

(2) What are the instructional strategies for the program being effective in improving high school biology teachers' PCK of argumentation?

Method:

This study will use a mixed-method approach. Teachers' PCK of argumentation will be evaluated with respect to the quantitative data analysis from the pre-and post-assessment. Qualitative data from semi-structured interviews, other written and video materials will be coded and analyzed to describe teachers' PCK of argumentation.

Quantitative Data Collection and Analysis

An instrument to assess teachers' PCK of argumentation will be developed following the procedure: conceptualization of the domain, creating the initial item pool, reviewing and revising the items, cognitive interviewing, pilot testing, and validation (Luo et al., 2019). A confirmatory factor analysis (CFA) will be used to verify the fit and validity of the measurement model. A Rasch model will be used to provide empirical evidence for the unidimensionality, validity, and reliability of the instrument. A paired-sample t-test for each teacher for pre- and post-assessment will be used to evaluate the impact of the professional development program.

Qualitative Data Collection and Analysis

Qualitative data will be collected through interviews, video recordings of the professional development program, participants' artifacts, and their video-recorded classroom practices. A coding scheme will be developed through previous research to capture teachers' PCK of argumentation. An inter-rater reliability will be calculated to ensure the quality of the coding scheme.

Expected Outcome:

1. Formulation of a framework for PCK of argumentation, including three elements:

(1) knowledge of students' conceptions, (2) knowledge of instructional strategies, and (3) knowledge of assessment.

2. Development of a reliable and valid instrument to assess high school biology teachers' PCK of argumentation.

3. Development of an effective program to improve high school biology teachers' PCK of argumentation.

References:

Alozie, N. M., Moje, E. B., & Krajcik, J. S. (2010). An analysis of the supports and constraints for scientific discussion in high school project-based science. *Science Education*, 94(3), 395–427. https://doi.org/10.1002/sce.20365

Borko, H. (2004). Professional Development and Teacher Learning: Mapping the Terrain. *Educational Researcher,* 33(8), 3-15. https://doi.org/10.3102/0013189X033008003

Crippen, K. J. (2012). Argument as professional development: Impacting teacher knowledge and beliefs about science. *Journal of Science Teacher Education*, 23(8), 847 – 866.

Department for Education. (2014). *The National Curriculum in England: key stages 3 and 4 framework document*. https://www.gov.uk/government/publications/national-curriculum-in-england-secondary-curriculum.

Khishfe, R. (2014). Explicit nature of science and argumentation instruction in the context of socioscientific issues: An effect on student learning and transfer. *International Journal of Science Education*, 36(6), 974–1016. https://doi.org/10.1080/09500693.2013.832004

Kind, V. (2009). Pedagogical content knowledge in science education: Perspectives and potential progress. *Studies in Science Education*, 45(2), 169–204.

Kutluca, A. Y. (2021). An investigation of elementary teachers' pedagogical content knowledge for socioscientific argumentation: The effect of a learning and teaching experience. *Science Education*, 105, 743–775. https://doi.org/10.1002/sce.21624

Lee, E., & Luft, J. (2008). Experienced secondary science teachers' representation of pedagogical content knowledge. *International Journal of Science Education*, 30(10), 1343 – 1363.

Luo, T., Wang, J., Liu, X., & Zhou, J. (2019). Development and application of a scale to measure students' STEM continuing motivation. *International Journal of Science Education*, 1–20. doi:10.1080/09500693.2019.1647472

McNeill, K.L. & Knight, A.M. (2013), Teachers' Pedagogical Content Knowledge of Scientific Argumentation: The Impact of Professional Development on K–12 Teachers. *Science Education*, 97: 936-972.

McNeill, K.L., González-Howard, M., Katsh-Singer, R. and Loper, S. (2016), Pedagogical content knowledge of argumentation: Using classroom contexts to assess high-quality PCK rather than pseudo argumentation. *Journal of Research in Science Teaching*, 53: 261-290. https://doi.org/10.1002/tea.21252

Ministry of Education of China. (2020). *High school biology curriculum standard (2017 edition revised in 2020)*. People's Education Press (in Chinese).

National Research Council (NRC) (2012). *A framework for k-12 science education: Practices, crosscutting concepts and core ideas*. Washington, DC: The National Academies Press.

NGSS Lead States. (2013). *Next Generation Science Standards: For States, By States*. The National Academies Press.

Osborne, J. (2005). The role of argument in science education. In K. Boersma, M. Goedhart, & O. De Jong (Eds.), *Research and the quality of science education* (pp. 367–380). Dordrecht: Springer.

Osborne, J. (2010). Arguing to learn in science: The role of collaborative, critical discourse. *Science*, 328, 463 – 466.

Park, S., & Oliver, S. (2008). Revisiting the conceptualisation of pedagogical content knowledge (PCK): PCK as a conceptual tool to understand teachers as professionals. *Research in Science Education*, 38. 261 – 284.

Sampson, V., Grooms, J., & Walker, J. (2009). Argument-driven inquiry: A way to promote learning during laboratory activities. *The Science Teacher*, 76(8), 42–47.

Sengul, O., Enderle, P. J., & Schwartz, R. S. (2020) Science teachers' use of argumentation instructional model: linking PCK of argumentation, epistemological beliefs, and practice, *International Journal of Science Education*, 42:7, 1068-1086, DOI: 10.1080/09500693.2020.1748250

Simon, S., Erduran, S., & Osborne, J. (2006). Learning to teach argumentation: Research and development in the science classroom. *International Journal of Science Education*, 28(2 – 3), 235 – 260.

Simon, S., & Johnson, S. (2008). Professional learning portfolios for argumentation in school science. *International Journal of Science Education*, 30(5), 669 – 688.

Wang, J., & Buck, G.A. (2016). Understanding a High School Physics Teacher's Pedagogical Content Knowledge of Argumentation. *Journal of Science Teacher Education*, 27, 577-604.

Yang, M. *Design and implementation of professional development curriculum on argumentation for middle school biology teachers* [Unpublished doctoral dissertation]. Beijing Normal University.

Zembal-Saul, C. (2009). Learning to teach elementary school science as argument. Science Education, 93, 687 719.

Zohar, A., & Nemet, F. (2002). Fostering students' knowledge and argumentation skills through dilemmas in human genetics. *Journal of Research in Science Teaching*, 39, 35 – 62

China: Mr Kuerbanjiang Jielili, Beijing Normal University

Title:

A Study on Hierarchical Teaching Practice Based on Cognitive Diagnosis Theory

Objectives:

The objectives of this research proposal are:

1. To develop a cognitive diagnostic test based on the DINA model to assess students' understanding of momentum and energy concepts.
2. To analyse the diagnostic results to identify students' specific misconceptions and areas of difficulty related to momentum and energy.
3. To implement a stratified teaching approach based on the cognitive diagnostic information, targeting specific areas of difficulty for different groups of students.
4. To evaluate the effectiveness of the stratified teaching approach in improving students' understanding and mastery of momentum and energy concepts.

Background:

In the context of differentiated instruction, stratified teaching models aim to accommodate the diverse cognitive levels of students and meet their individual learning needs. Stratified teaching is a teaching method that fully focuses on student differences and considers the cognitive levels of students at different levels, to meet the diverse needs of students. It is also an effective approach to achieving educational equity (Tomlinson et al., 2006). However, traditional stratified teaching practices have often relied on using exam scores to group students for differentiated instruction, which may not accurately capture students' cognitive states. Even if students achieve similar scores on a test, their cognitive processes and understanding may vary significantly. This raises questions about the scientific validity of using exam scores alone to inform differentiated instruction.

The field of psychometrics offers a potential solution to this challenge through cognitive diagnostic theory. This theoretical framework allows for the identification of students' existing cognitive states, providing teachers with a more accurate understanding of students' knowledge, skills, and problem-solving processes (de la Torre, 2009). By leveraging cognitive diagnostic models, teachers can tailor instruction to better meet the needs of individual students.

Drawing on the principles of cognitive diagnostic theory, this research proposal aims to optimize stratified teaching models using a cognitive diagnostic approach. Specifically, this study will focus on the application of cognitive diagnostic theory in the context of a high school physics review course on "Comprehensive Applications of Momentum and Energy." By integrating cognitive diagnostic theory into the stratified teaching model, this research seeks to enhance the effectiveness of differentiated instruction.

Method:

This research will be conducted through the following steps:

Step 1: Analysis of Cognitive Attributes and Hierarchical Relationships Based on the literature review, an analysis will be conducted to examine the cognitive attributes and hierarchical relationships of the topic of momentum and energy in various countries' curriculum standards and textbooks.

Step 2: Development of Cognitive Diagnostic Tests. A Q-matrix will be constructed based on the identified cognitive attributes and hierarchical relationships. Utilizing the Delphi method, two parallel cognitive diagnostic tests will be developed—one for pre-testing and cognitive diagnosis, and the other for post-testing.

Step 3: Implementation of Stratified Teaching Model. The target audience for cognitive diagnosis will be determined, and a stratified teaching model will be designed based on the diagnostic results. Subsequently, the designed model will be implemented in the instructional practice.

Step 4: Evaluation of the Impact. To evaluate the impact of the cognitive diagnostic-informed stratified teaching model, a quasi-experimental approach will be employed to assess the implementation and effectiveness of the instructional intervention, following the methodology proposed by Templin and Henson (2006).

Data Collection and Analysis Data will be collected through pre- and post-tests using the developed cognitive diagnostic tests. The performance of students in different cognitive attribute categories will be analyzed to assess the effectiveness of the stratified teaching model. Additionally, qualitative data, such as teacher and student feedback, will be collected and analyzed to provide a comprehensive evaluation of the intervention.

Ethical Considerations Ethical approval will be sought from the relevant institutional review board to ensure the protection of participants' rights and well-being throughout the research process.

Expected Outcome:

The expected outcome of the proposed research is to provide empirical evidence regarding the effectiveness of implementing a cognitive diagnostic-informed stratified teaching model for the topic of momentum and energy in high school physics. The research aims to demonstrate that the application of cognitive diagnostic theory can lead to improved student learning outcomes by identifying specific cognitive attributes and addressing them through tailored instructional interventions.

Specifically, it is anticipated that the analysis of cognitive attributes and hierarchical relationships will provide insights into the underlying cognitive processes involved in understanding momentum and energy concepts. The development of cognitive diagnostic tests based on the identified attributes is expected to yield reliable and valid instruments for assessing student understanding and diagnosing specific areas of difficulty.

The implementation of the stratified teaching model, informed by cognitive diagnostic results, is expected to result in improved student performance, particularly in addressing misconceptions and knowledge gaps related to momentum and energy. The evaluation of the impact of the instructional intervention is expected to demonstrate positive outcomes in terms of student achievement and conceptual understanding.

Furthermore, the research is expected to contribute to the body of knowledge on instructional interventions informed by cognitive diagnostic theory, particularly in the context of high school physics education. The findings of the study are anticipated to provide valuable insights for educators, curriculum developers, and educational policymakers regarding the potential benefits of utilizing cognitive diagnostic-informed instructional approaches to enhance student learning in physics.

References:

de la Torre, J. (2009). The generalized DINA model framework. Psychometrika, 74(4), 675-699.

Templin, J., & Henson, R. A. (2006). Measurement of psychological disorders using cognitive diagnosis models. Psychological Methods, 11(3), 287-305.

Tatsuoka, K. K. (2009). Cognitive assessment models with few assumptions, and connections with nonparametric item response theory. Applied Psychological Measurement, 33(8), 639-649.

Tomlinson, C. A., & McTighe, J. (2006). Integrating differentiated instruction and understanding by design: Connecting content and kids. Alexandria, VA: Association for Supervision & Curriculum Development.

South Korea: Ms Haejung Ahn, Kongju National University

Title:

Design Study on the Development of Pre-service Science Teachers' Teaching Professionalism in the Educational Internship Semester System

Objectives:

Prior to the full implementation of the Educational Internship Semester System, teacher training institutions in Korea are currently conducting a pilot operation of the program with limited participants to develop an Educational Internship Semester System program that reflects the characteristics of teacher training institutions in each region.

This research aims to propose a one-semester program with a focus on inquiry-based improvement of pre-service science teachers' teaching professionalism by analyzing the education internship program experiences of pre-service science teachers as the 4-week program currently in place expands to a full semester.

Background:

While numerous studies on teacher training emphasize the effectiveness of practical education and the enhancement of pre-service teachers' professionalism through internships, the 4-week duration of the current internship program in Korea has been criticized as insufficient for pre-service teachers to gain substantial experience, especially with the upcoming shift to a one-semester internship program starting from the 2026 academic year. Research on the Korean internship program is in its early stages, and concrete program design and effectiveness studies have not been conducted, making it an opportune time to prepare for the upcoming changes.

Method:

1.Participants

The study recruited pre-service teachers who entered teacher training colleges with a strong commitment to teaching. Ultimately, the research focused on two pre-service science teachers from K University in the Chungnam region participating in the pilot operation of the Educational Internship Semester System.

2. Procedure

Participants engaged in the internship program from September 6 to December 29, 2023, experiencing an average of six classes per week over three months. Qualitative analysis was conducted using instructional plans, activity materials, class recordings, expert analyses, and in-depth interviews with pre-service science teachers.

3. Theoretical Framework for Data Analysis

Over five sessions from October to December, pre-service science teachers developed and implemented inquiry-based activities in middle and high school classes using proposed classroom talk techniques. These techniques were collaboratively discussed by K University's education professors and mentor teachers, resulting in a three-stage strategy for selecting and applying various types of classroom talk strategies before and after inquiry activities to aid student understanding.

Expected Outcome:

The application of the first stage will identify the frequency and patterns of the 11 questioning strategies used by pre-service science teachers to induce productive student thinking. The second stage will analyze discourse patterns commonly found in pre-service teachers' classes, and the third stage will observe the application of the Ask-To-Think-Tell-Why approach. Based on these results, the study aims to propose a one-semester program focusing on classroom dialogue for the gradual improvement of pre-service science teachers' teaching professionalism before and after the introduction of the staged strategies.

References:

Chin, Christine. "Teacher questioning in science classrooms: Approaches that stimulate productive thinking." *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching* 44.6 (2007): 815-843.

Gillies, Robyn M., et al. "Primary students’ scientific reasoning and discourse during cooperative inquiry-based science activities." International Journal of Educational Research 63 (2014): 127-140.

Mortimer, Eduardo, and Philip Scott. *Meaning Making In Secondary Science Classroomsaa*. McGraw-Hill Education (UK), 2003.

Taiwan: Ms Pei-Wan Liu, National Changhua University of Education

Title:

Developing The Observation Instrument for Teacher's Mathematical Teaching Knowledge

Objectives:

The practical knowledge of teaching means that teachers possess professional knowledge and skills to support students' mathematical learning about their teaching practice (Ball, Thames & Phelps, 2008). The traditional assessment of the teacher professional evaluation using paper-and-pencil tests, self-report questionnaires and the qualitative analysis of in-class observation to analyze teachers' Content Knowledge and Pedagogical Content Knowledge. However, the problem with self-report questionnaires lacks evidence to examine teachers' teaching practice and the qualitative analysis of classroom observation is exerted on a teacher to analyze their mathematics teaching. Therefore, the purpose of this study is to develop the Observation Instrument for Mathematical Teaching Knowledge.

Background:

Educators constructed many mathematical and scientific teaching knowledge models since the concept of Subject Matter Content Knowledge, Pedagogical Content Knowledge, and Curricular Knowledge has been proposed (Shulman, 1986). Ball, Thames and Phelps (2008) analyzed elementary school teachers' in-class teaching videos, and developed "Mathematical Knowledge for Teaching (MKT) and Park and Oliver (2008) discussed the case of teachers' integration of teaching practice and developed "the Pentagon Model of PCK for Teaching Science". Based on the aforementioned literature review, the researchers adopt the five constructs for mathematics teaching knowledge including Mathematical Content Knowledge [MCK], Knowledge of Mathematical Teaching [KMT], Knowledge of Mathematical Learning [KML], Knowledge of Mathematical Curriculum [KMC], Knowledge of Mathematical Assessment [KMA] and Mathematical Classroom Management [MCM] for develop the Observation Instrument for Mathematical Teaching Knowledge.

Method:

This study analyzed the literature on teachers' professional standards, self-report questionnaires for teachers' knowledge and teachers' knowledge coding (15 articles in total) to construct the items and indicators in the first draft of the "Observation Instrument for Mathematical Teaching Knowledge". Then, sixteen mathematics educators and exemplary teachers are invited to review and adjust the items and indicators by means of the Delphi Method. After three rounds of expert review, the manuscript of the observation instrument is finalized.

Expected Outcome:

The validated version of the Observation Instrument for Mathematical Teaching Knowledge contains 10 items and 19 indicators, which are:

	Items	Indicators
MCK	MCK 1 Knowledge of the mathematical content and skills	MCK 1-1 Proficiency in mathematics concepts, procedure and mathematical representation. MCK 1-2 Master strategies for solving routine and non-routine problems in mathematics.
	MCK 2 Knowledge of links between mathematical knowledge and social culture	MCK 2-1 Connections between mathematics knowledge and other subjects. MCK 2-2 Interlinking in mathematical knowledge and natural environment and social culture.
KMC	KMC 1 Proficiency in mathematical curriculum syllabus and textbooks	KMC 1-1 Proficiency in the basic curriculum concepts, connotations, learning content. KMC 1-2 Fluency in the content of mathematics textbooks.

KMT	KMT 1 Knowledge of mathematics instruction	KMT 1-1 Proficiency with teaching purpose, content and process. KMT 1-2 Provide math task and activity based on the teaching purpose.
	KMT 2 Knowledge of mathematics instruction practical	KMT 2-1 Fluency in using different pedagogy and strategies for teaching mathematics. KMT 2-2 Using Information Technology Integrated into Instruction to support mathematical learning.
KML	KML 1 Knowledge of students' cognitive and skill development	KML 1-1 Proficiency with students' prior knowledge, skills and experience in lesson. KML 1-2 Proficiency in students' mathematical thinking, language representation, and misconception.
	KML 2 Knowledge of students' individual differences	KML 2-1 Fluency in individual differences in students' development of cognitive and skills.
KMA	KMA 1 Knowledge of mathematics learning assessment	KMA 1-1 Proficiency in assessment standards and contents based on students' cognitive and affective development. KMA 1-2 Proficiency with different assessment strategies in math learning. KMA 1-3 Connections between mathematics content and the ability of Information Technology Integrated.

	KMA 2 Knowledge of analysis learning assessment results	KMA 2-1 Proficiency in adjustment of teaching based on the results of multiple assessments.
MCM	MCM 1 Knowledge in mathematical course management	MCM 1-1 Creating a safe and positive learning environment. MCM 1-2 Managing students' behavior on the basis of fair and respectful rule.

References:

Ball, D. L., Thames, M. H., & Phelps G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education, 59*, 389-407.

Park, S., & Oliver, J. S. (2008). Revisiting the conceptualization of Pedagogical Content Knowledge (PCK): PCK as a conceptual tool to understand teachers as professionals. *Research in Science Education, 38*(3), 261-284.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4-14.

Thailand: Ms Kusumar Ubonmoung, Kasetsart University

Title:

Development of 8th Grade Students' Empathetic Problem-Solving Ability through Design-based Learning

Objectives:

1. To investigate 8th grade students' empathetic problem solving ability
2. To develop 8th grade students' empathetic problem solving ability through Design-based Learning

Background:

The issue of garbage in schools typically refers to concerns related to waste management and environmental sustainability within educational institutions. Several aspects contribute to these issues example for Waste Generation the schools generate a significant amount of waste, including paper, plastic, food, and other materials. Improper disposal of this waste can lead to environmental pollution and have a negative impact on the local community. Waste problems have become a very serious problem, especially in big cities. Continuous waste production increases along with population growth, changes in consumption patterns, and people's lifestyles that have increased the amount of waste generation both in type and diversity of waste characteristics. Shared awareness and commitment are needed towards a change in attitudes, behaviors, and ethics that are culturally cultured. [1][2]

Students' empathetic problem solving ability

"Students' empathetic problem-solving ability" refers to the capacity of students to understand and address problems by considering and empathizing with the perspectives, feelings, and needs of others. This skill involves not only analytical thinking but also an awareness of the emotional and human aspects of a situation.

A Learning trough design-based learning for practicing empathetic problem solving ability

Problem solving ability has played a critical role in human history (Chi & Glaser,1985; Ohlsson, 2012). Problem solving involves people's efforts to find a solution to a problem using analytical thinking, critical thinking, creativity, reasoning, and experiences along with available information (Chi & Glaser, 1985; Schunk, 2004; Reeve, 2013). Since childhood, we actively solve problems presented by the world. We acquire information about people, objects, events, or phenomena and organise the information into the structure of knowledge that is stored in our memory. The structure of knowledge contains bodies of understanding, mental models, convictions and beliefs, and influences how we relate our experiences together and how we solve problems that we encounter in everyday life at school, work, even at play (Resnick & Glaser, 1975; Chi & Glaser, 1985) [3]

This research aims to develop the students' empathetic problem solving ability by creating the solution which is chosen based on the empathizing their target people such as students, teachers, school keeper and administration team. Additionally, this learning has the potential to enhance empathy as students consider the needs and perspectives of end-users while designing solutions, leading to more user-centered designs. Overall, design-based learning provides a holistic approach to education, preparing students with practical skills and mindsets necessary for success in various fields.

Method:

This study is quasi-experimental research. Reseach participants will be 40 eighth grade students. The student's empathetic problem-solving ability will be assessed before and after learning through design-based learning by using the Empathetic Problem-solving Ability and Performance test. The specific rubric scores will be constructed which related the components of the empathetic problem-solving ability. The qualitative data will be analyzed by using content analysis. The interviews and fieldnoted will be conduced in order to deeper understanding of the way students improve their own student's empathetic problem-solving ability.

Expected Outcome:

The students are expected to exhibit an enhanced ability to apply their knowledge to solve the problem about garbage in the school based on the empathizing their target people.

References :

[1] El Haggar, Salah 2007 Sustainable Industrial Design and Waste Management (United States of America: Elsevier Academic Press)

[2] Widiarti, Ika Wahyuni 2012 Pengelolaan Sampah Berbasis Zero Waste Skala Rumah Tangga Secara Mandiri Jurnal Sains dan Teknologi Lingkungan vol 4, 2

[3] Chi, M.T.H., & Glaser, R. (1985). Problem solving ability. The Education Resources Information Center. Retrieved July 31, 2017, from http://files.eric.ed.gov/fulltext/ED257630.pdf

[4] Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed method approaches (5th ed.). SAGE.

Research Proposal EASE Winter School 2024

Group 3

Indonesia: Ms Vivi Mardian, Universitas Pendidikan Indonesia

Title:

Development of STEM-Worksheet to Improve Students' Problem-Solving and Collaboration Skills on Static Fluid Concepts

Objectives:

Examining the effect of STEM Worksheet on students' problem-solving and collaboration skills on static fluid concepts.

Background:

STEM approach is an approach that emphasizes the field of science with other fields with the aim of solving a problem (Mkhize, 2023; Musavi et al., 2018). This STEM approach encourages students to learn more actively and learn like a scientist (Atkins et al., 2020) because learning is cohesive (Suwarma et al., 2019). The integration of STEM in learning can improve students' understanding of concepts, dispositions and 21st century skills (Kelley et al., 2023). Two 21st century skills that need to be trained to students in learning are student problem-solving and collaboration skills. The problem-solving skill that students need to master are complex and unstructured problem solving (Chrismawaty et al., 2023; Son & Lee, 2021). Collaboration is the presence of two or more students in working on a problem to achieve a common goal (Saldo & Walag, 2020). Collaboration skill is very important for students because students really need good cooperation to help each other in the learning process.

Most students are skilled in understanding problems and explaining problems in the form of terms. However, students have not been trained in planning solutions, implementing plans, and evaluating solutions. Meanwhile, the collaboration skills of high school students are still developing based on the 2023 survey. One of the right ways to practice both skills is learning supported by STEM integrated student worksheet. STEM worksheet developed based on appropriate approaches, methods, and learning models so that learning activities are more systematic and can guide students in discovering new concepts in learning (Bakri et al., 2020). STEM worksheet encourage students to be more active in learning and increase interest in learning science (Mahtari et al., 2020).

Research Hartini et al. (2020) found that STEM based worksheet can effectively improve students' critical thinking skills. Therefore, STEM integrated worksheets need to be developed to train students' problem solving and collaboration skills.

Method:

This study used a complex mixed method design with design type experimental study, aims to review basic experimental design in a study (Creswell, 2019). The initial data was consisting of literature studies, surveys of students' collaboration skills, and students' initial problem-solving skills. Both data were analyzed to serve as guidelines in STEM development worksheet. At this stage, instruments measuring students' problem-solving and collaboration skills are also designed. Furthermore, the implementation of learning for 4 meetings. During learning, student activities are recorded to reinforce qualitative data. At the end of the meeting, students' problem-solving skills were measured again in the form of a post-test. At this stage, quantitative data is more dominant than qualitative data.

Test instruments to measure students' initial and late problem-solving abilities after being given treatment. The test is in the form of 5 essay questions. Non-test instruments in the form of peer-assessment questionnaires, observation sheets, recordings of student discussions, and student perception questionnaire where is filled in by students. The qualitative data consisted of student peer-assessment questionnaires, transcripts, student perceptions and developed STEM worksheet validation sheets. The data were analyzed in a descriptive qualitative manner. Quantitative data, problem solving skills, are analyzed by calculating the N-Gain value.

Expected Outcome:

The STEM-worksheet developed is valid based on expert assessments and trials with students. Students show a positive tendency in solving physics problems. Students experience increased learning outcomes seen from indicators of problem- solving skills, useful descriptions, physics approaches, sketch, specific application of physics, mathematical procedures, and logical progression. Students' collaboration skills improve significantly with each meeting. In general, there are significant differences in learning outcomes between the experimental class and the control class.

References:

Atkins, K., Dougan, B. M., Dromgold-Sermen, M. S., Potter, H., Sathy, V., & Panter, A. T. (2020). "Looking at Myself in the Future": How mentoring shapes scientific identity for STEM students from underrepresented groups. *International Journal of STEM Education*, *7*(1), 42.

Bakri, F., Permana, H., Wulandari, S., & Muliyati, D. (2020). Student worksheet with AR videos: Physics learning media in laboratory for senior high school students. *Journal of Technology and Science Education*, *10*(2), 231. https://doi.org/10.3926/jotse.891

Chrismawaty, B. E., Emilia, O., Rahayu, G. R., & Ana, I. D. (2023). Clinical reasoning pattern used in oral health problem solving – A case study in Indonesian undergraduate dental students. *BMC Medical Education*, *23*(1), 52.

Creswell, J. W. (2019). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (Sixth edition). Pearson.

Hartini, S., Mariani, I., Misbah, & Sulaeman, N. F. (2020). Developing of students worksheets through STEM approach to train critical thinking skills. *Journal of Physics: Conference Series*, *1567*(4), 042029.

Kelley, T. R., Sung, E., Han, J., & Knowles, J. G. (2023). Impacting secondary students' STEM knowledge through collaborative STEM teacher partnerships. *International Journal of Technology and Design Education*, *33*(4), 1563–1584.

Kit, D. N. T., & Chu, S. K. W. (2021). Motivating Students to Learn STEM via Engaging Flight Simulation Activities. *Journal of Science Education and Technology*, *30*(5), 608–629.

Mahtari, S., Wati, M., Hartini, S., Misbah, M., & Dewantara, D. (2020). The effectiveness of the student worksheet with PhET simulation used scaffolding question prompt. *Journal of Physics: Conference Series*, *1422*(1), 012010.

Mkhize, Z. (2023). Is it transformation or reform? The lived experiences of African women doctoral students in STEM disciplines in South African universities. *Higher Education*, *86*(3), 637–659.

Musavi, M., Friess, W. A., James, C., & Isherwood, J. C. (2018). Changing the face of STEM with stormwater research. *International Journal of STEM Education*, *5*(1), 2.

Saldo, I. J. P., & Walag, A. M. P. (2020). Utilizing Problem-Based and Project-Based Learning in Developing Students' Communication and Collaboration Skills in Physics. *American Journal of Educational Research*, *8*(5), 232–237.

Shernoff, D. J., Sinha, S., Bressler, D. M., & Ginsburg, L. (2017). Assessing teacher education and professional development needs for the implementation of integrated approaches to STEM education. *International Journal of STEM Education*, *4*(1), 13.

Son, J.-W., & Lee, M. Y. (2021). Exploring the Relationship Between Preservice Teachers' Conceptions of Problem Solving and Their Problem-Solving Performances. *International Journal of Science and Mathematics Education*, *19*(1), 129–150.

Suwarma, I. R., Kaniawati, I., & Kaniawati, D. S. (2019). Engaging Students in STEM Based Learning Through Media and Technology. *Journal of Physics: Conference Series*, *1204*, 012054.

Indonesia: Mr Nur Ahmad, University of Jember

Title: Applying Project Based Learning PBL-STEM to Support [he Merdeka Curriculum in Indonesia
Research Questions: - How cognitive students' enhancement after participating PBL-STEM based worksheet? - How identify the collaboration of group work design to complete the project?
Background: As a member of G-20, Indonesia has begun to transform in increasing human resources through a new approach in higher education called Merdeka. The Merdeka curriculum emphasizes Project Based Learning (PBL) and Case Methods applied to learning on campus. It was designed to foster children's interests and skills at a young age by emphasizing vital material, character development, and student competency. Nadiem (Education Minister) said the core of this curriculum is the freedom to learn (Ahmad et al, 2022). The concept have been made to support students exploring their interests and talents. The curriculum has been tested in 2,500 driving schools and implemented in 140,000 other schools (Caesaria, 2022). This curriculum's primary distinguishing feature that promotes learning recovery is: PBL to strengthen soft skills and personality in line with Pancasila's profile (Indonesian principle). Concentrate on vital material until there is enough time for in-depth examination of fundamental abilities such as literacy and numeracy. Educators' ability to modify learning based on students' competencies and make modifications based on context and local wisdom (Kemdikbudristek, 2022; Ahmad et al, 2022). Through explanation above, the syllabus was advanced as a more pliable scheme that emphasized key materials and the development of student character and competencies. The PBL is essentially needed in Indonesian education approach to improve recent curriculum. It has been exercised in most of state universities since 2019. However, there are any weaknesses in applying its new learning model mainly assimilated with STEM. This study aimed to address this gap. I would like to study in STEM topics since it is most related to science and technology that support China's advancement. Furthermore, integrated STEM and PBL create students to

have more proficiency in technological concepts and principles to innovate in learning science (Rizkika et al., 2022. I also need to identify the effort of students who work collaboratively to collect evidence, analyze data, communicate and elaborate their ideas, justify their explanations, and reach a consensus on solutions to complete the project (Kuhn & Reiser, 2005; Kyza, 2009; Chen et al., 2021).

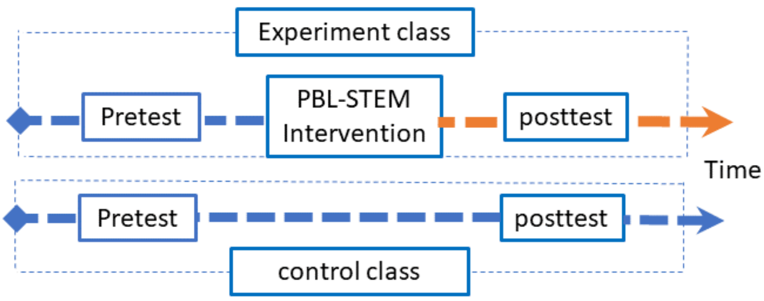
Meanwhile, STEM education in the Indonesian context is still a recent issue in science education. Conceptualizing of STEM education has been found after several concepts about bridge to integrating between the concept of science, technology, engineering, and mathematics (Ring, et al., 2017; Putra et al., 2021). Integrated STEM in learning creates students have more mastery of technological concepts and principles to innovate with new activities manipulation (Rizkika et al., 2022). According to the explanation above, I thought that PBL and STEM are linked to each other.

Method:

Preliminary research

I would observe PBL in three Science Education higher schools, such as in a state university, a private university and an outside Java's university. The observation and interview would be conducted to obtain student perception in applying PBL in those campuses around Merdeka educational program implementation (Ahmad et al, 2022). Student reports and lecture plans will be analyzed to gain the primary information. This inquiry will advance drafting of a worksheet product.

Major Research



Our study will involve 70 students in Science Education Department in University of Jember. We will use quasi experiment including pretest-posttest. We will identify whether PBL-STEM based worksheet have significant effect to cognitive student.

Expected Outcome:

Publication

Plan

1st year – Literatur Study for article 1

D. Preliminary research for article 1

E. *Student Perception Science Learning in PBL Supporting the Merdeka…* (article 1)

2nd year – write theoretic framework for article 2

E. conduct main research

F. enter and analyze data Development of Worksheet

G. *Development of Worksheet PBL STEM based…* **(article 2)**

– write theoretic framework **for article 3**

- enter and analyze data about student collaboration

3rd year **-** *Identification the collaboration of Group Work Design…* **(article 3)**

References:

Ahmad, N, Putra, PDA, Sutarto, Indrawati, Mahardika, IK. (2022). Student Learning Perception toward

Inbound and Outbound Student Exchange Mobility in Science Education. Jurnal Pendidikan MIPA. *Jurnal Pendidikan MIPA*, *20*(1), 23–29.

Chen, J., Wang, M., Kirschner, P. A., & Tsai, C. C. (2018). The Role of Collaboration, Computer Use,

Learning Environments, and Supporting Strategies in CSCL: A Meta-Analysis. *Review of Educational Research*, *88*(6), 799–843. https://doi.org/10.3102/0034654318791584

Chen, J., Wang, M., Dede, C., & Grotzer, T. A. (2021). Analyzing student thinking reflected in self-

constructed cognitive maps and its influence on inquiry task performance. *Instructional Science*, *49*(3), 287–312. https://doi.org/10.1007/s11251-021-09543-8

Caesaria, Sandra Desi. 2022. Apa Itu Kurikulum Merdeka? Begini Penjelasan Lengkap Kemendikbud.

11/10/2022 source: https://www.kompas.com/edu/read/2022/02/12/210034971/apa-itu-kurikulum-merdeka-begini-penjelasan-lengkap-kemendikbud?page=all

Kemdikbudristek. 2022. Kurikulum Merdekasource: https://kurikulum.kemdikbud.go.id/kurikulum-merdeka/

Kuhn, L., & Reiser, B. (2005). Students constructing and defending evidence-based scientific
explanations. Paper presented at the Annual Meeting of the National Association for Research in Science Teaching, Dallas, TX.
Kyza, E. A. (2009). Middle-school students' reasoning about alternative hypotheses in a scaffolded, software-based inquiry investigation. Cognition and Instruction, 27(4), 277–311. https:// doi. org/ 10. 1080/ 07370 00090 32217 18
Putra, P. D. A., Ahmad, N., Wahyuni, S., & Narulita, E. (2021). Analysis of the Factors Influencing of
Pre-service Science Teacher in Conceptualization of STEM Education: Self-Efficacy and Content Knowledge. *Jurnal Penelitian Pendidikan IPA*, *7*(SpecialIssue), 225–230. https://doi.org/10.29303/jppipa.v7ispecialissue.877
Ring, E. A., Dare, E. A., Crotty, E. A., & Roehrig, G. H. (2017). The Evolution of Teacher Conceptions
of STEM Education Throughout an Intensive Professional Development Experience. Journal of Science Teacher Education, 28(5), 444–467. https://doi.org/https://doi.org/10.1080/104656 0X.2017.1356671
Rizkika, M., Putra, P. D. A., & Ahmad, N. (2022). Pengembangan E-LKPD Berbasis STEM pada Materi
Tekanan Zat untuk Meningkatkan Kemampuan Berpikir Kritis Siswa SMP. *PSEJ (Pancasakti Science Education Journal)*, *7*(1), 41–48. https://doi.org/10.24905/psej.v7i1.142

Thailand: Ms Angkana Langkawong, Kasetsart University

Title:

Development of STEM Methods Course by Integrated Culturally Responsive to Promote STEM Teaching Competency of Elementary Preservice Teachers

Objectives:

1. To investigate the understanding of STEM education
2. To develop an integrated STEM learning management course that is culturally

responsive to promote STEM learning management competencies of elementary preservice teaching

3. To develop the STEM learning management competency of elementary preservice teachers who have undergone learning in the STEM learning management course by integrating and responding to culture

Background:

Strategy 2 of Thailand's national education plan (2017-2036) aims to provide a workforce with the required competencies by promoting learning that integrates knowledge (Office of the Secretariat of the Education Council, Ministry of Education, 2017). STEM education is considered to be learning that integrates four sciences, science, engineering, technology, and mathematics, by integrating the distinctive characteristics of each science. To provide students with knowledge and understanding of how things work and make improvements using the design process that directly participates in solving various problems and applying knowledge in daily life (Sanders, 2009). According to STEM education, effective teaching and learning requires teachers to understand teaching methods in that content and concepts, steps, and processes for designing learning management for development (Bybee, 2010). Therefore, teachers should be developed, mainly teaching preservice teachers at the higher education level, where producing teachers to promote professional competency according to STEM education is very important (Teachers Council Secretariat, 2021).

The preservice teachers can learn from things around them in organizing learning that uses local cultural knowledge to bring into the classroom. Through their practice, they can see through the dimensions of learning, becoming a part of their identity (Panich, 2015). That is, organizing culturally responsive learning, which Gay (2002) defines as culturally responsive teaching that uses the cultural characteristics, experiences, and perspectives of students of diverse nationalities to make learning more meaningful, has higher interest, and makes learning more accessible for all the reasons that the researcher has mentioned. This present study aims to develop integrated STEM learning courses that are culturally responsive.

Method:

This study is interpretive research (Creswell and Miller, 2000). The researcher believes that the truth in this world can be understood through interpretation and created from the inner thoughts of humans and uses the theory of self-knowledge creation (Constructivism) in the learning process where students are the knowledge creators of learning experiences they encounter on their own through interaction with society and culture.

Participant

The participants are preservice teachers at a university in the North of Thailand.

Data collection

The researcher collected data through various methods, including surveys, observations, interviews, and learning management plans. The details are as follows,

1. Survey: The researcher surveyed the understanding of STEM education among preservice teachers before and after participating in the STEM methods course.

2. Observation: The researcher observes the events, preservice teachers' actions during their teaching practice, and their feelings.

3. Interviews: The researcher conducted group and individual interviews about preservice teachers' STEM teaching and learning during group learning activities and after teaching practice.

4. Preservice teachers' lesson plans

Data analysis

Thematic analysis

Expected Outcome:

The preservice teachers can learn from things around them in organizing learning that uses local cultural knowledge to bring into the classroom.

References:

Bybee, R. (2010). American Association for the Advancement of Science. *Science, New, Series, 329*(5995), 996.

Creswell, J. W. and Miller, D.L. (2000). Determining validity in qualitative inquiry. *Theory into Practice, 39*(3), 124-130.

Education Council, Ministry of Education. (2017). *The National Education Plan B.E. 2560-2579*. Bangkok: Prig Wan Graphic.

Gay, G. (2002). Preparing for culturally responsive teaching. *Journal of Teacher Education, 53*(2), 106-116.

Panich W. (2015). *Transformative Learning*. Bangkok: SCB Foundation Press.

Sanders, M. (2009). STEM, STEM Education, STEMmania. *The Technology Teacher, 69*(4), 20-27.

Teachers Council Secretariat, (2021). *Five Years Action Plan B.E. 2566 – 2570*. The Teachers Council of Thailand.

Thailand: Ms Chanita Butrattana, Khon Kaen University

Title:
The BCG-battery STEM education for enhancing students computational thinking
Objectives:
To identify suitable learning activities and instructional strategies for enhancing computational thinking skills in the BCG-Battery STEM education.
Background:
Battery, known as clean energy, offer both increased sustainability and reduced reliance on fossil fuels. However, battery production raises concerns. Lithium extraction involves drilling large holes in salt flats and pumping out brine. Additionally, managing waste from end-of-life electric vehicles remains a challenge. *How can we effectively improve Thai students' awareness and understanding of practical battery challenges?* The way battery is taught in Thai schools is completely out of touch with current concerns. While it covers the science (electron flow and measurement), it ignores the important social issues surrounding battery production. Battery management system could be in lesson unit for frosting student to operated, skill and practice with knowledge, even though environment management. Battery knowledge is an important part of the Thai core curriculum for science content. Students should learn about battery at primary school, as they are a common source of energy in everyday life. In secondary schools, students should learn about the electrochemical cells that make up battery, and the different types of battery that are available. (The Institute for the Promotion of Teaching Science and Technology (IPST), 2017b) Computational thinking (CT) is also an important part of the Thai core curriculum. (The Institute for the Promotion of Teaching Science and Technology (IPST), 2017a) CT is the ability to solve problems, design systems, and understand the world around us by breaking down problems into smaller steps, identifying patterns, and using algorithms. (Wing, 2006) CT can be enhanced by activities that involve unplugged coding, visual block-based programming languages, and computational thinking challenges. STEM education is also included in the Thai core curriculum. (The Institute for the Promotion of Teaching Science and Technology (IPST), 2017c) STEM education integrates science, technology, engineering, and mathematics to teach students how to solve real-world problems. STEM education can help students develop CT skills by requiring

them to use CT to design and build solutions to problems.(Wongwatkit et al., 2017) The STEM curriculum in Thailand focuses on charging battery with clean energy. This curriculum may include knowledge of solar cells as clean energy to charge battery. However, there is no current lesson unit that integrates battery knowledge, CT, and STEM education. This research paper will explore the potential of integrating battery knowledge, CT, and STEM education.

In Thailand, the "BCG economic model" or Bio-Circular-Green Economy Model as a national agenda has approved since 2021. (National Science and Technology Development Agency (NSTDA), 2021) This model aims to make Thailand a high-income country while pursuing the Sustainable Development Goals (SDGs). The BCG model is based on three pillars: bioeconomy, circular economy, and green economy. The bioeconomy focuses on using renewable biological resources to create products and services. The circular economy focuses on reducing waste and pollution by reusing and recycling materials. This can help to reduce our reliance on fossil fuels and to improve air quality. The green economy focuses on using clean energy and technologies to conserve the environment. The BCG battery is a key component of the Climate change reduction. By teaching students about battery technology, we can help them to develop the skills and knowledge they need to create and use sustainable battery technologies. This can help to make Thailand a leader in the global green economy and contribute to the achievement of the Sustainable Development Goals. This means that education should not only focus on academic achievement, but also on developing the values and ethics that are necessary for sustainable living. (Charles Taylor et al., 2022)

Battery knowledge, computational thinking, and STEM education are all important components of the Thai core curriculum. Student need knowledge and practice which is related the real-world problem. Enhancing skill such as analysis data, decompose skill and system thinking. STEM education and framework of computational thinking skill can be used for support. Battery in schools is vital for fostering sustainable development and addressing global challenges. (Wang et al., 2021) By integrating battery technology education with the SDGs, students can gain a comprehensive understanding of the impact and potential of this field.

Method:

This research aims to identify appropriate learning activities and instructional strategies that effectively enhance students' computational thinking skills in secondary school within the context of BCG-Battery STEM education. In addition, the research aims to assess students' competency in computational thinking as they engage in the BCG-Battery STEM education unit.

Target group is pre-service teacher and students in two secondary schools in Buriram where my workplace is. Mix method has been employed, I consider the quality data such as discussion from teacher and expert on battery. In addition, collect data by computational thinking skill assessment as scored could be included.

Phase 1, to examine epistemology and ontology of learning about BCG-Battery STEM education, experts panel would be set up to discuss on the key concepts of BCG-Battery STEM knowledge and computational thinking.

Phase 2, the lesson unit of Computational thinking BCG-Battery STEM education would be designed with expert comment by Professional Learning Community: PLC process.

Phase 3, to implement STEM unit in two schools, students' competency would be investigated on computational thinking in learning about the BCG-Battery STEM education unit.

Expected Outcome:

1. The BCG-Battery STEM education unit
2. Assessment of Computational thinking skill in classroom

References:

Charles Taylor, P., Lily, E. (, & Taylor,). (2022). STEAM Educators Embracing the Arts to Develop Students' Capabilities for Resolving Global Sustainability Crises. In Asia Research Network Journal of Education (Vol. 2, Issue 2).

The Institute for the Promotion of Teaching Science and Technology (IPST). (2017a). *Guidebook of course technology (computation science) Science learning content* (Vol. 2).

The Institute for the Promotion of Teaching Science and Technology (IPST). (2017b). *Indicators and Core curriculum Science learning content* (Vol. 2).

The Institute for the Promotion of Teaching Science and Technology (IPST). (2017c). *STEM activities Secondary level (M.1-M.6) STEM Education Science Technology Engineering and Mathematics Education*.

National Science and Technology Development Agency (NSTDA). (2021). Bio-circular-green economy action plan 2021–2027: Summary.

Wing, J. M. (2006). Computational thinking. Communications of the ACM, 49(3), 33–35.

Wongwatkit, C., Hutamarn, S., & Chookaew, S. (2017). A STEM Robotics Workshop to Promote Computational Thinking Process of Pre-Engineering Students in Thailand : STEMRobot Adaptive View

China: Mr Lihua Tan, University of Macau

Title:
How science teachers deal with STEM education: An explorative study from the lens of curriculum ideology
Objectives:
Through the lens of curriculum ideology, this study aim to explore how science teachers dealt with STEM education at primary schools. Specifically, based on the discrimination of what curriculum ideologies teachers have, we intend to critically investigate *what* STEM education visions they have, *why* they promote it, and *how* they enact it in primary school settings.
Background:
With the increasing global demand for science-related workforces, promoting the STEM (Science, Technology, Engineering and Mathematics) education has become a significant curriculum issue in education reforms over the past decade (Millar, 2020). Given the pivotal role teachers played in curriculum implementation, one essential question that researchers continue to explore is how teachers deal with the issue of STEM education within schools. Numerous studies have investigated how teachers would perceive or implement STEM education (e.g., Bybee, 2013; Fang & Fan, 2023; Holmlund et al., 2018; Martín-Páez et al., 2019), and found teachers approached STEM education in distinct ways, ranging from integrated STEM to emphasizing one or several disciplines as the core, or even teaching them individually (Bybee, 2013; Fan et al., 2021; Holmlund et al., 2018; Ring et al., 2017). However, when studying how teachers perceive and enact STEM education, researchers primarily focus on pedagogical aspects like teaching, learning, and assessment (e.g., Dare et al., 2018; Falloon et al., 2022; Gao et al., 2020; Thibaut et al., 2019). Although these aspects constitute a significant portion of teachers' daily work, addressing STEM education at the school level inevitably involves other (even more) crucial issues like aim negotiations, content organizations, and subject integrations (Fan et al., 2021; Millar, 2020; Reynante et al., 2020). These issues profoundly shape teachers' instructional approaches (Tran & Guzey, 2023), yet they receive comparatively less attention. To gain a more complete understanding of how teachers approach STEM education, it is necessary to comprehensively examine curricular issues entwined in STEM education. Moreover, when investigating the reasons teachers deal with STEM education in different ways, most research attribute it to teachers' different

dispositions, knowledge, competences, or school contexts (e.g., Dong et al., 2020; Fang & Fan, 2023; Shahali & Halim, 2023; Thibaut et al., 2019; Wan et al., 2021). Few studies have explored how the inherent tensions between different value stances or interests within STEM education shape teachers' perceptions and practices. STEM education encompasses a range of diverse interests, values, and aims (Andrée & Hansson, 2020; Gough, 2015; Hoeg & Bencze, 2017; Zeidler, 2016). These distinct values and aims, such as promoting overall learner development or meeting societal labour demands, lead individuals to have different preferences or curriculum orientations regarding how to perceive or enact STEM education (Bybee, 2013; Fensham, 2022; Roberts, 2007). Therefore, to gain deeper insights into why teachers deal with STEM education in varying ways, it is necessary to reveal how different values are situated in teachers' perceptions and practices.

To address these gaps, this study aims to explore how science teachers deal with STEM education via the lens of curriculum ideology (CI) as framed by Schiro (2013). Curriculum ideology refers to "curriculum visions, conceptions, or belief systems that provide the value premises for educators' actions or decisions about practical educational matters" (Schiro, 2012, p. 8). Informed by the works of Schiro (2012) and Mnguni (2018), we utilize CI as a theoretical lens to not only systematically describe individuals' perceptions and actions across six essential aspects of the curriculum (i.e., aim, knowledge, teaching, learning, student, and assessment), but also explain them based on the value stances and overall orientations discerned from teachers' rationales for their perceptions and practices (Schiro, 2013).

Method:

We employed a qualitative comparative cases study (Yin, 2018) to develop an in-depth understanding of what curriculum ideologies primary science teachers have and how these teachers deal with the issue of STEM education. Specifically, We will initially invite four to eight science teachers, who actively involved in local STEM education initiatives and may contribute to more comprehensive reflections and richer experiences on STEM education issues, to participate in this study. The primary form of data collection will be one-on-one interviews using a protocol developed to explore their learning and teaching experience and gain insights into their philosophy and practices of STEM education. Other forms of qualitative data like field notes of school visits, tapes of classroom observation, artefacts like students' works, and documents like lesson plans and classroom videotapes will be also gathered to investigate how they enact STEM education at schools. The analysis will first examine the data for descriptions and themes within each case and note any critical events that shows participants curriculum ideologies. This was followed by a qualitative and inductive approach to how participants (with their own curriculum ideologies) deal with STEM education in terms of three fundamental dimensions: in their cases, *what* is STEM education like, *why* promote that STEM education, and *how* to enact it at school. By analysing the differences and similarities among cases, we aim to identify the patterns and reasons behind participants' conceptions and enactments of STEM education in school setting from the lens of curriculum ideology.

Expected Outcome:

One or two SSCI indexed journal papers revealing how Chinese science teachers deal with STEM education from the lens of curriculum ideology

References:

Bybee, R. W. (2013). *The case for STEM education: Challenges and opportunities*. NSTA press.

Dare, E. A., Ellis, J. A., & Roehrig, G. H. (2018). Understanding science teachers' implementations of integrated STEM curricular units through a phenomenological multiple case study. *International Journal of STEM Education*, *5*, Article 4.

Dong, Y., Wang, J., Yang, Y. Y., & Kurup, P. M. (2020). Understanding intrinsic challenges to STEM instructional practices for Chinese teachers based on their beliefs and knowledge base. *International Journal of STEM Education*, *7*(1), Article 47.

Falloon, G., Forbes, A., Stevenson, M., Bower, M., & Hatzigianni, M. (2022). STEM in the Making? Investigating STEM Learning in Junior School Makerspaces. *Research in Science Education*, *52*(2), 511-537.

Fang, S. C., & Fan, S. C. (2023). Exploring Teachers' Conceptions and Implementations of STEM Integration at the Junior Secondary Level in Taiwan: an Interview Study. *International Journal of Science and Mathematics Education*, *21*(7), 2095-2121.

Gough, A. (2015). STEM policy and science education: scientistic curriculum and sociopolitical silences. *Cultural Studies of Science Education*, *10*(2), 445-458.

Holmlund, T. D., Lesseig, K., & Slavit, D. (2018). Making sense of "STEM education" in K-12 contexts. *International Journal of STEM Education*, *5*, Article 32.

Martín-Páez, T., Aguilera, D., Perales-Palacios, F. J., & Vílchez-González, J. M. (2019). What are we talking about when we talk about STEM education? A review of literature. *Science Education*, *103*(4), 799-822.

Millar, V. (2020). Trends, Issues and Possibilities for an Interdisciplinary STEM Curriculum. *Science & Education*, *29*(4), 929-948.

Ring, E. A., Dare, E. A., Crotty, E. A., & Roehrig, G. H. (2017). The Evolution of Teacher Conceptions of STEM Education Throughout an Intensive Professional Development Experience. *Journal of Science Teacher Education*, *28*(5), 444-467.

Schiro, M. (2013). *Curriculum theory: Conflicting visions and enduring concerns*. Sage.

Thibaut, L., Knipprath, H., Dehaene, W., & Depaepe, F. (2019). Teachers' Attitudes Toward Teaching Integrated STEM: the Impact of Personal Background Characteristics and School Context. *International Journal of Science and Mathematics Education*, *17*(5), 987-1007.

Tran, K. Q., & Guzey, S. S. (2023). Cultivating culturally sustaining integrated science, technology, engineering, and mathematics classrooms: A narrative inquiry case study of a science teacher. *Science Education*.

Yin, R. K. (2018). *Case Study Research and Applications: Design and methods* (6 ed.). sage.

Zeidler, D. L. (2016). STEM education: A deficit framework for the twenty first century? A sociocultural socioscientific response. *Cultural Studies of Science Education*, *11*(1), 11-26.

Zweeris, K., Tigelaar, E. H., & Janssen, F. J. J. M. (2023). Studying curriculum orientations in teachers' everyday practices: A goal systems approach. *Teaching and Teacher Education*, *122*.

Japan: Mr Tetsuya Ida, Okayama University

Title:

Teaching Invasive Alien Species through Drawing

Objectives:

Invasive species pose a serious threat to biodiversity and can destroy ecosystems and impact human health and agriculture, forestry, and fisheries (Action Plan for the Prevention of Invasive Alien Species Damage, 2015; Toda, 2005). Invasive species are species that are introduced by humans and grow or nurture outside their natural distribution areas. The process of introduction can be intentional or unintentional. Intentional introductions include breeding, cultivation, and field release, while unintentional introductions occur when the species is mixed in with materials or tanker ballast water (Toda, 2005). Among those species, those that cause or are likely to cause damage to the ecosystem, human life or body, or agriculture, forestry, and fisheries in Japan are referred to as “invasive alien species”. Invasive alien species have a significant impact outside of Japan.

In order to protect the biodiversity that surrounds us, we need to understand the characteristics of invasive alien species and develop strategies to deal with them. This is the learning opportunity that science classes provide students. The ability to study invasive alien species while considering their impact on biodiversity and ecosystems is a unique feature of the science class. In classes dealing with invasive species, students deepen their understanding of invasive species mainly through observation. However, there is little practice in learning to understand the characteristics of invasive alien species, and it is difficult for students to understand the characteristics of invasive alien species. Therefore, in this study, we developed a class for learning to understand the characteristics of invasive alien species.

Background:

Education is important in dealing with the problem of invasive alien species. In the "Action Plan for the Prevention of Invasive Alien Species Damage," educational institutions are positioned to play a role in conveying the importance of the prevention of invasive alien species damage. In the Courses of Study, which are the national curriculum standards, it is indicated that invasive alien species should be studied in "Balance and Conservation of Ecosystems" in "Basic Biology" in high schools in 2008, and that invasive alien species should be touched in "Human and Environment" in the third grade of junior high school science class in 2009. However, there are not enough descriptions in elementary, junior high, and high school textbooks to promote understanding of "Invasive Alien Species Requiring Caution" and the "Three Principles of Invasive Alien Species Damage Prevention" (Doi, 2015). In addition, in biodiversity classes involving invasive alien species, there is a lack of teaching materials on their conservation and only scientific knowledge is presented, which does not go into more practical measures (Yamanoi, 2015; Higa, 2018). Therefore, accumulation of classroom practice using invasive alien species as teaching materials is required for future science education.

Method:

Drawing activities are used as a method of teaching, and Sasaki reports that "Children can also compare and compare their own images with those of others, observations, and the results of experiments, as well as grasp the transformation of their own images, based on their own subjective perception of their own images. This kind of drawing activity is called the "drawing method" and is also used to analyse and examine the state of cognition using image drawings made by the analysed subjects (Yamada, 2014). This method can be used to help students understand the characteristics of invasive alien species and to analyse the characteristics of invasive alien species that students recognize.

The only other practice using the drawing method in invasive alien species content is the work of Lampert (2015). Lampert had students research local invasive species issues and conceptualize their characteristics and appearance by having them name invasive features. Based on the characteristics and actual species, he had students draw pictures of invasive alien species and present their ideas on how to manage and control them. This study is a fun way for students to learn about invasive species by making them imagine impossible invasive alien species. We report that this is an effective way to create a unit of study on invasive alien species.

We analysed the students' worksheets based on the SCAT (Steps for Cording and Theorization) method (Otani, 2007). We also administered a questionnaire to examine changes in knowledge of invasive alien species before and after the class. The questions were divided into animal and plant categories, and were open-ended, asking students to write the name of one invasive alien species and three invasive characteristics for each.

Expected Outcome:

In most of the questionnaires and student drawings, the main changes were found in the characteristics of reproduction and the appearance of the organisms. The students' drawings before and after the class and the students' drawings of the reproduction questionnaire did not change much for animals, while for plants, the students' drawings had notations and the notations increased in the after-class questionnaire survey. This indicates that during the drawing activity, students realized that one of the characteristics of invasive alien plants is related to reproduction. The reason for this is that the students often used the expression "spores and pollen easily fly," which can be attributed to the fact that the image of easy reproduction is often associated with invasive plants. However, the impact of the reproductive trait was not indicated in either case, although hybridization with native species is one of the effects of the reproductive trait. This may be due to the fact that students do not have much knowledge of the less visible characteristics of hybridization. It is necessary to have the students learn about the effects of hybridization and other reproductive characteristics in their studies.

References:

Evan, L. (2015). "Invented invaders": An engaging activity to teach characteristics & control of invasive species. *The American Biology Teacher*, *77* (1), 73-77.

Ministry of the Environment, Ministry of Agriculture, Forestry and Fisheries, Ministry of Land, Infrastructure, Transport and Tourism (2015). *Action plan for the prevention of invasive species damage*. (in Japanese)

Otani, H. (2008). Proposal of a qualitative data analysis method SCAT by 4 step coding: A theorizing procedure easy to start and applicable to small data. *Bulletin of the Graduate School of Educational Development, Nagoya University. Educational Science*, *54*(2), 27-44. (in Japanese)

Toda, M., & Yoshida, G. (2005). Invasive alien species problem in reptiles and amphibians. *Bulletin of the Society of Reptiles and Amphibians*, *2005*(2), 139-149. (in Japanese)

South Korea: Ms Yang Jiyun, Kongju National University

<table>
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Title:

The Impact of Experiential Learning Program for Advanced Science on the Students' Science Academic Passion

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Objectives:

How does students' academic passion for science change before and after in an experiential learning program for advanced science?

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Background:

In recent years, as the need for cognitive, social, and emotionally balanced talents of students has been emphasized, there has been a great deal of global interest in Social and Emotional Learning (SEL). The SEL that we value is the process through which children acquire and effectively apply the knowledge, attitudes, and skills necessary to understand and manage emotions, set and achieve positive goals (CASEL, 2023). The OECD study on Social and Emotional Skills defines SEL skills as curiosity, creativity, and so on (Chernyshenko, O. S. et al., 2018), and research on the positive effects of SEL programs on science academic achievement (Corcoran, R. P. et al., 2018) shows that SEL competencies have a strong relationship with academic achievement. However, results from the Trends in International Mathematics and Science Study (TIMSS), an international assessment of academic achievement, show that while South Korean students are currently ranked among the top in the world in terms of academic performance in science courses, defining attitudes such as interest and confidence in science are at the bottom (Seo, 2021). Out-of-classroom interactions with science experiences play a key role in improving students' scientific reasoning skills (Gerber et al., 2001). Indeed, visits to science centers have a positive effect on students' scientific thinking skills (Sasson, 2014), and student' science inquiry skills and scientific attitudes improve after participating in science camps (Shin & Lee, 2012). Science outreach labs can also have a positive effect on students' science-related affective domains, even in short-term programs (Molz et al., 2022). Therefore, this study aims to investigate the effects of an experiential learning program on improving students' academic passion for science.

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Method:

This study aims to use the one group pretest–posttest design to assess the science academic passion of students who participated in an experimental learning program for advanced science organized by StarBridge Chungcheong

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Center in Korea. The instrument to be used is the Kim & Lim (2020) Elementary School Academic Passion Instrument, which Kang (2021) used to compare the science academic passion of elementary school general and science gifted students, modified by replacing 'study' with 'science study'. Kim & Lim's (2020) instrument was developed with satisfactory reliability and validity based on previous studies on passion-related instruments (Vallerand et al., 2003; Marsh et al., 2013; Schaufeli et al., 2002; Lee & Lee, 2012) and is therefore suitable for examining students' science academic passion in experiential learning programs. The instrument consists of five factors: importance, like, time/energy investment, harmonious passion, and obsessive passion, with a total of 20 items on a five-point Likert scale.

Expected Outcome:

To find out the change in science academic passion of all students who participated in the experiential learning program for advanced science, we want to run a paired t-test on the pre- and post-response results. Additionally, to explore potential differences in this change across various demographics, paired t-tests will also be applied separately to groups categorized by gender, school level, and interest in pursuing a STEM or non-STEM career. We will also calculate Cohen's d as an effect size for areas where there is a significant change in the t-test results. For the calculated effect sizes, we will interpret 0.20 as a small effect size, 0.50 as a medium effect size, and 0.80 as a large effect size (Cohen, 2013) to compare the effects between the science academic passion categories and with existing studies.

References:

CASEL. (n.d.). Fundamentals of SEL. https://casel.org/fundamentals-of-sel/ (accessed 2023-12-14).

Chernyshenko, O. S., Kankaraš, M., & Drasgow, F. (2018). Social and emotional skills for student success and well-being: Conceptual framework for the OECD study on social and emotional skills. https://www.oecd-ilibrary.org/education/social-and-emotional-skills-for-student-success-and-well-being_db1d8e59-en

Cohen, J. (2013). Statistical power analysis for the behavioral sciences. New York: Lawrence Erlbaum.

Corcoran, R. P., Cheung, A. C., Kim, E., & Xie, C. (2018). Effective universal school-based social and emotional learning programs for improving academic achievement: A systematic review and meta-analysis of 50 years of research. Educational Research Review, 25, 56-72.

Gerber, B. L., Cavallo, A. M., & Marek, E. A. (2001). Relationships among informal learning environments, teaching procedures and scientific reasoning ability. International Journal of Science Education, 23(5), 535-549.

Kang, H. (2021). Comparison of science academic passion between elementary general and science-gifted students. Journal of Korean Elementary Science Education, 40(4), 421-432.

Kim, S. B., Lim, H. J. (2020). The development and validation of academic passion scale for elementary school students. The Journal of Elementary Education, 33(3), 171-200.

Lee, J. & Lee, S. M. (2012). The development and validation of Korean academic engagement inventory (KAEI). The Korean Journal of Educational Methodology Studies, 24(1), 131-147

Marsh, H. W., Vallerand, R. J., Lafrenière, M.-A. K., Parker, P., Morin, A. J. S., Carbonneau, N., Jowett, S., Bureau, J. S., Fernet, C., Guay, F., Salah Abduljabbar, A., & Paquet, Y. (2013). Passion: Does one scale fit all? Construct validity of two-factor passion scale and psychometric invariance over different activities and languages. Psychological Assessment, 25(3), 796–809.

Molz, A., Kuhn, J., & Müller, A. (2022). Effectiveness of science outreach labs with and without connection to classroom learning: Affective and cognitive outcomes. Physical Review Physics Education Research, 18(2), 020144.

Sasson, I. (2014). The role of informal science centers in science education: attitudes, skills, and self-efficacy. JOTSE: Journal of Technology and Science Education, 4(3), 167-179.

Schaufeli, W. B., Salanova, M., González-Romá, V., & Bakker, A. B. (2002). The measurement of engagement and burnout: A two sample confirmatory factor analytic approach. Journal of Happiness Studies, 3(1), 71-92.

Seo, M., Kim, K., Lee, J., Jeon, S. Kim, S., & Lee, B. (2021). The affective characteristics and changes of elementary and middle school students in Korea based on the results of TIMSS (Issue Brief ORM 2021-40-17). Korea Institute for Curriculum and Evaluation. https://www.kice.re.kr/resrchBoard/view.do?seq=793&s=kice&m=030103

Shin, M. -R. & Lee, Y. -S. (2012). The Effects of The Science Camp Program on Science Process Skills and Scientific Attitudes for The Elementary Scientific Gifted Students. Journal of Gifted/Talented Education, 22(4), 967-983.

Vallerand, R. J., Blanchard, C., Mageau, G. A., Koestner, R., Ratelle, C., Léonard, M., Gagné, M., & Marsolais, J. (2003). Les passions de l'âme: On obsessive and harmonious passion. Journal of Personality and Social Psychology, 85(4), 756–767.

Research Proposal EASE Winter School 2024

Group 4

Indonesia: Ms Anisa Puteri, Universitas Pakuan

Title:

Development of STEM Learning Media Virtual Reality Based on Self Paced Learning to Improve Metacognitive Skills

Objectives:

1. Developing innovative STEM learning media in accordance with the principles of self-paced learning that can improve metacognition skills.
2. Measuring the improvement of students' metacognitive skills after using the developed learning media.
3. Obtaining information about the effectiveness of virtual reality-based learning media

Background:

Education in the STEM fields (Science, Technology, Engineering, And Mathematics)is essential to producing a new generation capable of advancing society, facing global challenges, and innovating. In addition to offering a thorough understanding of scientific and technological ideas, STEM topics foster the development of critical thinking, problem-solving, and creative abilities. Success in STEM domains is largely dependent on metacognitive abilities, which include self-awareness and the capacity to control and supervise learning. These abilities help students create learning plans more successfully, assess how well they comprehend the subject matter, and determine the best approaches to addressing problems. Students who receive STEM education combined with metacognitive skills become not only specialists in science and technology but also capable of handling challenging.

It is commonly known that metacognitive abilities like self-control and introspective thinking are important for developing deep understanding in STEM subjects. A key component of STEM education is metacognition, which is thinking about one's own thinking, being aware of oneself as a problem solver, and planning, organizing, and regulating mental processing.(Saundra Y. McGuire, 2018). The STEM learning approach requires a more student-centered

instructional approach, where students explore complex real-world issues and work to develop solutions, emphasizing the need for metacognitive skills such as reflective thinking and self-regulation. (Melinda, 2020)
Studies have indicated that robust metacognitive abilities can aid students in their transition to higher education and are crucial for in-depth learning reinforced by critical thinking and self-assessment abilities, which are especially significant in STEM fields. Therefore, the development of metacognitive skills is key to achieving deep understanding in STEM fields.

Students are often faced with significant challenges in understanding complex STEM concepts. Learning materials in Science, Technology, Engineering and Mathematics often involve abstract and often complex concepts. These challenges can stem from the complexity of mathematical concepts, the intricacy of scientific processes, or even the integration of evolving technologies. In addition, students may feel intimidated by the amount of information that must be understood, as well as the difficulty in connecting these concepts to real-world situations.

The STEM areas dynamic nature poses a challenge for educators and students who need to stay up to date with the most recent advancements. The culture of STEM education, including uninspired teaching and barriers related to departmental, institutional, and national policies, can also hinder students' learning experiences. (Yan Dong et al, 2020). By identifying and understanding these challenges, educators can design more effective learning strategies, facilitate better understanding, and encourage student interest in STEM fields that are so crucial to the future of education and technological development.

The advent of virtual reality (VR) technology offers a substantial chance to improve STEM education. Virtual reality (VR) technologies can help students visualize and understand complicated scientific subjects by providing them with realistic and immersive experiences. Virtual reality (VR) offers students the chance to explore inaccessible places and participate in hands-on learning experiences by imitating real-world environments and activities. These experiences are vital for mastering STEM courses. (Murat Çoban, 2022)

The necessity to accommodate a wide range of student demands and learning styles highlights the urgency of self-paced learning in STEM education. Self-paced learning gives students the freedom to move through the content at a comfortable pace, which enables them to fully comprehend even the most difficult STEM concepts. This method also fosters metacognitive abilities, which are critical for success in STEM professions and include self-regulation and introspective thinking. (Melinda, 2020) Furthermore, self-paced learning can assist in addressing the differences in students' past knowledge and experience in STEM disciplines, enabling each student to establish a solid foundation at their own speed. Self-paced learning is very advantageous in STEM education since it allows students to study abstract and complex concepts at their own pace.

The delivery of STEM education may be hampered by the shortcomings of the current STEM learning materials. There are still issues that need to be resolved even if research indicates that interactive STEM media can be a valuable teaching tool for young children. According to one study, more research is necessary to fully understand the nature of the connection between STEM media and STEM skills, especially on whether media is used in instead of or in addition to discovery and discussion.(Sheehan et al, 2018). Teachers can guarantee that all students have equitable access to high-quality STEM learning opportunities and foster a more inclusive learning environment by addressing constraints in learning media.

In order to help students enhance their metacognitive skills, self-paced learning methods and the utilization of Virtual Reality (VR) technology are highly relevant. The relevance of using virtual reality (VR) and self-paced learning in developing students' metacognitive skills can be explained through the following points: (1) Increasing self-awareness Students can plan, monitor, and test their comprehension while critically conscious of their function as thinkers in VR's authentic and immersive setting, which fosters heightened self-awareness . (2) Personalized and adaptive learning: Virtual reality (VR) can help students improve critical thinking abilities and self-regulation by providing them with personalized and adaptive learning pathways, scaffolds, and prompts. (3) ndividual practice and review: By incorporating virtual reality (VR) experiences into the curriculum, students are provided with chances for individual practice, review, and customized learning assignments, all of which support the development of metacognotive skills. (Cowan et al, 2023)

This research has the potential to contribute significantly to the development of more effective STEM learning media. This research represents a step toward changing how we impart scientific information to future generations, rather than merely being an experiment with new technology, especially in the setting of STEM education, where learning dynamics are always changing. The creation of Virtual Reality (VR)-based learning resources specifically designed for the self-paced learning methodology constitutes the primary contribution of this research. The use of VR technology enhances the educational process by producing realistic and captivating simulations and presenting content in an interactive and immersive style. Self-paced learning offers students freedom and independence in the learning process by creating content that they may access at their own speed.

Method:

A. Research Methods and Design

This research method uses research and development with ADDIE. The ADDIE model stands for Analyze, Design, Develop, Implement, and Evaluate. (Branch, 2013).

In this research, the device developed is virtual reality interactive learning media. The research instruments used in this study include validation sheets, student response questionnaires, and observation sheets. This research was conducted with a quasi-experimental design to determine the effectiveness of learning media. This research will analyze the control class and the experimental class. In addition, it will be analyzed quantitatively using SPSS.

B. Location, Population, and Sample Research

The location of the research will be carried out at SMP IT Al Qalamm, Depok. By taking purposive sampling from the population of class VII junior high school students, which consists of 2 female gender classes and 2 male gender classes

C. Research Instruments

Metacognitive Skill test (Schraw, G. & Dennison, R.S. (1994). Assessing metacognitive awareness. Contemporary Educational Psychology, 19, 460-475.), observation sheets, and meadia learning virtual reality on concept of mixture separation.

F. Research procedure

1. Preliminary Test
2. ADDIE (Analyze, Design, Develop, Implement, and Evaluate)
3. Final Stage (After conducting the assessment, then collecting the data on the results of the assessment and analyzing the results obtained).

G. Data Analysis Techniques

- Test normality and homogeneity.
- The amount of increase before and after learning is calculated by the normalized gain formula developed by (Hake, 1998)

H. Research Product

STEM Learning Media Virtual Reality Based on Self Paced Learning to Improve Metacognitive Skills

Expected Outcome:

- STEM Digital Learning Media assisted by Virtual Reality can improve metacognitive skills
- Publication in reputable international journals or national journals SINTA 1

References:

Allcoat, D.; von Muhlenen, A. Learning in virtual reality: Effects on performance, emotion and engagement. *Res. Learn. Technol.* **2018**, *26*, 2140.

Amanda Kathryn Nichols Hess, Oakland University Katie Greer. Designing for Engagement: Using the ADDIE Model to Integrate High-Impact Practices into an Online Information Literacy Course. Communications In Information Literacy | Vol. 10, No. 2, 2016

Cooper, G.; Thong, L.P. Implementing Virtual Reality in the Classroom: Envisaging Possibilities in STEM Education. In *STEM Education: An Emerging Field of Inquiry*; Brill: Leiden, The Netherlands, 2019.

Cowan, P.; Farrell, R. Using Virtual Reality to Support Retrieval Practice in Blended Learning: An Interdisciplinary Professional Development Collaboration between Novice and Expert Teachers. *Digital* **2023**, *3*, 251-272. https://doi.org/10.3390/digital3030016

Dong, Y., Wang, J., Yang, Y. *et al.* Understanding intrinsic challenges to STEM instructional practices for Chinese teachers based on their beliefs and knowledge base. *IJ STEM Ed* **7**, 47 (2020). https://doi.org/10.1186/s40594-020-00245-0

Hamilton, D.; McKechnie, J.; Edgerton, E.; Wilson, C. Immersive Virtual Reality as a Pedagogical Tool in Education: A Systematic Literature Review of Quantitative Learning Outcomes and Experimental Design. *J. Comput. Educ.* **2021**, *8*, 1–32.

Knowledge Management & E-Learning, Vol.14, No.3. Sep 2022 Using virtual reality technologies in STEM education: ICT pre-service teachers' perceptions Murat Çoban Nilüfer Okur Akçay İsmail Çelik Agri Ibrahim Cecen University, Turkey

Schraw, G. & Dennison, R.S. (1994). Assessing metacognitive awareness. Contemporary Educational Psychology, 19, 460-475.

Sheehan KJ, Hightower B, Lauricella AR, Wartella E. STEM Media in the Family Context: The Effect of STEM Career and Media Use on Preschoolers' Science and Math Skills. *European Journal of STEM Education*. 2018;3(3), 17. https://doi.org/10.20897/ejsteme/3877

Indoneisa: Mr Muhamad Taufiq, Universitas Pendidikan Indonesia

Title:

Development of STEM-Coding Team-Based Project Using Scratch to Increase Students' Creative Thinking and Collaboration Skills on Mechanics Concepts

Objectives:

Investigate the efficacy of a STEM-Coding Team-Based Project utilizing the Scratch programming platform in enhancing students' creative thinking and collaboration skills concerning mechanics concepts.

Background:

Universities are essential in increasing the nation's competitiveness in facing globalization and disruption in all fields. Higher Education Institutions, as providers of higher education, must be able to develop science and technology and produce intellectuals, scientists, and/or professionals who are cultured, creative, tolerant, democratic, have a tough character, and have the courage to defend the truth in the interests of the nation, as stated in Law of the Republic of Indonesia Number 12 of 2012 concerning Higher Education. In this context, higher education must be oriented towards directing student-centered learning with the principles of example, ability, and creativity development.

Creativity in the current era is recognized as an essential skill to face the challenges of the 21st century (Akkari & Maleq, 2020). Therefore, creativity has become a core goal at all levels of education (Snyder et al., 2019). Therefore, according to the paradigm that describes the characteristics of 21st-century learning, the learning process in higher education must be interactive, holistic, integrative, scientific, thematic, contextual, practical, creative, and collaborative. For this reason, higher education must be an environment where students can learn by conducting experiments and contextualizing them with real life, rather than just listening to abstract theoretical teachings, and also replace the competitive orientation in the learning process with cooperation or teamwork.

STEM is an approach that combines science with other fields to solve a problem (Sutaphan & Yuenyong, 2019; Priemer et al., 2020). This STEM approach encourages students to learn more actively and learn like scientists (Atkins et al., 2020) because learning is cohesive (Suwarma et al., 2019). Integrating STEM into learning can improve students' understanding of concepts, dispositions, and 21st-century skills (Chen et al., 2023). Two 21st-century skills that need to be trained to students in learning are student creative thinking and collaboration skills. Students need to master creative thinking skills, including fluency, flexibility, originality, and elaboration, collectively known as the "FOE" characteristics, to foster innovative problem-solving and generate unique ideas in educational settings (Shively et al., 2018). Collaboration involves two or more students working on a problem to achieve a common goal (Le et al., 2018). Collaboration skills are essential for students because students need good cooperation to help each other learn.

In line with the latest developments in Information and Communication Technology (ICT) in education, it has opened up new insights for more creative learning management. The use of information technology within the STEM (Science, Technology, Engineering, and Mathematics) framework in developing learning programs is expected to be more focused, flexible, able to improve students' creative thinking skills, visualize abstract science concepts through modeling, animation, and simulations that are more interesting and interactive. The Scratch application is a visual programming language based on coding blocks that makes it possible for beginner learning environments (pupils, teachers, students, or parents) to learn to create programs without having to think about miswriting the syntax (Erol & Çırak, 2022). Therefore, the STEM-Coding Team-Based Project learning method must be developed to train students' creative and collaboration skills.

Method:

Research and development methods using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) will be carried out to develop a STEM-Coding Team-Based Project Using Scratch to Increase Students' Creative Thinking Skills on Mechanics Concepts. The subjects of this research were students of the Science Education Study Program.

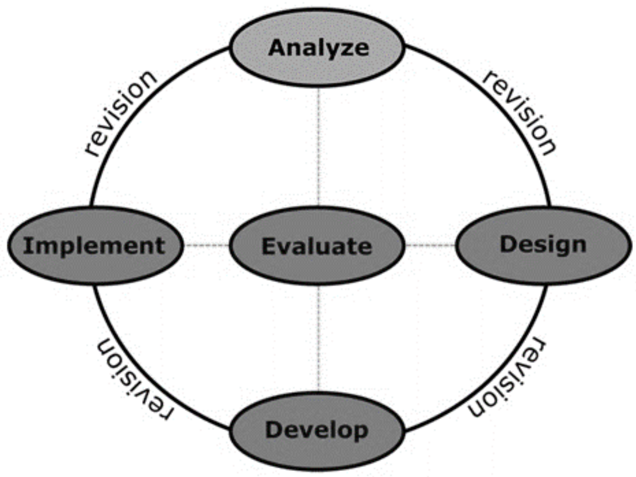

Figure 1. ADDIE procedure (Branch, 2009)

Expected Outcome:

The STEM-Coding Team-Based Project learning method developed is valid based on expert assessments and trials with students. Students show a positive tendency to solve mechanics problems. Students experience increased learning outcomes from indicators of creative thinking skills, including fluency, flexibility, originality, and elaboration. Students' collaboration skills improve significantly with each meeting. In general, there are significant differences in learning outcomes between the experimental class and the control class.

References:

Akkari, A., & Maleq, K. (2020). *Global citizenship education: Critical and international perspectives* (p. 217). Springer Nature.

Atkins, K., Dougan, B. M., Dromgold-Sermen, M. S., Potter, H., Sathy, V., & Panter, A. T. (2020). "Looking at Myself in the Future": How mentoring shapes scientific identity for STEM students from underrepresented groups. *International Journal of STEM Education*, *7*(1), 42.

Branch, R. M. (2009). *Instructional design: The ADDIE approach* (Vol. 722). New York: Springer.

Chen, S. K., Yang, Y. T. C., Lin, C., & Lin, S. S. (2023). Dispositions of 21st-Century Skills in STEM Programs and Their Changes over Time. *International Journal of Science and Mathematics Education*, *21*(4), 1363-1380.

Le, H., Janssen, J., & Wubbels, T. (2018). Collaborative learning practices: teacher and student perceived obstacles to effective student collaboration. *Cambridge Journal of Education*, *48*(1), 103-122.

Priemer, B., Eilerts, K., Filler, A., Pinkwart, N., Rösken-Winter, B., Tiemann, R., & Zu Belzen, A. U. (2020). A framework to foster problem-solving in STEM and computing education. *Research in Science & Technological Education*, *38*(1), 105-130.

Shively, K., Stith, K. M., & Rubenstein, L. D. (2018). Measuring what matters: Assessing creativity, critical thinking, and the design process. *Gifted Child Today*, *41*(3), 149-158.

Snyder, H. T., Hammond, J. A., Grohman, M. G., & Katz-Buonincontro, J. (2019). Creativity measurement in undergraduate students from 1984 to 2013: A systematic review. *Psychology of Aesthetics, Creativity, and the Arts, 13*(2), 133–143.

Sutaphan, S., & Yuenyong, C. (2019). STEM education teaching approach: Inquiry from the context based. In *Journal of Physics: Conference Series* (Vol. 1340, No. 1, p. 012003). IOP Publishing.

Suwarma, I. R., Kaniawati, I., & Kaniawati, D. S. (2019). Engaging Students in STEM Based Learning Through Media and Technology. *Journal of Physics: Conference Series*, *1204*, 012054.

South Korea: Mr So-Yoon Bang, Gyeongin National University of Education

Title: The Development and Application of SWH performance evaluation using AI and data -Focusing on Middle School 'Motion and Energy' Part
Objectives: This study aims to develop SWH performance assessment using AI and data, focusing on middle school 'Motion and Energy'. By applying the developed performance assessment to the evaluation of middle school students, we will analyze how it affects AI literacy, student initiative, scientific communication skills, and change in science concepts, and discuss its implications for teaching and learning.
Background: 1. SWH (Self-Inquiry Science Writing) and Scaffolding 2. Self-Inquiry Science Writing (SWH): Tools for Scientific performance 3. Science class using AI(artificial intelligence) 4. Science class using Data
Method: **1. Prior research** **2. Analysis of Achievement Standards 'Motion and Energy' of the 2022 Revised Science Curriculum in Middle School** **3. Pre-TEST :** 78 students from 7 classes in the 3rd grade of Y Middle School in Seoul 1) Artificial Intelligence Literacy Test (Sungwon Kim, 2022) 2) CTPS; Constructivist Teaching Practice Scale) test (Yager, 1991) 3) Scientific Communication Skills Test (SCST) 4) Scientific Concept Test Paper - Example) Mechanical Energy Concept Test (**2021, Wongeun Oh)** **4. Development of SWH Performance Evaluation Model (Internal Validation)** **5. Application of SWH Performance Evaluation Model (Extrinsic Validity)** **6. Post-TEST : 78 students** from 7 classes in the 3rd grade of Y Middle School in Seoul 1) Artificial Intelligence Literacy Test (Sungwon Kim, 2022) 2) CTPS; Constructivist Teaching Practice Scale) test (Yager,

1991)

3) Scientific Communication Skills Test (SCST)

4) Scientific Concept Test Paper - Example) Mechanical Energy Concept Test (2021, Wongeun Oh)

7. Student Semi-Structured Interviews (Qualitative Research)

Expected Outcome:

1. Improve AI literacy
2. Change in student initiative
3. Improve your scientific communication skills
4. Positive impact on students' changes in science concepts

References:

Aeran Choi (2010). Argument Structure in the Science Writing Heuristic (SWH) Approach. *J Korea Assoc. Sci. Edu, 30(3), 323-336.*

Anisa, Ari Widodo, Riandi and Muslim(2019). The Use of Scientific Writing Heuristics (SWH) to Build Rebuttal Abilities in Scientific Argumentation. *Jurnal Pendidikan Sains, 8(2), 180-195.*

Eunji Shin and Wonho Choi(2020). Middle School Science Gifted Students' Perceptions of the Effectiveness of Science Classes Using Science Writing Heuristic. *Journal of the Korean Chemical Society 64(5).*

Esra Kabataş Memiş(2015). Effects of an SWH Approach and Self-Evaluation on Sixth Grade Students' Learning and Retention of an Electricity Unit. *International Journal of Progressive Education, 11(3).*

Jang, Kyung-hwa·Nam, Jeonghee and Choi, Aeran(2012). The Effects of Argument-Based Inquiry Using the Science Writing Heuristic (SWH) Approach on Argument Structure in Students' Writing. *J Korea Assoc. Sci. Edu, 32(7), 1099-1108.*

Jieun Kang and Kyunghee Kang(2023). Effect of Heuristic Science Writing Classes on Middle School Students' Scientific Attitudes. *JOEC, 29(5), 341-359.*

Mehmet Erkol, Mustafa Kisoglu and Erdogan Büyükkasap(2010). The effect of implementation of science writing heuristic on students' achievement and attitudes toward laboratory in introductory physics laboratory. *Procedia Social and Behavioral Sciences 2 , 2310–2314.*

Myeong-KyeongShin(2008). Applying Science Writing Heuristic for Science Classes of Pre-service Elementary Teachers. *Gyeongin National University of Education.21(1), 49-55.*

Park, Chan-sol ・ Son and Jeongwoo(2020). The Effects of Data-based Scientific Inquiry Linked with Science Writing Heuristic(SWH) on

Elementary School Students’ Science Core Competencies. *Teacher Education Research, 59(2), 245-258.*

Saetbyeol Moon and Wonho Choi(2018). The Effect of High School Research Project using the Science Writing Heuristic. *Journal of the Korean Chemical Society, 62(5).*

Seong-Won Kim and Youngjun Lee(2022). The Artificial Intelligence Literacy Scale for Middle School Students. *Journal of The Korea Society of Computer and Information, 27(3), 225-238.*

Shin, Soyoung, Choi Aeran and Park Jong-Yoon (2013). The Effects of the Science Writing Heuristic Approach on the Middle School Students' Achievements. J Korea Assoc. Sci. Edu, 33(5), 952-962.

Sung, Hwamok·Hwang, Soyoung·Nam and Jeonghee(2012). Examining the Relation Between Students' Reflective Thinking and the Reading Framework in the Science Writing Heuristic (SWH) Approach. *J Korea Assoc. Sci. Edu, 32(1),146-159.*

Tseng, Ching-mei(2014). The effects of the science writing heuristic (SWH) approach versus traditional instruction on yearly critical thinking gain scores in grade 5-8 classrooms. *University of Iowa.*

Thailand: Dr. Rames Kaewmanee, Srinakharinwirot University

Title:

Development of DIY Metal Air Battery to Enhance High School Science Students' Conceptual Understanding in Electrochemistry through Inquiry-based Learning

Objectives:

1. To develop DIY Metal-Air Battery to promote students' conceptual understanding of electrochemistry through Inquiry-based learning.
2. To study the effectiveness of DIY Metal-Air Battery with Inquiry-based on high school science students' conceptual understanding of electrochemistry

Background:

Electrochemistry is a complex and abstract subject that requires a deep understanding of the underlying concepts and principles. However, many students find electrochemistry difficult to learn and often develop misconceptions and alternative conceptions. For example, some students may confuse the terms oxidation and reduction [1], or may not understand the role of electrons and ions in electrochemical reactions [2]. These difficulties and misconceptions may hinder students' ability to apply electrochemistry to real-world problems.

One of the indicators of the quality of science education in Thailand is the performance of Thai students in the Programme for International Student Assessment (PISA), which is a triennial international survey that evaluates the education systems of various countries by testing the skills and knowledge of 15-year-old students in mathematics, science, and reading. In the latest PISA test in 2022, Thai students ranked 66th among 79 countries in science, with an average score of 426, which is significantly lower than the OECD average of 489, and also lower than other ASEAN countries, such as Singapore, Vietnam, Malaysia, and Indonesia. Moreover, Thai students showed low proficiency in scientific inquiry skills, such as explaining phenomena scientifically, evaluating and designing scientific enquiry, and interpreting data and evidence scientifically [3-4].

These results suggest that the teaching and learning of science in Thailand still need a lot of improvement which refers to teaching strategies and activities that actively engage students' cognitive processes and inquiry skills [5], as opposed to simply having them passively receive information. As Electrochemistry is one of the most important concepts for high school students that emphasizes conceptual understanding, and applying the concepts to real-world problems. But, most literature suggests that students still have a lot of misconceptions related to Electrochemistry [6]. Therefore, it is crucial to develop and implement effective teaching strategies that can facilitate the acquisition of students in electrochemistry concepts [7]. Therefore, the question arises: How can electrochemistry be taught in a way that engages Thai students with deeper understanding and be able to apply the concepts they learned to solve the problems in their everyday life.

Conceptual Understanding in Electrochemistry

Conceptual understanding refers to the ability to grasp the meaning and significance of a concept, and to relate it to other concepts and contexts [8]. As electrochemistry involves multiple levels of representation, such as the macroscopic, sub microscopic, and symbolic levels. Therefore, it is important to improve students' conceptual understanding of electrochemistry, by providing them with appropriate learning experiences and scaffolds that can help them construct and revise their understanding, and test them against empirical evidence and logical reasoning in multiple levels of representation.

A Learning Innovation for Electrochemistry

The Learning Innovation of this research focuses on the importance of conceptual understanding in electrochemistry, achieved through an inquiry-based learning approach. This method involves conducting Hands-on experiments where students create batteries using materials commonly found at home. By combining practical skills with theoretical knowledge, students can better understand and tangibly apply electrochemical principles. The batteries they assemble can power toy cars, an exciting and real-world application of their learning. This approach is more interactive and engaging than traditional teaching methods. It improves students' understanding of the subject and highlights the practical applications of electrochemistry. The success of using household batteries to power toy cars demonstrates the potential of electrochemistry and its relevance in our daily lives. This educational model is a testament to the effectiveness of combining theoretical learning with practical application, making complex scientific concepts accessible and appealing to students [9].

This research aims to develop a metal-air battery that high school science students can construct as part of their inquiry-based learning process. The primary objective of this battery is to assist students in gaining a deeper understanding of electrochemistry concepts by enabling them to create and test a working battery. This battery is based on the constructivist theory of learning, which emphasizes the importance of interactive and meaningful interactions between learners, their environment, and others. Additionally, this innovation has the potential to enhance students' conceptual understanding of electrochemistry and promote a lifelong interest in science by allowing them to construct their knowledge through experimentation.

Method:

This study proposes a mixed-method, intervention research design involving 30 participants [10]. The research methodology will begin with a pre-test that assesses the student' Conceptual Understanding. Next, an intervention will be carried out, which involves a hands-on Metal Air Battery Lab to enhance the student' understanding of electrochemistry. Following the intervention, a similar post-test will be conducted to evaluate the educational impact. Additionally, interviews will be conducted to obtain insights into the students' experiences during the tests. The data collected will be analyzed by scoring and categorizing the student' conceptual understanding from the tests for quantitative assessment. The interviews will provide qualitative insights. By combining both types of analysis, we can comprehensively compare the pre-and post-intervention results, describing and interpreting the changes in the student's knowledge and conceptual grasp.

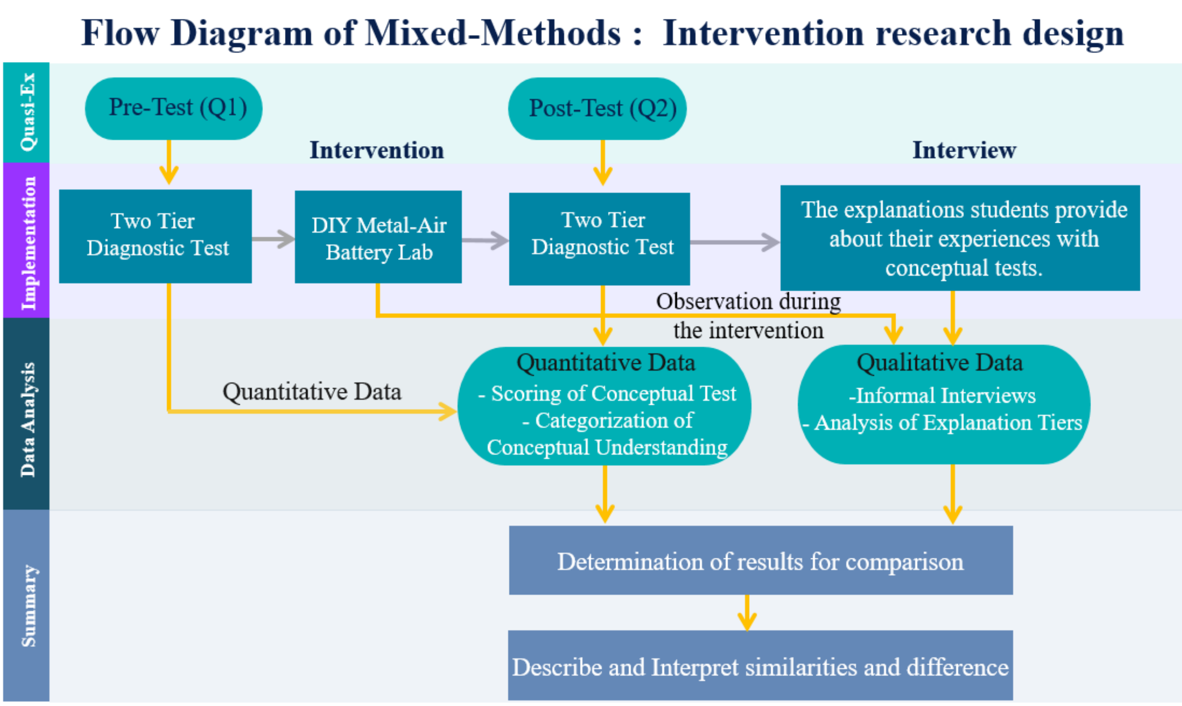

Fig. 1 Flow Diagram of Mixed-Methods: Intervention research design, (Creswell, and Creswell, 2017; 60)

Expected Outcome:

1. Students should demonstrate a statistically significant improvement in their understanding of electrochemical concepts.

2. Students should be able to bridge the gap between theoretical knowledge and practical application, using their learning to understand and predict real-world electrochemical reactions.

3. The students are expected to exhibit an enhanced ability to apply scientific principles to problem-solving and to reason logically through scientific questions.

4. The teachers and educators are able to apply the innovation and research method used in this study to enhance students' learning in challenging concepts or topics.

References:

[1] Shukla, A., & Kumar, T. P. (2023). Galvanizing electrochemical education. Journal of Solid State Electrochemistry. https://doi.org/10.1007/s10008-023-05508-8

[2] Nakıboğlu, C., Rahayu, S., Nakiboğlu, N., & Treagust, D. F. (2023). Exploring senior high-school students' understanding of electrochemical concepts: patterns of thinking across Turkish and Indonesian contexts. Chemistry Education. Research and Practice.

[3] Durongkaveroj, W. (2022). Recent developments in basic education in Thailand: issues and challenges. Social Science Research Network.

[4] Pholphirul, P., Rukumnuaykit, P., & Teimtad, S. (2023). Teacher shortages and educational outcomes in developing countries: Empirical evidence from PISA-Thailand. Cogent Education, 10(2).

[5] Kwangmuang, P., Jarutkamolpong, S., Sangboonraung, W., & Daungtod, S. (2021). The development of learning innovation to enhance higher order thinking skills for students in Thailand junior high schools. Heliyon, 7(6), e07309.

[6] Turner, K. L., He, S., Marchegiani, B., Read, S., Blackburn, J. B., Miah, N., & Leketas, M. (2023). Around the world in electrochemistry: a review of the electrochemistry curriculum in high schools. Journal of Solid State Electrochemistry.

[7] Orozco, M., Boon, M., & Susarrey-Arce, A. (2022). Learning electrochemistry through scientific inquiry. Conceptual modelling as learning objective and as scaffold. European Journal of Engineering Education, 48(1), 180–196.

[8] Stammes, H., Henze, I., Barendsen, E., & De Vries, M. J. (2022). Characterizing conceptual understanding during design-based learning: Analyzing students' design talk and drawings using the chemical thinking framework. Journal of Research in Science Teaching, 60(3), 643–674.
[9] Furlan, P. Y., Krupa, T., Naqiv, H., & Anderson, K. R. (2013). An Open-Ended project: building a high performance, yet simple, household battery. Journal of Chemical Education, 90(10), 1341–1345. https://doi.org/10.1021/ed4000603
[10] Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed method approaches (5th ed.). SAGE.

Hong Kong: Ms Jing Zhang, Education University of Hong Kong

Title:

A Three-Year Longitudinal Study on Online Graphical Programming Learning: Investigating the Effects of Self-Regulated Learning and Autonomous Motivation

Objectives:

This study will undertake Self-Determination Theory (SDT) and Social Cognitive Theory (SCT) to investigate the impact of autonomous motivation and self-regulated learning on sustaining and enhancing the online coding learning experiences of primary students in CT education over an extended period. Additionally, it aims to shed light on identifying the origins of autonomous motivation and strategies for effectively sustaining learning motivation in an online learning environment.

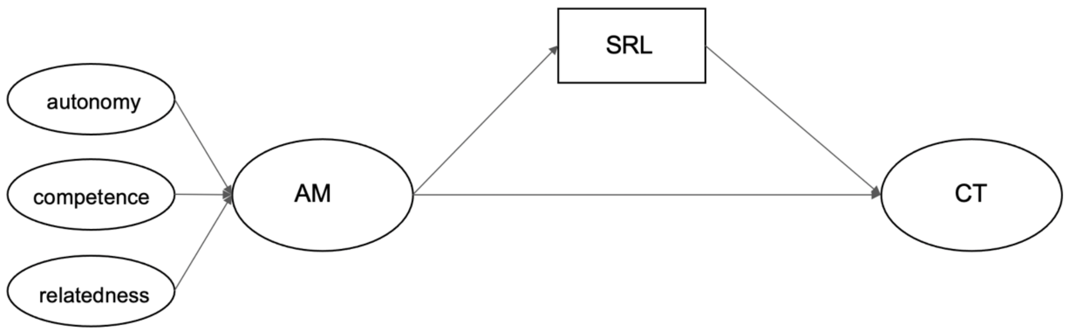

Fig.1 Proposed research model

Background:

In recent years, China has seen the emergence of numerous local graphical programming interfaces and a wide range of online courses dedicated to cultivating Computational Thinking (CT) in elementary school students. These initiatives align with the increasing significance of CT skills in the modern era. Designed to be interactive and captivating, these platforms and courses provide young students with an engaging approach to learning basic programming concepts and developing CT skills. Nonetheless, one of the significant challenges faced in this domain is sustaining students' long-term motivation in online programming education to effectively nurture CT skills.

Method:

Participants The study will engage primary school students from 2nd to 5th grade, utilizing data from Nemo, one of China's leading graphical programming educational platforms. Data collection is set to occur over three years, documenting the participants' experiences from the 2nd through the 5th grades.

Measures Instruments such as the Basic Psychological Need Scales (BPNS), Self-regulation Questionnaire Academic (SRQ-A), Online Self-Regulated Learning Questionnaire (OSLQ), Computational Thinking Scale (CTS), and tailored CT tasks will be employed.

Procedure The research will encompass two semi-structured interviews, one before and another after the questionnaire distribution, to document the learning experiences' dynamics. Questionnaires will be issued online in sections, allowing for breaks, with the entire procedure expected to last two weeks and be supervised by classroom teachers. Analysis will be carried out using Linear Regression Models (LRM) and Latent Growth Model (LGM) to assess the impacts of autonomous and self-regulated learning on sustained CT learning online.

Expected Outcome:

The research is anticipated to deepen the understanding of how motivation and self-regulated learning evolve in online coding education over time. It seeks to bridge the research gap in the arena of extended online programming studies within the Chinese educational landscape. Furthermore, it aims to develop CT assessment tools that are well-suited for Chinese primary school students, thereby enhancing the quality of coding education.

References:

Arfé, B., Vardanega, T., Montuori, C., & Lavanga, M. (2019). Coding in Primary Grades Boosts Children's Executive Functions. *Frontiers in Psychology*, *10*, 2713. Q2. https://doi.org/10.3389/fpsyg.2019.02713

Attane, P., & Kanjug, I. (2020). A Study of Learner's Mental Model and Motivation Using Constructivism Online Learning Environment to Promote Programming in Rural School. In T.-C. Huang, T.-T. Wu, J. Barroso, F. E. Sandnes, P. Martins, & Y.-M. Huang (Eds.), *Innovative Technologies and Learning* (Vol. 12555, pp. 361–366). Springer International Publishing. https://doi.org/10.1007/978-3-030-63885-6_40

Bachu, E., & Bernard, M. (2011). Enhancing computer programming fluency through game playing. *International Journal of Computing*, *1*(3).

Bers, M. U. (2018). Coding and Computational Thinking in Early Childhood: The Impact of ScratchJr in Europe. *European Journal of STEM Education*, *3*(3). https://doi.org/10.20897/ejsteme/3868

Buitrago Flórez, F., Casallas, R., Hernández, M., Reyes, A., Restrepo, S., & Danies, G. (2017). Changing a generation's way of thinking: Teaching computational thinking through programming. *Review of Educational Research*, *87*(4), 834–860. Q1.
Chou, P.-N. (2020). Using ScratchJr to Foster Young Children's Computational Thinking Competence: A Case Study in a Third-Grade Computer Class. *Journal of Educational Computing Research*, *58*(3), 570–595. Q2. https://doi.org/10.1177/0735633119872908
Colby, A., & Kohlberg, L. (1981). *Invariant sequence and internal consistency in moral judgment stages.*
Dichev, C., Dicheva, D., Angelova, G., & Agre, G. (2014). From gamification to gameful design and gameful experience in learning. *Cybernetics and Information Technologies*, *14*(4), 80–100.
Dignath, C., Buettner, G., & Langfeldt, H.-P. (2008). How can primary school students learn self-regulated learning strategies most effectively? *Educational Research Review*, *3*(2), 101–129. Q1. https://doi.org/10.1016/j.edurev.2008.02.003
Dirzyte, A., Vijaikis, A., Perminas, A., Rimasiute-Knabikiene, R., Kaminskis, L., & Zebrauskas, G. (2021). Computer Programming E-Learners' Personality Traits, Self-Reported Cognitive Abilities, and Learning Motivating Factors. *Brain Sciences*, *11*(9), 1205. https://doi.org/10.3390/brainsci11091205
Facey-Shaw, L., Specht, M., Van Rosmalen, P., & Bartley-Bryan, J. (2020). Do Badges Affect Intrinsic Motivation in Introductory Programming Students? *Simulation & Gaming*, *51*(1), 33–54. Q1. https://doi.org/10.1177/1046878119884996
Fessakis, G., & Prantsoudi, S. (2019). Computer Science Teachers' Perceptions, Beliefs and Attitudes on Computational Thinking in Greece. *Informatics in Education*, *18*(2), 227–258. Q1. https://doi.org/10.15388/infedu.2019.11
Giannakoulas, A., & Xinogalos, S. (2018). A pilot study on the effectiveness and acceptance of an educational game for teaching programming concepts to primary school students. *Education and Information Technologies*, *23*(5), 2029–2052. Q2. https://doi.org/10.1007/s10639-018-9702-x
Hava, K., Guyer, T., & Cakir, H. (2020). Factors That Enable or Hinder the Implementation of Game Development Activity in Learning Environments: In R. Z. Zheng (Ed.), *Advances in Educational Technologies and Instructional Design* (pp. 267–288). IGI Global. https://doi.org/10.4018/978-1-7998-3250-8.ch014
Higashi, R. M., Schunn, C., & Flot, J. (2017). Different underlying motivations and abilities predict student versus teacher persistence in an online course. *Educational Technology Research and Development*, *65*, 1471–1493. https://doi.org/10.1007/S11423-017-9528-Z
Jiang, S., & Wong, G. K. W. (2018). Are Children More Motivated with Plugged or Unplugged Approach to Computational Thinking?: (Abstract Only). *Proceedings of the 49th ACM Technical Symposium on Computer Science Education*, 1094–1094. https://doi.org/10.1145/3159450.3162270
Kafai, Y. B., & Burke, Q. (2014). *Connected code: Why children need to learn programming*. Mit Press.
Kalelioğlu, F. (2015). A new way of teaching programming skills to K-12 students: Code.org. *Computers in Human Behavior*, *52*, 200–210. Q1. https://doi.org/10.1016/j.chb.2015.05.047
Kim, Y. J., & Shute, V. J. (2015). The interplay of game elements with psychometric qualities, learning, and enjoyment in game-based assessment. *Computers & Education*, *87*, 340–356. Q1.
Korkmaz, Ö., Çakir, R., & Özden, M. Y. (2017). A validity and reliability study of the computational thinking scales (CTS). *Computers in Human Behavior*, *72*, 558–569. Q1. https://doi.org/10.1016/j.chb.2017.01.005

Kotini, I., & Tzelepi, S. (2015). A Gamification-Based Framework for Developing Learning Activities of Computational Thinking. In T. Reiners & L. C. Wood (Eds.), *Gamification in Education and Business* (pp. 219–252). Springer International Publishing. https://doi.org/10.1007/978-3-319-10208-5_12

Kynigos, C., & Grizioti, M. (2018). Programming Approaches to Computational Thinking: Integrating Turtle Geometry, Dynamic Manipulation and 3D Space. *Informatics in Education*, *17*(2), 321–340. Q1. https://doi.org/10.15388/infedu.2018.17

La Guardia, J., Ryan, R., Couchman, C., & Deci, E. (2000). Basic psychological needs scales. *Journal of Personality and Social Psychology*, *79*(3), 367–384. Q1.

Lu, O. H. T., Huang, J. C. H., Huang, A. Y. Q., & Yang, S. J. H. (2017). Applying learning analytics for improving students engagement and learning outcomes in an MOOCs enabled collaborative programming course. *Interactive Learning Environments*, *25*(2), 220–234. Q2. https://doi.org/10.1080/10494820.2016.1278391

Martinez-Lopez, R., Yot, C., Tuovila, I., & Perera-Rodríguez, V.-H. (2017). Online self-regulated learning questionnaire in a Russian MOOC. *Computers in Human Behavior*, *75*, 966–974. Q1.

Mega, C., Ronconi, L., & De Beni, R. (2014). What makes a good student? How emotions, self-regulated learning, and motivation contribute to academic achievement. *Journal of Educational Psychology*, *106*(1), 121–131. Q1. https://doi.org/10.1037/a0033546

Morales-Urrutia, E. K., Ocana, J. M., Perez-Marin, D., & Pizarro, C. (2021). Can Mindfulness Help Primary Education Students to Learn How to Program With an Emotional Learning Companion? *IEEE Access*, *9*, 6642–6660. Q2. https://doi.org/10.1109/ACCESS.2021.3049187

Niemiec, C. P., & Ryan, R. M. (2009). Autonomy, competence, and relatedness in the classroom: Applying self-determination theory to educational practice. *Theory and Research in Education*, *7*(2), 133–144. Q1. https://doi.org/10.1177/1477878509104318

Palti, A., & Rosenberg-Kima, R. (2021). A Microlearning Online Framework for Teaching Programming Basics. *Proceedings of the 52nd ACM Technical Symposium on Computer Science Education*, 1369–1369. https://doi.org/10.1145/3408877.3439554

Papavlasopoulou, S., Giannakos, M. N., & Jaccheri, L. (2019). Exploring children’s learning experience in constructionism-based coding activities through design-based research. *Computers in Human Behavior*, *99*, 415–427. Q1. https://doi.org/10.1016/j.chb.2019.01.008

Pérez-Marín, D., Hijón-Neira, R., Bacelo, A., & Pizarro, C. (2020). Can computational thinking be improved by using a methodology based on metaphors and scratch to teach computer programming to children? *Computers in Human Behavior*, *105*, 105849. Q1. https://doi.org/10.1016/j.chb.2018.12.027

Pintrich, P. R. (2003). A Motivational Science Perspective on the Role of Student Motivation in Learning and Teaching Contexts. *Journal of Educational Psychology*, *95*(4), 667–686. Q1. https://doi.org/10.1037/0022-0663.95.4.667

Potvin, P., & Hasni, A. (2014). Interest, motivation and attitude towards science and technology at K-12 levels: A systematic review of 12 years of educational research. *Studies in Science Education*, *50*(1), 85–129. Q1. https://doi.org/10.1080/03057267.2014.881626

Resnick, M., Maloney, J., Monroy-Hernández, A., Rusk, N., Eastmond, E., Brennan, K., Millner, A., Rosenbaum, E., Silver, J., Silverman, B., & others. (2009). Scratch: Programming for all. *Communications of the ACM*, *52*(11), 60–67. Q1.

Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: Examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, *57*(5), 749–761. Q1. https://doi.org/10.1037/0022-3514.57.5.749

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, *61*, 101860. Q1. https://doi.org/10.1016/j.cedpsych.2020.101860

Shao, J., Zhang, L., Ren, Y., Xiao, L., & Zhang, Q. (2018). Parent–Child Cohesion, Basic Psychological Needs Satisfaction, and Emotional Adaptation in Left-Behind Children in China: An Indirect Effects Model. *Frontiers in Psychology*, *9*, 1023. Q2. https://doi.org/10.3389/fpsyg.2018.01023

Shute, V. J., Sun, C., & Asbell-Clarke, J. (2017). Demystifying computational thinking. *Educational Research Review*, *22*, 142–158. https://doi.org/10.1016/j.edurev.2017.09.003

Smith, S. M., & Chen, C. (2015). MSLQ: Instrument validation of motivation and learning strategies for acquiring computer software application skills. *Issues in Information Systems*, *16*(3).

Tsai, M.-J., Liang, J.-C., Lee, S. W.-Y., & Hsu, C.-Y. (2022). Structural Validation for the Developmental Model of Computational Thinking. *Journal of Educational Computing Research*, *60*(1), 56–73. Q2. https://doi.org/10.1177/07356331211017794

Vrieling-Teunter, E., Henderikx, M., Nadolski, R., & Kreijns, K. (2022). Facilitating Peer Interaction Regulation in Online Settings: The Role of Social Presence, Social Space and Sociability. *Frontiers in Psychology*, *13*, 793798. Q2. https://doi.org/10.3389/fpsyg.2022.793798

Werneburg, S., Manske, S., Feldkamp, J., & Hoppe, H. U. (2018). Improving on guidance in a gaming environment to foster computational thinking. *Proceedings of the 26th International Conference on Computers in Education*, 676–685.

Wong, J., Baars, M., Davis, D., Van Der Zee, T., Houben, G.-J., & Paas, F. (2019). Supporting Self-Regulated Learning in Online Learning Environments and MOOCs: A Systematic Review. *International Journal of Human–Computer Interaction*, *35*(4–5), 356–373. https://doi.org/10.1080/10447318.2018.1543084

Xu, Q., Wu, J., & Peng, H. (2022). Chinese EFL university students' self-efficacy for online self-regulated learning: Dynamic features and influencing factors. *Frontiers in Psychology*, *13*, 912970. Q2.

Yu, J., Bai, C., & Roque, R. (2020). Considering Parents in Coding Kit Design: Understanding Parents' Perspectives and Roles. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–14. https://doi.org/10.1145/3313831.3376130

Yücel, Y., & Rızvanoğlu, K. (2019). Battling gender stereotypes: A user study of a code-learning game, "Code Combat," with middle school children. *Computers in Human Behavior*, *99*, 352–365. Q1. https://doi.org/10.1016/j.chb.2019.05.029

Zhang, S., Wong, G. K. W., & Chan, P. C. F. (2023). Playing coding games to learn computational thinking: What motivates students to use this tool at home? *Education and Information Technologies*, *28*(1), 193–216. Q2. https://doi.org/10.1007/s10639-022-11181-7

Zimmerman, B. J., & Martinez-Pons, M. (1988). Construct validation of a strategy model of student self-regulated learning. *Journal of Educational Psychology*, *80*(3), 284–290. Q1. https://doi.org/10.1037/0022-0663.80.3.284

China: Ms Xiaowan Jin, Capital Normal University

Title: Professional Learning in a Web-based Community of Practice of, by, and for Chinese elementary science teachers: A Narrative Inquiry
Objectives: This study aims to examine science teachers' participatory experience in a web-based community of practice (*XKW*), which serves the professional needs of Chinese elementary science teachers. Through a narrative inquiry, we examined science teachers' participatory experience in *XKW*, trying to inform two main research questions: ● What organizational features afford the science teachers' professional learning practices in the XKW community, and how do such features get constructed and fall into place? ● What characterizes science teachers' professional learning practices in the XKW community, and how does that contribute to their personal and community growth?
Background: Sustainable PD requires ongoing support not only from external experts but also through peer networks (Schlager & Fusco, 2004). Over the past two decades, the concept of teacher communities (TCs) gradually gained attention (Chen,2020; Vangrieken et al.,2017). With the proliferation of online collaboration tools in recent years, much effort has been made to develop sustainable and scalable TCs in web-based form (Schlager & Fusco, 2004). Evidence has accumulated regarding its positive effects on teaching practice and student achievement (Hord, 2004; Lomos et al., 2011). Previous work on web-based TCs showed its positive effects in organizing interaction and collaboration among teachers, promoting reflective dialogue and critical thinking, facilitating the dissemination and acquisition of practical knowledge, and enhancing individual teachers' professional beliefs (Hough et al., 2004; Selwyn, 2000; Stephens & Hartmann, 2004). However, some cases also report that teachers favor face-to-face interaction over its online substitute (Goos & Bennison, 2002; Stephens & Hartmann, 2004), show little commitment to online CoPs, and reduce participation over time (Selwyn, 2000). In such a situation, structured tasks involving mandatory contributions could not help sustain their interest or participation (Hough et al., 2004). These

contradicting findings suggested the need to better characterize how web-based CoPs afford effective professional learning (Grangeia et al., 2019; Malinen, 2015). While we know that PD's organizational and institutional contexts can shape teachers' participation and practices (Allen & Engel, 2015; Cobb et al., 2003), we do not know enough about their working mechanisms, especially for web-based communities.

Elementary School Science Teaching Network (Xiaoxue Kexuejiaoxue Wang, XKW hereafter) is an unofficial, web-based Chinese TC established and run by practitioners. Over time, it has grown into a preferred knowledge-sharing base for elementary science teachers of the region and gradually gained national recognition. Without administrative requirements or credit certification, many teachers devoted themselves to professional learning on XKW in their off-work time. The vitality of the community and its participants' spontaneous engagement in learning attracted our attention. We entered the field to understand how learning takes place in the community.

Theoretical Framework:

With joint enterprise (i.e., professional development), mutual engagement (i.e., create shared understandings/resources through interactions), and shared repertoire (i.e., use of shared resources and concepts in interactions), *XKW* qualifies as an instance of CoP (Lave & Wenger, 1991). It is also characterized by being virtual, that is, capable of going beyond the limitations in time, space, and social connections, and being decentralized and dynamic, that is, with many organizational features less set-ahead and more emergent in nature (Abedini, Abedin, & Zowghi, 2021; Schwen & Hara, 2003). To serve our research agenda, we adopt the following theoretical constructs:

- Teachers' professional learning practices can be characterized as knowledge sharing (Ardichvili, 2008), knowledge building (Hmelo-Silver & Barrows, 2008), or a mixture in terms of function; and as book knowledge, practical knowledge, and cultural knowledge in terms of content (Hara, 2007)
- From the perspective of sociocultural theory (Vygotsky, 1979), organizational contexts of
  CoP can be analyzed in two folds. On one hand, local organizational features such as the norms of interaction, the goals, the roles, and the participant relationships, shape the practices that can take place. On the other hand, the local organizational features should also be situated in its

broader contexts, that is, its history of interactions and the infrastructural environment.

Method:

Our narrative inquiry focuses on examining the teachers' professional learning experience on *XKW* as observed or told stories, framed by the metaphorical space of temporality, sociality, and place (Connelly & Cladinin, 2000). Diverse data were collected through 1) in-depth interviews with 20 participants, including the founders, the moderators, and active users of *XKW*; 2) non-participatory observations of a variety of *XKW*'s public and inner activities;and 3) records of and artifacts from previous activities on *XKW*. In the retelling of these stories, we attend to the types of learning practices the science teachers have engaged in, the aspects of organizational features that afford such practices; and the temporal, social, and cultural elements of the broader contexts that contribute to the emergence and development of the CoP. Through the process of storying, re-storying, and burrowing, we are attempting to build a mechanistic account on how *XKW*, as a self-organized online CoP, emerge and develop into a way of empowering Chinese elementary science teachers in their own professional development.

Expected Outcome:

- Introducing the community of practice framework and review how the existing literature characterizes learning and knowledge sharing in web-based CoPs.
- Adopting the lens of CoP and a sociocultural perspective, we attend to how the teachers' participations shaped and got shaped by the organizational contexts of XKW, gaining mechanistic insights into how this self-organized, web-based CoP developed into a way of empowering Chinese elementary science teachers in their own professional development.

References:

Abedini, A., Abedin, B., & Zowghi, D. (2021). Adult learning in online communities of practice: A systematic review. British Journal of Educational Technology, 52, 1663-1694.

Allen, C. D., & Penuel, W. R. (2015). Studying Teachers' Sensemaking to Investigate Teachers' Responses to Professional Development Focused on New Standards. Journal ofTeacher Education, 66(2), 136–149.

Ardichvili, A. (2008). Learning and Knowledge Sharing in Virtual Communities of Practice: Motivators, Barriers, and Enablers. Advances in Developing Human Resources, 10(4), 541-554.

Chen, X., Wei, G., & Jiang, S. (2017). The ethical dimension of teacher

practical knowledge: a narrative inquiry into Chinese teachers' thinking and actions in dilemmatic spaces. Journal of Curriculum Studies, 49, 518 – 541.
Cobb, P., McClain , K., de Silva Lamberg, T., & Dean, C. (2003). Situating Teachers' Instructional Practices in the Institutional Setting of the School and District. Educational Researcher, 32(6), 13-24.
Desimone, L. M. (2009). Improving Impact Studies of Teachers' Professional Development: Toward Better Conceptualizations and Measures. Educational Researcher, 38(3), 181- 199.
Goos, M., & Bennison, A. (2002, December). Building learning communities to support beginning teachers' use of technology. In Paper presented at the Annual Conference of the Australian Association for Research in Education. Brisbane, 1e5 December 2002.
Grangeia, T., de Jorge, B., Cecílio-Fernandes, D., Tio, R., & de Carvalho-Filho, M. (2019). Learn+Fun! Social media and gamification sum up to foster a community of practice during an emergency medicine rotation. Health Professions Education, 5(4), 321–335.
Hara, N. (2007). Information technology support for communities of practice: How public defenders learn about winning and losing in court. J. Assoc. Inf. Sci. Technol., 58, 76-87.
Hmelo-Silver, C. E. & Eberbach, C. (2012). Learning theories and problem-based learning. In S. Bridges, C. McGrath, & T. Whitehill (Eds.). Researching problem-based learning in clinical education: The next generation (pp. 3-17). New York: Springer
Hord, S. M. (2004). Learning together, leading together: Changing schools throughprofessional learning communities. New York, NY: Teachers College.
Hough, B., Smithey, M., & Evertson, C. (2004). Using computer-mediated communication to create virtual communities of practice for intern teachers. Journal of Technology and Teacher Education, 12, 361-386.
Lave, J., & Wenger, E. C. (1991). Situated learning: Legitimate peripheral participation:Cambridge University Press.
Lomos, C., Hofman, R.H., & Bosker, R.J. (2011). Professional communities and student achievement – a meta-analysis. School Effectiveness and School Improvement, 22, 121 – 148.
Luft, J. A., & Hewson, P. W. (2014). Research on teacher professional development programs in science.In S. K. Abell & N. G. Lederman (Eds.), Handbook of research on science education (Vol. II). New York, NY: Routledge.
Malinen, S. (2015). Understanding user participation in online communities: A systematic literature review of empirical studies. Computers in Human Behavior, 46, 228-238.
Schlager, M., & Fusco, J. (2004). Teacher Professional Development, Technology, and Communities of Practice: Are We Putting the Cart before

the Horse? In S. Barab, R. Kling, & J. Gray (Eds.), Designing for Virtual Communities in the Service of Learning (Learning in Doing: Social, Cognitive and Computational Perspectives, pp. 120- 153). Cambridge: Cambridge University Press.

Schwen, T.M., & Hara, N. (2003). Community of Practice: A Metaphor for Online Design? The Information Society, 19, 257 – 270.

Selwyn, N. (2000). Creating a "Connected" Community? Teachers' Use of an Electronic Discussion Group. Teachers College Record, 102(4), 750–778.

Stephens, A., & Hartmann, C. (2004). A successful professional development project's failure to promote online discussion about teaching mathematics with technology. Journal of Technology and Teacher Education, 12, 57-73.

Vangrieken, K., Meredith, C., Packer, T., & Kyndt, E. (2017). Teacher communities as a context for professional development: A systematic review. Teaching and Teacher Education, 61, 47-59.

Vygotsky, L. (1978). Mind in society: Development of higher psychological processes. Harvard University Press.

Westheimer, J. (2008). Learning among colleagues: Teacher community and the shared enterprise of education. In M. Cochran-Smith, S. Feiman-Nemser, &J. McIntyre (Eds.), Handbook of research on teacher education (pp. 756e782).Lanham, MD: Rowman: Reston, VA:Association of Teacher Educators.

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Title: An analysis of physics textbooks from different cultures: Revealing unique characteristics in Japanese and Chinese educational tradition to improve curriculum design.
Objectives: This research aims to conduct a comparative analysis of Japanese and Chinese physics textbooks with the objective of identifying the distinctive characteristics of Japanese textbooks and deriving valuable suggestions for educational practices and curriculum development.
Background: Transversal and broad abilities that are not limited to certain expertise are becoming more important as society changes. As a result, educational reform is gaining traction as a global trend based on a new perspective that includes skills, emotions, attitudes, and values. In light of this context, Japan initiated a review of its Courses of Study in 2018, with particular emphasis on three competencies (資質・能力), Similarly, in 2017 the Ministry of Education in China shifted its attention towards curricular imperative for secondary education that are centered around core competencies (核心素养) (MEXT,2018, MOE, 2020). Moreover, textbooks underwent revisions in alignment with the updated curricula. An analysis these educational reforms in textbooks offer valuable perspectives and recommendation for shaping future educational initiative.
Method: This research aims to investigate a comparative analysis of Japanese and Chinese physics textbooks with the objective of identifying the distinctive characteristics of Japanese textbooks and deriving valuable suggestions for educational practices and curriculum development.
Expected Outcome: Type of Knowledge in Textbooks Japanese Textbooks: It focuses on declarative knowledge, providing detailed explanations of the laws of universal gravitation, position energy, and deriving the period of artificial satellites. It is intended to promote scholarly understanding, evident in the presentation of the gravitational constant and the derivation of the second cosmic velocity.

Chinese Textbooks: It introduces declarative knowledge and touches upon scientific history, achievements in space development, and epistemological knowledge which include the achievement and limitation of Newtonian mechanics, and the role of inquiry nature for human beings.

Insights from the Comparison: Japanese textbooks emphasize scholarly understanding, focusing on cosmic velocity's derivation process and position energy treatment in universal gravitation. The goal of physics in Japan's Courses of Study states that students should "develop an attitude to engage with physical things and phenomena on their initiative, and to explore them scientifically" (MEXT, 2018, p. 62). Further, it points out that “it is important to set up situations that enable students to realize the usefulness of science in daily life and in society” (MEXT, 2018, p.63). To achieve the goal, the utility of science and the development of attitudes may need to be described in textbooks, providing insights into History of science, the outcomes, and limitations of Newtonian mechanics and relating them to everyday life and societal contexts.

References:

Ministry of Education [MOE]. (2020). *普通高中物理课程标准* [National curriculum standards for senior secondary school]. [in Chinese]

Ministry of Education, Culture, Sports, Science and Technology [MEXT]. (2018). *高等学校学習指導要領理数編理科編* [The Course of Study for upper secondary science: Guideline]. [in Japanese] Retrieved from https://www.mext.go.jp/content/20211102-mxt_kyoiku02-100002620_06.pdff (Accessed December 15, 2023).

Peng, Q. C., Huang S. (Eds.). (2019). *普通高中物理教科书 必修第二册* [Physics book 2] [in Chinese]. Shanghai: People’s Education Press.

Maeda, K et.al. (Eds.). (2022). *物理* [Physics] [in Japanese]. Tokyo: Tokyo Shoseki.

Research Proposal EASE Winter School 2024

Group 5

Indonesia: Ms Eliyawati, Universitas Pendidikan Indonesia

Title:

Identifying Science Teacher Competencies to Teach Education for Sustainable Development (ESD) in East Asian Countries: A Survey Research

Objectives:

Identify science teacher competencies to teach ESD in several East Asian Countries.

Background:

The achievement of ASEAN countries in sustainability somehow needs improvement (Ding & Beh, 2022). Education can play a central role in achieving the Sustainable Development Goals (SDGs). It means that Education is not only one of 17 SDGs but also the way to achieve SDGs. Education for Sustainable Development (ESD) implies the need for everyone to promote sustainable development through education (Palomino, Burgos-García, & Martinez-Valdivia, 2021). ESD provides opportunities to acquire knowledge, skills, value, and attitude on sustainability to develop an equitable lifestyle and achieve positive long-term social transformation (Joseph & Said, 2019). ESD can address sustainable development challenges and contribute to present and future well-being.

In contrast to the previous finding that science teachers were less suitable to teach ESD (Borg, Gericke, Höglund, & Bergman, 2012), in the context of Indonesia, science teachers are in a better position to teach ESD compare to other subjects. When the government introduced "Environmental Education" as a school subject, it was science teachers who were appointed to teach the subject. Indeed, there are challenges in incorporating ESD principles into science lessons. Firstly, science teachers view ESD as content. As a result, the essence of ESD as action-oriented and integrated subjects are not sufficiently implemented (Sinakou, Donche, & Petegem, 2022). Analysis of student textbooks for environmental education also shows that the books are content-oriented (Eliyawati, Widodo, Kaniawati, & Fujii, 2022). Secondly, integrating the three dimensions of ESD into science lessons also presents a unique challenge for science teachers (Murphy et al., 2021). Science teachers are "science-minded" and less pluralistic (Borg et al., 2012) that make it difficult to relate the social and economic aspects of ESD. Therefore, the science teacher must be trained to incorporate ESD into lessons (Anyolo, Kärkkäinen, & Keinonen, 2018). However, there is still much discussion on how national policies and training initiatives can effectively support teacher education to solve issues with sustainable development (Manasia, Ianos, & Chicioreanu, 2019).

The significance of teacher training in the instruction of ESD requires preparation. This preparation encompasses acquiring ESD knowledge and the pedagogical skills in teaching ESD effectively. Numerous scholarly investigations have been conducted to elucidate the concept of teacher preparedness in delivering ESD (Manasia et al., 2019). No one has yet described the identification of science teachers' competencies to teach ESD. It is very urgent to analyze science teachers competencies to teach ESD. The result of science teachers' readiness to teach ESD in Indonesia shows that the teachers are not prepared to teach ESD in any competencies. Comparing this result with several East Asian Countries is really needed. How the science teacher can prepare, implement, and evaluate ESD based learning as well as their attitudes toward professional development. Therefore, this research attempts to identify science teacher competencies to teach ESD in several East Asian Countries.

Method:

The research design that will be used is survey research. The participants for this research are the science teachers who implement ESD-based learning in China, Taiwan, Hong Kong, Japan, Korea, Thailand, and Indonesia. The data will be gathered through online questionnaires using a Likert scale of 1-4 with a description of the scale range strongly disagree to strongly agree. The science teacher competencies to teach ESD are an instrument used in this research. This instrument combined science teachers' competencies and ESD teachers' competencies. It has already been developed and validated (E. Eliyawati, Widodo, Kaniawati, & Fujii, 2023). The instrument consists of six primary standards of science teachers' competencies to teach ESD, i.e., pedagogical content knowledge, inquiry, professional practice, professional development, evaluation and assessment, and attitude. The data will be analyzed by calculating statistical description (mean and standard deviation) and Rasch analysis.

Expected Outcome:

There is a collaboration among East Asian Countries students to conduct research supervised by EASE. The competencies of science teacher in teaching ESD can be identified and analyzed by comparing the result among several countries. The results of the research will be reported in an article that will be submitted to the Scopus journal.

References:

Anyolo, E. O., Kärkkäinen, S., & Keinonen, T. (2018). Implementing education for sustainable development in Namibia: School teachers' perceptions and teaching practices. *Journal of Teacher Education for Sustainability, 20*(1), 64-81.

Borg, C., Gericke, N., Höglund, H.-O., & Bergman, E. (2012). The barriers encountered by teachers implementing education for sustainable development: Discipline bound differences and teaching traditions. *Research in Science & Technological Education, 30*(2), 185-207.

Ding, D. K., & Beh, S. E. (2022). Climate Change and Sustainability in ASEAN Countries. *Sustainability, 14*(2), 1-17.

Eliyawati, Widodo, A., Kaniawati, I., & Fujii, H. (2022). Education for Sustainable Deevelopment (ESD in Students' Textbooks. *Journal of Engineering Science and Technologi, 17*(Spesial Issue), 50-57.

Eliyawati, E., Widodo, A., Kaniawati, I., & Fujii, H. (2023). The Development and Validation of an Instrument for Assessing Science Teacher Competency to Teach ESD. *Sustainability, 15*(4), 3276. doi:https://doi.org/10.3390/su15043276

Joseph, C., & Said, R. (2019). Student Engagement: Catalyst to Achieve the Sustainable Development Goal. *Quality Education. Encyclopedia of the UN Sustainable Development Goals; Leal Filho, W., Azul, A., Brandli, L., Özuyar, P., Wall, T., Eds*, 812-820.

Manasia, L., Ianos, M. G., & Chicioreanu, T. D. (2019). Pre-service teacher preparedness for fostering education for sustainable development: An empirical analysis of central dimensions of teaching readiness. *Sustainability, 12*(1), 166.

Murphy, C., Mallon, B., Smith, G., Kelly, O., Pitsia, V., & Martinez Sainz, G. (2021). The influence of a teachers' professional development programme on primary school pupils' understanding of and attitudes towards sustainability. *Environmental Education Research, 27*(7), 1011-1036.

Palomino, M., Burgos-García, A., & Martinez-Valdivia, E. (2021). What does education for sustainable development offer in initial teacher training? A systematic review. *Journal of Teacher Education for Sustainability, 23*(1), 99-114.

Sinakou, E., Donche, V., & Petegem, P. V. (2022). Action-orientation in education for sustainable development: Teachers' interests and instructional practices. *Journal of Cleaner Production, 370*(133469).

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Title:

Investigating Students' Metacognition and Problem Solving Skilss through GPT-Assisted Learning: Combining SSI-Contextualized Chemistry Teaching

Objectives:

Therefore, this study is expected to answer the following three research questions:

1. How do students use GPT in learning chemistry and their views on using it?
2. How to implement effective GPT-assisted chemistry learning with the context of SSI?
3. How is the effect of GPT-assisted chemistry learning on students' metacognition and problem solving skills?

Background:

Socioscientific issues (SSIs) are problems that require scientific knowledge, critical thinking, and ethical considerations to resolve. For example, climate change, genetic engineering, and vaccination policies are all SSIs that require individuals to apply scientific knowledge, ethical considerations, and critical thinking to develop effective solutions. Research has shown that using SSIs as learning contexts can foster the development of problem-solving skills in students (Anggun & Rahayu, 2023; Zamakhsyari & Rahayu, 2020). Problem-solving skills are essential in socioscientific contexts as they enable individuals to identify, analyze, and address complex issues that arise at the intersection of science and society. However, according to a research, just 8% of chemistry students demonstrated advanced problem-solving abilities (Chen, Wilson, & Lin, 2019). On the contrary, developing strong problem-solving abilities is essential to learning chemistry since these abilities help one come up with solutions for chemistry-related issues in daily life (Shadle, Brown, Towns, & Warner, 2012). Providing lessons that can help students become more adept at problem-solving thus becomes evermore important.

Problem solving can be defined as "encouraging tasks that have been previously assigned to you." Different perspectives on problem solving define it as "the process of tackling unfamiliar problems that have not yet been fully understood" (Rickey & Stacy, 2000). The problem solving heuristic (rule of thumbs), communities of practice, affect and belief, control and monitoring (metacognition), and problem solving heuristics are factors that hinder problem solving skills in students (National Council of Teachers of Mathematics, 1992).

Other literature also suggests that students' success in problem-solving is influenced by metacognitive strategies (Cooper & Sandi-urena, 2009).

Since the middle of the 1970s, the word "metacognition" has been used extensively in psychology and education. The term "thinking about one's own thinking" refers to metacognition. Understanding that metacognition is more than just reflection is essential (Flavell, 1979). It makes pupils conscious of how they think and how they organize their solutions to problems. Conceptual thinking and problem-solving abilities are significantly shaped by metacognition. Yet there is still a lack of knowledge regarding the significance of metacognition in the learning process (Rickey & Stacy, 2000). Some chemistry teachers have an incorrect understanding of metacognition and believe they have no obligation to help students grow as learners (Heidbrink & Weinrich, 2021). In reality, to help students continue to learn, it is crucial to educate them metacognitive skills (Muteti et al., 2021). Additionally, students who possess strong metacognition also perform better (Mutambuki, Mwavita, Muteti, Jacob, & Mohanty, 2020; Oyelekan, Jolayemi, & Upahi, 2019). It is crucial to foster students metacognition during the learning process.

One chatbot-based artificial intelligence (AI) product is Generative Pre-Trained Transformer (GPT). GPT is capable of producing text that resembles human responses, just as AI in general is capable of cognition and decision-making processes. With the introduction of Open AI's ChatGPT in November 2022, the use of GPT in a variety of disciplines expanded dramatically. The use of GPT becomes more versatile with more broad capabilities, especially in education and learning (Farazouli et al., 2023). Within the educational setting, GPT can assist students with their assignments, provide flexible, tailored learning, and aid in the acquisition of new skills (Labadze & Grigolia, 2023). The GPT has the capacity to influence how students' metacognition develops, which in turn influences how well they solve problems.

In regard to this, the research effort will concentrate on enhancing chemistry education by SSI context integration with GPT and evaluating its impact on problem-solving and metacognition. Students should be able to demonstrate improved metacognition and problem-solving skills. Furthermore, the knowledge imparted can help students use GPT in chemistry classes more appropriately

Method:

This research is qualitative research that uses a case study research design. The steps of the study process were as follows: (1) creating a learning plan; (2) implementing GPT into integrated learning; (3) gathering relevant data; and (4) analyzing research data. Surveys, in-depth interviews, and the acquisition of usage logs and replies from GPT were all used to gather data. NVIVO software was utilized to assist in the thematic analysis of the data.

Expected Outcome:

The following are the expected outcomes of this study:

1. A overview of the GPT's application in chemistry education, including reasons for using it, how to respond to answers, and how to use prompts, as well as their opinions on its application (ethics, benefits, and drawbacks)
2. Use a chemistry education approach that incorporates GPT within the framework of SSI
3. Receiving understanding of how intended learning affects problem-solving and metacognition skills.

References:

Anggun, C., & Rahayu, S. (2023). The development of ill-structured problem-solving skills test using local socio-scientific issues (SSI) on the topic of solution chemistry. *The 5th International Conference on Mathematics and Science Education (ICoMSE)*, (January). AIP Publishing. https://doi.org/10.1063/5.0113477

Chen, Y., Wilson, K., & Lin, H. (2019). Research and Practice Identifying the challenging characteristics of systems thinking encountered by undergraduate students in chemistry problem-solving of gas laws. *Chemistry Education Research and Practice*, *20*, 594–605. https://doi.org/10.1039/c9rp00070d

Farazouli, A., Cerratto-pargman, T., Bolander-laksov, K., Farazouli, A., Cerratto-pargman, T., Bolander-laksov, K., … Cerratto-pargman, T. (2023). Assessment & Evaluation in Higher Education Hello GPT ! Goodbye home examination ? An exploratory study of AI chatbots impact on university teachers ’ assessment practices Hello GPT ! Goodbye home examination ? An exploratory study of AI chatbots impact o. *Assessment & Evaluation in Higher Education*, *0*(0), 1–13. https://doi.org/10.1080/02602938.2023.2241676

Flavell, J. H. (1979). Metacognition and Cognitive Monitoring A New Area of Cognitive — Developmental Inquiry. *American Psychologist*, *34*(10), 906–911.

Shadle, S. E., Brown, E. C., Towns, M. H., & Warner, D. L. (2012). A Rubric for Assessing Students ' Experimental Problem-Solving Ability. *Journal of Chemical Education*, *89*(1).

Zamakhsyari, Z., & Rahayu, S. (2020). Fostering ill-structured problem-solving skills of chemistry students using socioscientific issues as learning contexts. *The 3rd International Conference on Mathematics and Sciences Education*, (April). AIP Publishing. https://doi.org/10.1063/5.0000533

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Title:

The Development Of A Learning Model To Enhance Scientific Media Literacy Skills For Grade 8 Students

Objectives:

1. To develop the learning model to enhance scientific media literacy skills for grade 8 students.
2. To study scientific media literacy skills in grade 8 students through a learning model.

Background:

The world has entered the 21st century where science and technology are developing rapidly. Information media and technology are undeniably essential to life. Most of our daily activities rely on both information and technology. These factors unconsciously influence human thoughts, beliefs, and behaviors. Furthermore, humans spend almost all of their time in information media and technology. When people often see or hear any advertisements, many people mistakenly believe in those advertisements. If we have poor immunity, we will be a victim of media exposure. It is the origin of the important concept that children and juveniles must have knowledge and skills in accessing resources for media literacy as well [2]; [3].

In advanced technology era, students should have essential literacy skills such as Information Literacy, Media Literacy and ICT Information, Communications & Technology Literacy. Hence, The P21 indicated that all those essential skills especially Literacy skills; Information Literacy, Media Literacy and ICT Information, Communications & Technology Literacy, are related to 5 components of Media Literacy as follows: 1) Accessing Skill is ability to collect relevant and useful information properly and be able to understand content in any media efficiently 2) Analyzing Skill is ability to not only examine the type, structure and sequence of media, but also comprehend the concept of artistic, social, political, and economic in media context 3) Evaluating Skill is ability to relate their own experiences and judge the quality and relevance in media 4) Creating Skill is ability to express their opinions using various technology; essay, oral, sound and/or image, to deliver their message efficiently 5) Participating Skill is ability to engage and interact which have a great result in collaboration with others [1].

Science and technology have been advancing and developing rapidly which is a concern for the safety and impact of science and technology on life, society, economy, and environment. Controversial issues have emerged within society related to science. Currently, social issues related to science in daily life include cloning, stem cells, genetically modified organisms (GMOs), global warming, or alternative fuels. These controversial scientific issues are discussed by society with diverse opinions. In the future, these issues will tend to be increased and can be found in medias such as television, newspapers, magazines, journals, and social media online [4]; [5]. Moreover, the present Thai society has reflected that some people lack scientific knowledge and believe exaggerated advertisement of various goods and services as well as supernatural and unscientific phenomena that cannot be verified on the basis of science. Consequently, children and juveniles should be skilled in media literacy on social issues. If children and juveniles do not have good immunity, it can cause misunderstandings on scientific issues severely.

Scientific media literacy skills are the ability of individuals to access science-related media such as images, videos, infographics, newspapers, and social media by being able to analyze, interpret, or discern the content of science-related media and evaluate the credibility of science-related media to protect yourself from unwanted media. Moreover, it can create a wide range of science-related materials while participating in commenting and hearing about science-related media for oneself and others.

Nowadays, we can't deny the fact that media is an important factor in daily life, because our routine life needs information and technology to make our life easier and more comfortable. However, it was found that most of grade 9 student in OBEC Bangkok has Information Literacy skills at 2nd from 4, Understanding but couldn't analyze and evaluate media efficiently (Kitnuch Santawee, 2010), which means students can be easily manipulated by media (Visalak Sithkhunthod, 2008). 57.87% of Students in grade 6 in Nonthaburi has Media Literacy in average 26.62 in Good and 15.51 has no media literacy skills (Wandee Saengpratheepthong and Tassanee Chartthai, 2019) and from Media Literacy Skills surveys in 324 of secondary level students in Srisaket using Media Literacy Skills evaluation test in Rating Scale format, it as found that students gain Media. Literacy Skills in Good rank and when we investigate each factor, we also found that average point of Accessing Skills factor is higher than Evaluating skills. Creating skills Participating skills and Analyzing skills accordingly (Julalat Bussabong, 2020). While Study of Scientific Media Literacy that surveyed Scientific Media Literacy of Grade 7 students in SESAO Samut Prakan found that average of Scientific Media Literacy is in Low to Average rank which means students is lack of Accessing Analyzing Evaluating Creating and Participating skills with no awareness about how media doing business or having hidden agenda which can cause misunderstanding.

Teaching by narrating knowledge and experience to students is now not enough to encourage students necessarily competencies in 21st century. Teacher needs to encourage learning in digital age, especially in Science Mathematics and Technology which is foundations of life for crystallization of thinking. (PMST, 2021) From stated problems, educators is looking for Learning model to encourage Media Literacy Skills in students, for example 4ACA (AAAACA) (Nithida Wiwatpanich 2558) DACISR *(DCIR Instructional process on Media Literacy) (Chairat Tosila, 2555; isarat Rodbonkhong,, 2559) Scenario—based Learing (Warakorn Sirisith, 2563) Thinking-based Learning (Natcha Pakitfuangfoo, 2559) Analyzing and Evaluating Thinking Process (Wisuthiwat Ta-Pham, 2558) Blended Learning Model based on cooperative learning using resource-based learning (Napaporn Yodsin, 2562) Project-based Learning (Friesem, 2019b) The 5E's of Inquiry-Based Learning (Sumalee Chuachai, 2560) and Stimulation teaching method (Sumalee Chuachai, 2560). After studied all of mentioned theories, limitation of Learning model or teaching method encouraging Media Literacy Skills were found, which are, (1) Learning models are not able to encourage in every aspect or partly encourage but not cover in every behavior, especially Creating Skills cannot encourage student media creation using knowledge construction. (2) Some Learning model can't combine Information Media and Technology usage into classroom which is the reason why students lack of instrument to access retrieve create or be a portal to broadcast their media as a part of media engagement. (3) Some Learning model is not flexible enough for online learning since learning only in classroom will limit students' creating skills or to take part in any other media criticism meanwhile teacher also can't observe student learning behavior and communication between teacher and student is also limited if using only online. (4) Sampling of each Learning model used in each level has their own difficulties concerning student knowledge level. After been researching Media Literacy Skills Learning model characteristics, it was found that most of Learning model started by having student identify controversial media or teacher presenting such media then using question to encourage student to analyze media and let student research and explore related information to analyze evaluate and synthesis solution to collected knowledge and do some presentation. After that, student and teacher dispute and evaluate their assignment together. In this procedure, teacher can evaluate student Media Literacy Skills using various evaluation instrument or method. After mentioned teaching method analyzation, it was found that all of stated Learning models are parts of Constructivism theory.

After researching, limitation of the 5 E's of Inquiry-based Learning to encourage higher Scientific Media Literacy Skills was found since it couldn't encourage Analyzing Evaluating Creating and Participtating efficiently. (Sumalee Chuachai, 2560) Moreover, Media Analyzing and Evaluating skills encourage ways is to have student practice critical thinking in student to be not manipulated by presenting media. 5 core question of Media Literacy can be used in researching analyzing and evaluating content to solve the question (Friesem, 2019b; Mackenzie, 2020; Sperry, 2012; Tomorn Aphiwanthanakorn, 2552) by group discussion (Center for Media Literacy, 2008; Friesem, 2019a; Pornthip Yenjabok, 2558) to engage with media and conclude new scientific knowledge. Creating skills could be promote by having student create media in their own ways to convey scientific knowledge which Cooperative learning may be required to plan the media; concept planning, adaptation, and broadcasting, which can encourage Media Literacy Skills in better aspect of Creativity and Engagement. (Center for Media Literacy, 2008; Friesem, 2019a).

The primary goal of this study is to develop learning model to encourage Scientific Media Literacy skills in Grade 8 students as a way yo develop Constructivism learning process, encourage Scientific Media Literacy 21st Century Skills in student.

Method:

This Research is a dynamic process that can be organized into four stages: 1) Exploring and Investigating, 2) Development, 3) Try out and Revision and 4) Implementation. Based on research and development research design.

1) Exploring and Investigating

Study basic information in learning model development, research methodology for concept, theories, problem condition method of Scientific Media Literacy Skills.

2) Development

The aim of this stage was to design the instructional processes of Scientific Media Literacy Skills.

3) Try out and Revision

The aim of this stage is to test the learning model with 40 trial sampling in Basic Science subject of Grad 8 students indicated in developed lesson plan. After trial, Analyzing the result in appropriateness of content of learning activity, time usage, learning resource and learning evaluation. And gather problems and solution to adjust before using with sampling population.

4) Implementation

The aim of this stage is to use developed Scientific Media Literacy skills learning model and lesson plan that validated in previous stage to study effectiveness of learning model based in Mixed-Method research using Embedded design (Edmonds, 2017, pp.189-195) with quantity as primary and quantity as secondary. Scientific Media Literacy skills Test was used for quantitively research and collecting information of learning as quality research. Compare test result and interpret collected data of learning behavior accordingly.

Expected Outcome:

- To get a learning model to enhance scientific media literacy skills for grade 8 students.

- To know scientific media literacy skills in grade 8 students after learning through a learning model

References:

Center for Media Literacy. (2008). *Literacy for the 21st century: An overview & orientation guide to media literacy education.* (2nd ed.). Malibu. CA: Center for Media Literacy.

European Commission, (2007). *A European Approach to Media Literacy in the Digital Environment*. Retrieved April 16,2019, from www.europa.eu/avpolicy/media_literacy/does/com/en.pdf.

Hobbs, R, (2003). Measuring the acquisition of media – literacy skills. *Reading Research Quartery*, 38(3), 330-355. Retrieved April 16,2019, from https://mediaeducationlab.com/sites/default/files/Hobbs_and_Frost_RRQ_2003_0.pdf.

Nuangchalerm, P. 2008. Socioscientific in science learning. *Journal of Education Mahasarakhham University. 2*(3): 99-106.

Zeidler, D. L., Walker, K. A., Ackett, W. A., & Simmons, M. L. (2002). Tangled up in views : Beliefs in the nature of science and responses to socioscientific dilemmas. *Science Education, 86*(3), 343-367.

Thailand: Mr Witsanu Suttiwan, Khon Kean University

Title:

Science teacher’s competencies in transformative learning for sustainable development in the school context

Objectives:

To study and develop the theoretical framework of science teacher’s competency of transformative learning for sustainable development.

Background:

The term "well-being" is widely recognized in education, aligning with the United Nations' (UN) goal to achieve global well-being by 2030 through its Sustainable Development Goals (SDGs). These goals encompass diverse aspects like zero hunger, good health, climate action, and quality education. The UN emphasizes preparing citizens to be socially and environmentally responsible (United Nations, 2015). The OECD's "Learning Compass 2030" outlines an educational approach for quality urban development, focusing on core foundations, competencies (knowledge, skill, attitude, and value), and transformative competencies, fostering students' potential and transformative abilities (Organization for Economic Co-operation and Development, 2019; Srisawat & Yuenyong, 2021)

Following UN and OECD guidelines for transformative learning, educators have introduced the Constructivist Values Learning Environment (CVLE), aligning with Elisabeth Taylor's proposal for a transformative education environment. CVLE aims to cultivate meaningful education by fostering values, awareness, and societal/environmental responsibility. Taylor emphasizes collaborative learning, shared learning, collective decision-making, self-reflection, and addressing environmental issues. These activities prompt students to shift their frame of reference, particularly through self-reflection, clarifying thoughts, and influencing behavior. CVLE is grounded in transformative and constructivist learning theories (Mezirow, 2009; Rahmawati et al., 2021; E. Taylor, 2022; P. C. Taylor, 2014; Tobin & Tippins, 1993). In Thailand, education reform policies, particularly in transformative learning, are gaining traction among scholars, notably in teacher training at universities.

I worked at the Department of Science, Faculty of Education, Valaya Alongkorn Rajabhat University in Pathum Thani before pursuing a PhD in Science Education at Khon Kaen University. Apart from teaching, I supervised pre-service science teachers, discovering their strong interest in traditional textbook learning methods with minimal student engagement. During my doctoral studies at Khon Kaen University, my advisor, Chokchai, introduced me to the science educator apprenticeship approach. Collaborating on coaching and mentoring pre-service science teachers in Thailand, I encountered various challenges in their development. This experience led to my research question: What is the theoretical framework of science teacher's competency of transformative learning for sustainable development in the school context, and how can these findings enhance the competency of pre-service science teachers in the future?

Method:

This study is qualitative and follows the interpretive paradigm. In order to find answers to research questions and objectives, qualitative methods such as literature reviews, documentary synthesis, expert dialogue discussions, and content analysis will be used in research. *"What is the theoretical framework of science teacher's competency of transformative learning for sustainable development in the school context?"* This is the focus of the study. Trustworthiness will be considered to validate quality standard of methodology in this research.

This study will be carried out in the manner listed below in order to address research questions and meet research objectives:

1. Synthesize recommendations and the status quo of transformative learning in education for sustainable development in Thailand's classroom.
2. Literature review and documentary synthesis on science teacher's competency of transformative learning for sustainable development in order to provide a viewpoint for defining science teacher competency in transformative learning for sustainable development in the school context.
3. Set up expert dialogue discussions on the science teachers' competency in transformative learning for sustainable development in the school context to confirm (Ensure) the assumptions from the literature review and documentary synthesis.
4. Frame assumptions science teachers' competency in transformative learning for sustainable development in the school context from expert dialogue discussions, literature review, and documentary synthesis.
5. Interpretive paradigm: categorize ideas from literature reviews, expert dialogue discussions, and build patterns of science teachers' competency in transformative learning for sustainable development in the school context.

After the term "science teachers' competency in transformative learning for sustainable development in the school context" has been conceptualized, a professional development (PD) program will be created.

Expected Outcome:

The researcher hopes to create a theoretical framework for science teachers' transformative learning competency for sustainable development. The theoretical framework will be developed as a PD program and used to develop science teachers' and pre-service science teachers' competencies.

References:

Mezirow, J. (2009). Transformative learning theory. In J. Mezirow, E.W. Taylor, & Associates (Eds.), *Transformative learning in practice: Insights from community, workplace, and higher education* (pp. 18–32). Jossey-Bass.

Organization for Economic Co-operation and Development. (2019). *The OECD Learning Compass 2030*. https://www.oecd.org/education/2030-project/teaching-and-learning/learning/

Rahmawati, Y., Taylor, E., Taylor, P. C., & Koul, R. (2021). Student empowerment in a constructivist values learning environment for a healthy and sustainable world. In *Learning Environments Research* (Vol. 24, Issue 3, pp. 451–468). Springer Science and Business Media B.V. https://doi.org/10.1007/s10984-020-09336-9

Srisawat, A., & Yuenyong, C. (2021). Promoting Transformative Science Education in Secondary Schools regarding to the Future Education of OECD Learning Compass 2030 Concept. *Journal of Teacher Professional Learning Community (JTPLC)*, *1*(2), 138–155. https://so05.tci-thaijo.org/index.php/JTPLC/article/view/255782/173195

Taylor, E. (2022). *Ethical dilemma story pedagogy* (pp. 20–30). Brill. https://doi.org/10.1163/9789004524705_002

Taylor, P. C. (2014). Transformative Science Education. In *Encyclopedia of Science Education* (pp. 1–5). Springer Netherlands. https://doi.org/10.1007/978-94-007-6165-0_212-2

Tobin, K., & Tippins, D. (1993). Constructivism as a referent for teaching and learning. In K. Tobin (Ed.), *The practice of constructivism in science education* (pp. 3–21). AAAS Press.

United Nations. (2015). *Sustainable Development Goals (SDGs)*. Department of Economic and Social Affairs. https://sdgs.un.org/goals

Japan: Mr Junye Gao, Hiroshima University

Title:
Examining Educational Transformations: An Analysis of Global Influences and Local Dynamics in STEM Education in Japan and China
Objectives:
We aim to adopt a transnational perspective to explore the dynamic between global trends and local reactions in STEM education in both Japan and China.
Background:
With the progression of globalization, the domains of education and research within nation-states inevitably undergo internationally influences (Meyer, et al., 1992; Marginson, 2020). This is evident through the widespread adoption of international assessments like the Trends in International Mathematics and Science Study (TIMSS), the OECD's Programme for International Student Assessment (PISA) and the international educational trends(discourses) such as Science, Technology, Engineering, and Mathematics (STEM) education, 21st Century Skills, and Competencies-based curriculum. The results and ideas of them have become the essential resources and materials in the educational reform. As a result, these global influences have led to a degree of homogeneity in national school systems at a conceptual level. However, Tröhler and Lenz (2015) have underscored that the interaction between national educational idiosyncrasies and global agendas during harmonization processes in different countries has been overlooked. Returning to a local perspective, while some researchers in science education from Japan and China, since the beginning of 21st century, have emphasized the interplay of global agendas and local cultures (e.g., Ogawa, 1998; Wei, 2006), the current impact on school systems warrants further investigation.
Method:
The research methodology draws is inspiration from Goodson's ideas (2010), employing a narrative approach to examine educational transformations. In his study, Goodson employed two distinct methods to elucidate the historical and cultural refraction of educational changes. The first, 'systemic narratives', concentrates on the 'the main documentary sources of the restructuring and reform initiatives in each national and regional area'(Goodson, 2010, p. 767). The second, 'work life narrative', emphasize on teachers' life histories. Given the limited integration of STEM into the science curricula of both Japan and China, we plan to employ a snowball sampling (Tracy, 2020) to target the group who are

actively engaged with the relationship between global and local issues, diverging from the cohorts approach in Goodson's research.

Expected Outcome:

This two-pronged approach aims to seek to fully understand both the institutional and official perspectives from authoritative documents and the real-life experiences of educators, providing a comprehensive insight of the educational transformations under investigation.

References:

Goodson, I. (2010). Times of educational change: towards an understanding of patterns of historical and cultural refraction, *Journal of Education Policy, 25*:6, 767-775, DOI: 10.1080/02680939.2010.508179

Freeman, B., Marginson, S., & Tytler, R. (2020) *The Age of STEM: Educational policy and practice across the world in Science, Technology, Engineering and Mathematics*. Routledge.

Tröhler, D., Lenz, T. (2015). Between the national and global: introduction. In T. Lenz, D. Tröhler (Eds.), *Trajectories in the development of modern school systems* (pp. 3-9). New York and London: Routledge.

Meyer, et al. (1992). Introduction. In J. W. Meyer, D. H. Kamens, & A. Benavot (Eds.), *School knowledge for the masses: World models and national primary curricula categories in the twentieth century* (pp. 1-16). Washington, DC: Falmer Press.

Tracy, S. (2020). Qualitative research methods: *Collecting evidence, crafting analysis, communicating impact (second edition)*. Wiley Blackwell.

Meyer, M., Mayrhofer W. (2022). Selecting a sample. In U. Flich (Eds.), *The Saga handbook of qualitative research design* (pp. 273-289). SAGA Publications Ltd.

Patton, M. (2022). Impact-driven qualitative research and evaluation. In U. Flich (Eds.), *The Saga handbook of qualitative research design* (pp. 1165-1180). SAGA Publications Ltd.

South Korea: Ms Seongwoo Kim, Pusan National University

Title:

Cross-country Curriculum Analysis and Comparison of the Detailed Goals of Sustainable Development Goals (SDGs)

Research questions:

1. How much content corresponding to the detailed objectives of Sustainable Development Goals (SDGs) is included in the 2022 Revised Science Education Curriculum?
2. How much content corresponding to the detailed objectives of Sustainable Development Goals (SDGs) is included in the United States' Next Generation Science Standards (NGSS)?
3. What are the differences in the content related to the detailed objectives of Sustainable Development Goals (SDGs) included in the 2022 Revised Science Education Curriculum and the United States' Next Generation Science Standards (NGSS)?

Background:

1. Sustainable Development Goals (SDGs)

The Sustainable Development Goals (SDGs) are global development objectives adopted by the United Nations in 2015. Comprising 17 goals, they aim to achieve sustainable development worldwide by 2030 across various crucial areas such as poverty eradication, education, healthcare, clean water and energy provision, climate action, equality, economic growth, and more. These goals encourage collaboration among all nations to pursue sustainable development globally and improve the quality of life for everyone on the planet.

2. 2022 Revised Science Education Curriculum

It aims to nurture individuals as citizens of the future society who possess "Scientific literacy and thrive as creative beings." Within this curriculum, the goal is to foster a comprehensive set of abilities, known as competencies, where scientific knowledge and understanding, processes and functions, values, and attitudes are holistically developed and expressed. The focus lies on cultivating scientific inquiry and problem-solving skills, along with scientific decision-making abilities, aligning these with cross-curricular and general competencies such as self-management, information processing, creative thinking, aesthetic sensibility, collaborative communication, and community engagement. To achieve this, the science curriculum emphasizes ecological awareness, democratic citizenship, digital literacy, aiming to cultivate individuals capable of flexibly adapting to the future society that creates converged domains based on advanced scientific technology while possessing scientific literacy.

3. Next Generation Science Standards (NGSS)

It is a framework designed in the United States with the goal of providing new guidelines and educational standards for science education. It aims to impart scientific knowledge and skills to K-12 learners, emphasizing core concepts and scientific thinking necessary for students to explore and understand science. NGSS emphasizes students' ability to apply scientific problem-solving, inquiry, critical thinking, and collaboration skills for real-world applications.

Method:

1. Analysis of the Curriculum Through a Grading System – scores and percentages included.
2. Comparison of the South Korean and American education systems based on the findings and implications.

Expected Outcome:

1. Integration of content between science education and environmental education.
2. Improvement of science education and curriculum, incorporating education for sustainable development and development of teaching models for science classes.

References:

Ferry, M. F., & Eth, A. (2019). The case for K-12 system-based urban resiliency. Systems-Based Urban Resiliency Curriculum.

Kim, J.H., Baek, Y.S., Park, Y.G., Ji D.Y., Son Y.A. (2020). Science Textbooks According to the Revised 2015 Curriculum: Focusing on the Chapter 'IV. Environment and Energy' in Energy and Climate Change Education, 10(1), 37-49

Pae, J. K., Sung, K., Lee, M. K., Seo, J. Y., Lee, M., & Jang, G. (2023). An analysis of the connection between the national curriculum in elementary and secondary schools and the learning contents of education for sustainable development (ESD). Journal of Curriculum Evaluation, 26(2), 51-72.

Park, S. H., & Kim, H. T. (2019). Comparative analysis of the 2015 revised science curriculum and US next generation science standards-focusing on ecosystem related concepts in elementary school courses. Biology Education, 47(3), 336-353.

Trotz, M. (2019). Education innovation to meet Sustainable Development Goals (SDGs). In 12th Natural Resource Management & Research Symposium “BELIZE,‘THROUGH THE BOTTLENECK’”.

Hong Kong: Ms Khadeza Yasmin, The Education University of Hong Kong

Title:

Human Health Risk Assessment, Rice Safety Threshold and Remediation by Modified Bone Biochar from A Multi Metal Industrial Paddy Areas

Objectives:

1. To investigate the multiple heavy metals **pollution** in the **water, soil, and rice grain**
2. To identify **human** body loading of metals through biomarker agents of **human hair**
3. To establish **rice safety thresholds and pathway** of heavy metals with different **rice cultivars, seasonal variations and soil**
4. To investigate the effects of **modified biochar on metal bioavailability** of rice and identify **resistance soil bacterial community with** their **genetic variances**

Background:

Multiple heavy metal (MHMs) pollution in the environment is a major health concern for all living beings for consuming contaminated food and water (Ahmed at al., 2023; Haghnazar et al., 2023). These polluted foods are coming from increasing different industrial and non-industrial effluents to nearby crop fields (Biswas et al., 2023; Haghnazar et al., 2023). Where, globally rice is the major food (Liao et al., 2019), and daily rice consumers are prone to different health risk issues (Sarkar et al., 2023). Besides, global rice production in 2021 was nearly 788M tonnes and 90% of production came from Asia (708M tonnes) (FAO, 2023). On the other hand, the metal bioavailability in grain is depends on both edaphic (soil Ph, nutrient availability, contamination level etc.) and non-edaphic factors (temperature, season, variety etc.), which are widely dependent on food contamination (Cao et al., 2022; Huang et al., 2021; Yan et al., 2022). Biochar is a highly popular and effective remediation technology to remediate both anionic and cationic metal(loids) simultaneously from crops (Azeem et al., 2023; Hussain et al., 2021; Saadat et al., 2018). So, more research is still needed for increasing food safety in natural paddy field conditions for working on existing research gaps for better understanding the metal remediation strategy, pathway etc. by modified bone biochar.

Method:

Quantitative laboratory-based research method

- Harvesting standing rice with soil during ripening stage for survey of the study area and develop a model for safety rice production (Laboni et al., 2023; Mandal et al., 2022)
- Interviewing and collecting human hair sample (Biswas et al., 2023)
- Pollution index by excel (Setia et al., 2021)
- Rhizon soil moisture sample used for collection of pore water for column experiment (Li and Wong, 2010)
- Cultivating two different rice varieties in two consecutive rice growing seasons, and rice and soil samples are collected from panicle initiation, tillering, filling and harvesting stage from metal remediation study in real farmer's field by modified bone biochar
- Soil physicochemical analysis (Lu,1999)

Ttotal, available, sequential extraction of metal by ICPMS (Bibi et al., 2022)

- Beneficial bacteria identification by NGS and gene bank

Expected Outcome:

Firstly- remove human **health problems** and identify **metal accumulation, process, pathway** etc. for food and environmental safety

Secondly- establish rice **safety threshold** for various soil, varietal and field conditions.

Thirdly- develop a remediation strategy by **bone biochar** for clean food and reduce **secondary pollution**

Fourthly- investigate the **left-over biochar effectiveness** and identify **metal resistant bacteria** helpful for **bioremediation**

References:

Ahmed, R. S., Abuarab, M. E., Ibrahim, M. M., Baioumy, M., & Mokhtar, A. (2023).

Assessment of environmental and toxicity impacts and potential health hazards of heavy metals pollution of agricultural drainage adjacent to industrial zones in Egypt. *Chemosphere*, *318*, 137872.

Azeem, M., Jeyasundar, P. G. S. A., Ali, A., Riaz, L., Khan, K. S., Hussain, Q., ... & Zhu, Y. G. (2023). Cow bone-derived biochar enhances microbial biomass and alters bacterial community composition and diversity in a smelter contaminated soil. *Environmental Research*, *216*, 114278.

Bibi, I., Niazi, N. K., Shahid, M., Ali, F., ul Hasan, I. M., Rahman, M. M., ... & Rinklebe, J. (2022). Distribution and ecological risk assessment of trace elements in the paddy soil-rice ecosystem of Punjab, Pakistan. *Environmental Pollution*, *307*, 119492.

Biswas, T., Pal, S. C., Saha, A., Ruidas, D., Islam, A. R. M. T., & Shit, M. (2023). Hydro-chemical assessment of groundwater pollutant and corresponding health risk in the Ganges delta, Indo-Bangladesh region. *Journal of Cleaner Production*, *382*, 135229.

Cao, M., Zhu, W., Hong, L., Wang, W., Yao, Y., Zhu, F., ... & He, S. (2022). Assessing Pb-Cr Pollution Thresholds for Ecological Risk and Potential Health Risk in Selected Several Kinds of Rice. *Toxics*, *10*(11), 645.

Huang, L., Wang, X., Chi, Y., Huang, L., Li, W. C., & Ye, Z. (2021). Rhizosphere bacterial community composition affects cadmium and arsenic accumulation in rice (*Oryza sativa L.*). *Ecotoxicology and Environmental Safety*, 222. 112474.

Hussain, A., Nazir, A., & Shafiq, M. (2021). Potential Application of Biochar Composite Derived from Rice Straw and Animal Bones to Improve Plant Growth. *Sustainability*, *13*(19), 11104.

FAO (2023a). Food and Agriculture Organization of the United States. Crops and livestock products, Rice, *FAOSTAT*. Rome, Italy: FAO. Retrieved 18 April, 2023, from https://www.fao.org/faostat/en/#data/QCL/visualize

Haghnazar, H., Belmont, P., Johannesson, K. H., Aghayani, E., & Mehraein, M. (2023).Human-induced pollution and toxicity of river sediment by potentially toxic elements (PTEs) and accumulation in a paddy soil-rice system: A comprehensive watershed-scale assessment. *Chemosphere*, *311*, 136842.

Laboni, F. A., Ahmed, M. W., Kaium, A., Alam, M. K., Parven, A., Jubayer, M. F., ... & Khan, M. S. I. (2023). Heavy Metals in Widely Consumed Vegetables Grown in Industrial Areas of Bangladesh: a Potential Human Health Hazard. *Biological Trace Element Research*, *201*(2), 995-1005.

Lu, R., 1999. Analytical Methods for Soil and Agricultural Chemistry. China Agricultural Science and Technology Press, Beijing, China.

Liao, W., Wang, G., Li, K., Zhao, W., & Wu, Y. (2019). Effect of Cooking on Speciation and In Vitro Bioaccessibility of Hg and As from Rice, Using Ordinary and Pressure Cookers. *Biological trace element research*, 187(1).

Li, W. C., & Wong, M. H. (2010). Effects of bacteria on metal bioavailability, speciation, and mobility in different metal mine soils: a column study. *Journal of soils and sediments*, *10*(2), 313-325.

Mandal, J., Bakare, W. A., Rahman, M. M., Rahman, M. A., Siddique, A. B., Oku, E., ... & Mondal, D. (2022). Varietal differences influence arsenic and lead contamination of rice grown in mining impacted agricultural fields of Zamfara State, Nigeria. *Chemosphere*, *305*, 135339.

Mei, H., Huang, W., Wang, Y., Xu, T., Zhao, L., Zhang, D., ... & Pan, X. (2022). One stone two birds: Bone char as a cost-effective material for stabilizing multiple heavy metals in soil and promoting crop growth. *Science of The Total Environment*, *840*, 156163. https://doi.org/10.1016/j.scitotenv.2022.156163

Saadat, S., Raei, E., & Talebbeydokhti, N. (2018). Enhanced removal of phosphate from aqueous solutions using a modified sludge derived biochar: Comparative study of various modifying cations and RSM based optimization of pyrolysis parameters. *Journal of environmental management*, *225*, 75-83.

Sarkar, M. I. U., Shahriar, S., Naidu, R., & Rahman, M. M. (2023). Concentrations of potentially toxic and essential trace elements in marketed rice of Bangladesh: Exposure and health risks. *Journal of Food Composition and Analysis*, *117*, 105109.

Setia, R., Dhaliwal, S. S., Singh, R., Kumar, V., Taneja, S., Kukal, S. S., & Pateriya, B. (2021). Phytoavailability and human risk assessment of heavy metals in soils and food crops around Sutlej River, India. *Chemosphere*, *263*, 128321.

Yan, Y., Qi, F., Zhang, L., Zhang, P., & Li, Q. (2022). Enhanced Cd adsorption by red mud modified bean-worm skin biochars in weakly alkali environment. *Separation and Purification Technology*, *297*, 121533.

Curriculum Vitae: Professor

Bing Wei (Macao)

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List of Research

Year	Research Title
2022	Wei, B., Wang, C., & Tan, L. (2022). Visual representation of optical content in China's and Singapore's junior secondary physics textbooks. Physical Review Physics Education Research. 18 (2), 120138.
2022	Wei, B., Jiang, Z., & Gai, L. (2022). Examining the nature of practical work in school science textbooks: Coverage of the diversity of scientific methods. Science & Education. 31 (4), 943-960.
2022	Wei, B. & Lin, J. (2022). Manifestation of three visions of scientific literacy in a senior high school chemistry curriculum: A content analysis study. Journal of Chemical Education. 99 (5), 1906-1912.
2021	Wei, B., Avraamidou, L., Chen, N. (2021). How a beginning science teacher deals with practical work: An explorative study through the lens of identity. Research in Science Education, 51 (Suppl 1), S1-S19.
2021	Wei, B. & Long, F. (2021). Teaching chemistry in context: What we know from teachers' lesson plans. International Journal of Science Education. 43 (8), 1208-1227.

Year	Research Title
2021	Wei, B. & Chen, X. (2021). Examining teaching emphases of history of science in award-winning science lesson plans in Macao. Science & Education. 30 (3), 639-657.

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List of Research

Year	Research Title
2024	Onodera, K., & Fujii, H. (2024). Learning about the coexistence between nature and humans in elementary science education: Developing lessons using folktales that reflect ancestors' views on nature. *Education Sciences*, *14*(1), 28.
2023	Fiel'ardh, K., Torkar, G., Rožman, H., & Fujii, H. (2023). Sustainable Development Goals in teacher education: Comparing syllabi in a Japanese and a Slovenian university. *Frontiers in Education*, Section Higher Education, Volume 8. doi: 10.3389/feduc.2023.1215500
2023	Eliyawati, Widodo, A., Kaniawati, I., & Fujii, H. (2023). The development and validation of an instrument for assessing science teacher competency to teach ESD. *Sustainability*, *15*(4), 3276. doi.org/10.3390/su15043276
2023	Onodera, K., & Fujii, H. (2023). Perceptions of lower elementary school children about thinking from the perspective of insects. *Journal of Research in Science Education*, *64*(1), 63-72. (in Japanese)

Year	Research Title
2022	Fujii, H. (2022). Trends and perspectives of climate change education in the Asia-Pacific. In W. O. Lee, P. Brown, A. L. Goodwin, & A. Green (Eds.), *International handbook on education development in Asia-Pacific*. Online publishing 17 pages, Springer Nature Singapore. DOI https://doi.org/10.1007/978-981-16-2327-1_96-1
2022	Güler, U., Schrader, N., Fujii, H., & Bolte, C. (2022). Vorstellungen zum Konzept der Radio-aktivität in Deutschland and Japan. In Gesellschaft für Didaktik der Chemie und Physik (Eds.). *Tagungsbänd 42. Unsicherheit als Element von naturwissenschaftsbezogenen Bildungsprozessen* (S.368-371). Gesellschaft für Didaktik der Chemie und Physik (Online publishing).

Hyoung-Yong Park (South Korea)

Name	Hyoung-Yong Park
Position	Associate Professor
Region	South Korea
Education	Bachelor: Biology Education, Seoul National University (Mar. 1997 – Aug. 2006) Master: Science Education, Seoul National University (Mar. 2007 – Feb. 2009) Doctor: Science Education, Seoul National University (Mar. 2009 – Aug. 2016)
Institution	Gyeongin National University of Education
Email	hypark@ginue.ac.kr
Field of Research/Expertise	He is researching science education, STEAM and artificial intelligence convergence education, Education for Sustainable Development (ESD), gifted science education, and teacher professional development. He has expertise in computer-based science education and working as a professor at AIEDAP (AI Education Alliance and Policy lab), aiming to cultivate prospective and current teachers' AI and digital capabilities.

List of Research

Year	Research Title
2023	H.-Y. Park. (2023). Analysis of Online Mass Communication on “Evolution”. EASE Letters, 2(2), 76-86.
2023	I. Yu, & H.-Y. Park. (2023). Developing an AI-based Sentence-Generating Web Service for Writing Activities in Elementary Language Education. Journal of Research in Curriculum & Instruction, 27(2), 210-221.
2022	S.W. Lim, & H.-Y. Park. (2022). Development of a Physical-Computing Based STEAM Education Program - Focused on Exploring the Heartbeat -. Biology Education, 50(2), 172-186.

Year	Research Title
2022	Y.S. Na, Y Jeong, H.-Y. Park, & J. G. Kim (2022). Development of Microcomputer-Based Laboratory Inquiry Activity for Learning the ‘Carbon Cycle’ Concept. School Science Journal, 16(1), 95-108.
2021	J.-H. Lee, K. Ryu, J. Park, H.-G. Yoon, H.-Y. Park, & S.K. Lee (2021). Implications of Scientific Practices on Science Education from the Actor-Network Theory Perspective: Focusing on the Concept of 'Circulating Reference'. Journal of Research in Curriculum & Instruction, 25(2), 133-150.
2020	J.-Y. Lee, Y.-S. Kim, H.-Y. Park. (2020). Comparison of Conceptual Networks in Biology I Textbooks under the 2009 and 2015 Revised Science Curriculum - Focused on the Continuity of Life -. Biology Education, 48(4), 607-620.
2020	H.-P. Shim, M.Y. Kim, & H.-Y. Park. (2020). An Analysis of College Scholastic Ability Test Items of Life-Science I of 2009 Revised Curriculum - Focused on the ‘Cells and Cell Division’ Unit -. Biology Education, 48(4), 559-570.
2019	H. Lim, S.-Y. Choi, H.-Y. Park, & S.-I. Yeo. (2019). Understanding of Applicants for Science Gifted Education on the Phenomena and Problems of Global Warming. Journal of Energy and Climate Change Education, 9(3), 293-301.

Zhihong Wan (Hong Kong)

Name	Peter Zhihong Wan (萬志宏)
Position	Associate Professor, Department of Curriculum & Instruction, Faculty of Education & Human Development, The Education University of Hong Kong Vice President, EASE
Region	Hong Kong
Education	B.Sc. in Physics Education, Jingdezhen Institute of Education M. Phil. in Educational Psychology, Soochow University Ph. D. in Curriculum & Instruction, The University of Hong Kong
Institution	The Education University of Hong Kong
Email	wanzh@eduhk.hk
Field of Research/Expertise	Design-based STEM learning, Nature of Science, STEM creativity

List of Research

Year	Research (From 2019)
2024	Wan, Z. H., So, W. W. M., Xie, D., & Luo, T. (2024). Policies and Practices of Cross-disciplinary School STEM Education in Asia: An Overview. In So, W. W. M , *Wan, Z.H., & Luo, T. (ed.). Cross-disciplinary STEM Learning for Asian Primary Students* (pp. 12-26). Routledge.
2024	So, W. W. M., Wan, Z. H., & Luo, T. (2024). Preface–Cross-disciplinary STEM Learning for Asian Primary Students. In So, W. W. M., *Wan, Z.H., & Luo, T. (ed.). Cross-disciplinary STEM Learning for Asian Primary Students* (pp. 1-11). Routledge.
2024	Luo, T., Zhou, Y., Huang, X., So, W. W. M., Wan, Z. H., & Huang, Q. (2024). Scaffolds for Educators for Designing STEM Activities: A Review of the Frameworks in STEM Education in Asia. In So, W. W. M., *Wan, Z.H., & Luo, T. (ed.). Cross-*

Year	Research (From 2019)
	disciplinary STEM Learning for Asian Primary Students (pp. 27-46). Routledge.
2024	He, Q., So, W. W. M., Tsang, Y. F., & Wan, Z. H.* (2024). Environment-centred STEM Learning for Primary Students: School-STEM Professional Collaboration. In So, W. W. M *, Wan, Z.H., & Luo, T. (ed.). Cross-disciplinary STEM Learning for Asian Primary Students* (pp. 129-146). Routledge.
2023	Wan, Z. H., Zhan, Y., & Zhang, Y. (2023). Positive or negative? The effects of scientific inquiry on science achievement via attitudes toward science. *Science Education*. 1-23.
2023	Zhan, Y., Wan, Z. H., & Khon, M. (2023). What predicts undergraduates' student feedback literacy? Impacts of epistemic beliefs and mediation of critical thinking. *Teaching in Higher Education*, 1-19.
2023	Zhan, Y., Wan, Z. H., Chen, J., & Wang, M. (2023). How is Student Resilience Affected by Teacher Feedback, Teacher Support, and Achievement Goals? A Mediation Model Based on PISA 2018 Survey Data. *The Asia-Pacific Education Researcher*, 1-12.
2023	Sun, D., Zhan, Y., Wan, Z. H., Yang, Y., & Looi, C. K. (2023). Identifying the roles of technology: A systematic review of STEM education in primary and secondary schools from 2015 to 2023. *Research in Science & Technological Education*, 1-25.
2023	Wan, Z.H., English, L.D., So, W. W. M., & Skilling, K. (2023). STEM integration in primary schools: Theory, implementation, and impact. *International Journal of Science and Mathematics Education*, 1-5.
2023	Wan, Z. H., So, W. M. W., & Zhan, Y. (2023). Investigating the Effects of Design-Based STEM Learning on Primary Students' STEM Creativity and Epistemic Beliefs. *International Journal of Science and Mathematics Education*, 1-22.
2023	Zhang, Y., Zhan, Y., Wan, Z. H.*, & Sun, D. (2023). What are the effects of formative assessment on students' science learning motivational beliefs and behaviours? Comparison between Western and East Asian learners. *International Journal of Science Education*, 1-16.

Year	Research (From 2019)
2023	Zhan, Y., Yan, Z., Wan, Z. H., Wang, X., Zeng, Y., Yang, M., & Yang, L. (2023). Effects of online peer assessment on higher-order thinking: A meta-analysis. *British Journal of Educational Technology,* 1-22.
2023	Wan, Z.H., English, L.D., So, W. W. M., & Skilling, K. (2023). Special issue of *International Journal of Science and Mathematics Education*. STEM integration in primary schools: Theory, implementation, and impact.
2023	So, W. W. M. Wan, Z.H. & Luo, T. (2023). *Cross-disciplinary STEM learning for Asian primary students: Design, Practices and Outcomes*. Routledge. *(EDUHK Rank: A)*
2022	Wan, Z. H. (2022). What predicts students' critical thinking disposition? A comparison of the roles of classroom and family environments. *Learning Environments Research*, 25(2), 565-580.
2022	Wan, Z.H., So, W. W. M., & Zhan, Y. (2022). Developing and validating a scale of STEM project based learning experience. *Research in Science Education*, 52, 599-615.
2022	Wan, Z. H., Wan, S. L., & Zhan, Y. (2022). For harmony and democracy: Secondary students' views on the value of developing critical thinking in a Confucian heritage context. *Thinking Skills and Creativity*, *44*, 101031.
2022	Zhan, Y., Wan, Z. H., & Sun, D. (2022). Online formative peer feedback in Chinese contexts at the tertiary Level: A critical review on its design, impacts and influencing factors. *Computers & Education*, doi: 10.1016/j.compedu.2021.104341.
2021	Wan, Z. H., Wang, W., & Leung, Y. H. (2021). *Think4Doing super robot-makers: An innovative STEM curriculum that can be learned at home*. Alpha STEM Education Ltd. *(19 student books & 3 teacher books)*
2021	Wan, Z.H., So, W. W. M., & Hu, W. (2021) Necessary or sufficient? The impacts of epistemic beliefs on STEM creativity and the mediation of intellectual risk-taking. *International Journal of Science Education*. doi: 10.1080/09500693.2021.1877368.
2021	Wan, Z.H., Lee, J. C. K, & Hu, W. (2021). How should undergraduate students perceive knowledge as a product of human creation? Insights from a study on epistemic beliefs,

Year	Research (From 2019)
	intellectual risk-taking, and creativity. *Thinking Skills and Creativity*, doi:10.1016/j.tsc.2021.100786.
2021	Wan, Z. H., Lee, J. C. K., Yan, Z., & Ko, P. Y. (2021). Self-regulatory school climate, group regulation and individual regulatory ability: towards a model integrating three domains of self-regulated learning. *Educational Studies*, 1-16. doi:10.1080/03055698.2021.1894093.
2021	Wan, Z. H. (2021). Exploring the effects of intrinsic motive, utilitarian motive, and self-efficacy on students' science learning in the classroom using the expectancy-value theory. *Research in Science Education*, *51*(3), 647-659.
2021	Jiang, Y., Lee, C. K. J., Wan, Z. H.*, & Chen, J. (2021). Stricter teacher, more motivated students? Comparing the associations between teacher behaviors and motivational beliefs of Western and East Asian learners. *Frontiers in Psychology*, 11, 3743. doi:10.3389/fpsyg.2020.564327.
2021	Luo, T., So, W. W. M., Wan, Z. H., & Li, W. C. (2021). STEM stereotypes predict students' STEM career interest via self-efficacy and outcome expectations. *International Journal of STEM Education*, *8*(1), 1-13.
2021	Zhan, X., Sun, D., Wan, Z. H., Hua, Y., & Xu, R. (2021). Investigating Teacher Perceptions of Integrating Engineering into Science Education in Mainland China. *International Journal of Science and Mathematics Education*, *19*(7), 1397-1420.
2021	Zhan, Y., Jiang, Y., Wan, Z. H., & Guo, J. J. (2021). Is there an "expectancy× value" effect? Investigating the impact of self-efficacy and learning motives on Chinese undergraduates' use of deep language learning strategies. *The Asia-Pacific Education Researcher*, *30*, 83-94.
2021	Wan, Z. H., Jiang, Y., & Zhan, Y. (2021). STEM education in early childhood: A review of empirical studies. *Early Education and Development*, *32*(7), 940-962.
2020	Luo, M., Wang, Z., Sun, D., Wan, Z. H., & Zhu, L. (2020). Evaluating Scientific Reasoning Ability: The Design and Validation of an Assessment with a Focus on Reasoning and the Use of Evidence. *Journal of Baltic Science Education*, *19*(2), 261-275.

Year	Research (From 2019)
2019	So, W. M. W., Chen, Y., Wan, Z.H. (2019). Multimedia e-learning and self-regulated science learning: A study of primary school learners' experiences and perceptions. *Journal of Science Education and Technology*, 28(5), 508-522.
2019	Lee, J. C. K., Wan, Z. H.*, Hui, S. K. F., & Ko, P. Y. (2019). More student trust, more self-regulation strategy? Exploring the effects of self-regulatory climate on self-regulated learning. *Journal of Educational Research*, *112*(4), 463-472.
2019	Zhan, X., Sun, D., Qiang, C., Song, R., & Wan, Z. H. (2019). Propensity Score Analysis of the Impacts of Junior Secondary Students' Participation in Engineering Practices on Their Attitudes toward Engineering. *EURASIA Journal of Mathematics, Science and Technology Education*, *15*(11).
2018	Wan, Z. H. (2018). Intended curriculum of nature of science for prospective school science teachers: scientism in Chinese science teacher educators' conceptions. In Kennedy, K. J. & Lee, J.C.K. (ed.). *Routledge International Handbook of Schools and Schooling in Asia* (pp. 125-141). Routledge.
2018	Cheng, M. H. M. & Wan, Z.H. (2018). Assessment policy in the senior physics curriculum documents of Mainland China and Hong Kong. In Cheng, M. H. M., Jones, A., & Buntting, C. (ed.), *Studies in Science Education in the Asia-Pacific Region* (167-178). London: Routledge.
2018	Wan, Z. H., & Cheng, M. H. M. (2018). Classroom learning environment, critical thinking, and achievement in an interdisciplinary subject: A study of Hong Kong secondary school graduates. *Educational Studies*, 45(3), 285-304.

Chokchai Yuenyong (Thailand)

Name	Chokchai Yuenyong
Position	Associate Professor
Region	Thailand
Education	B.Ed. in Physics and Mathematics, Khon Kaen University, Thailand PhD in Science Education, Kasetsart University, Thailand
Institution	Faculty of Education, Khon Kaen University, Thailand
Email	ychok@kku.ac.th
Field of Research/Expertise	- Science Learning - Science Teacher Education - Physics Education - STEM Education

List of Research

Year	Research Title
2023	Marlina, R., Suwono, H., **Yuenyong, C**., Ibrohim, Mahanal, S., and Hamdani (2023). Technological Pedagogical Content Knowledge (TPACK) for Preservice Biology Teachers: Two Insights More Promising. *Participatory Educational Research*, 10(6): 245 – 265, DOI: http://dx.doi.org/10.17275/per.23.99.10.6
2023	Sutaphan, S., & **Yuenyong, C**. (2023). Enhancing grade eight students' creative thinking in the water STEM education learning unit. *Cakrawala Pendidikan: Jurnal Ilmiah Pendidikan, 42*(1), 120-135. DOI: https://doi.org/10.21831/cp.v42i1.36621.
2022	Suwono, H, Maulidia, L, Saefi, M., Kusairi, S. and **Yuenyong**, C. (2022). The Development and validation of prospective science teachers' perceptions of scientific literacy. *Eurasia Journal of Mathematics, Science and Technology Education* 18 (1), em2068
2022	Sohsomboon, P. & **Yuenyong**, C. (2022). Examine in-service teachers' initial perceptions toward STEM education in Thailand. *Asia Pacific Journal of Educators and Education*, 37 (2), 325–352. https://doi.org/10.21315/ apjee2022.37.2.16

Year	Research Title
2021	Sohsomboon, P and **Yuenyong**, C. (2021). Strategies for Teacher Utilizing Ethnography as a Way of Seeing for STEAM Education. *Journal of Physics: Conference Series* 1933 (1), 012080
2020	**Yuenyong**, C. and Thao-Do, T.P. (2020). Developing a tool to assess students' views of nature of science in Vietnam. Jurnal Pendidikan IPA Indonesia, 9 (1): 134 – 144.
2019	Wongsila, S. and **Yuenyong**, C. (2019). Enhancing Grade 12 Students' Critical Thinking and Problem-Solving Ability in Learning of the STS Genetics and DNA Technology Unit. *Journal for the Education of Gifted Young Scientists*, 7(2), 215-235.
2019	Sutaphan, S. **Yuenyong**, C. (2019). STEM Education Teaching approach: Inquiry from the Context Based. *Journal of Physics: Conference Series*, 1340 (1), 012003
2018	Ngaewkoodrua, N. and **Yuenyong**, C. (2018). The Teachers' Existing Ideas of Enhancing Students' Inventive Thinking Skills. *The Turkish Online Journal of Educational Technology*, 17(2): 169 – 175.
2017	Thao-Do, T.P and **Yuenyong**, C. (2017) Dilemmas in examining understanding of nature of science in Vietnam. *Cultural Studies of Science Education*. 12(2):255–269
2016	Thao-Do, T.P., Bac-Ly, D.T., and **Yuenyong**, C. (2016) Learning Environment in Vietnamese Physics Teacher Education Programme through the Lens of Constructivism: A Case Study of a State University in Mekong Delta Region, Vietnam. *International Journal of Science and Mathematics Education*, 14(Suppl 1): S55 - S79
2015	Anantasook, S., **Yuenyong**, C. and Hume, A. (2015) Thai Students' Understanding about Celestial Motion within Their Social and Cultural Context. *International Journal of Science, Mathematics and Technology Learning*, 21 (2): 11 – 22
2014	Sengdala, P. and **Yuenyong**, C. (2014). Enhancing Laos students' understanding of nature of science in physics learning about atom for peace. *European Journal of Science and Mathematics Education*, 2(2): 116 – 126.
2009	**Yuenyong**, C. and Narjaikaew, P. (2009). Scientific Literacy and Thailand Science Education. *International Journal of Environmental and Science Education*. Vol. 4 No.3 pp. 335 – 349.

Year	Research Title
2008	**Yuenyong**, C., Jones, A. and Yutakom, N. (2008). A Comparison of Thailand and New Zealand Students' Ideas about Energy Related to Technological and Societal Issues. *International Journal of Science and Mathematics Education*. 6 (2): 293 – 311.

Silvia Wen-Yu Lee (Taiwan)

Name	Silvia Wen-Yu Lee
Position	Distinguished Professor and Associate Dean
Region	Taiwan
Education	BS in Zoology, National Taiwan University, Taiwan MS, University of Michigan, Ann Arbor, MI, USA PhD, University of Michigan, Ann Arbor, MI, USA
Institution	Graduate Institute of Information and Computer Education, National Taiwan Normal University
Email	swylee@ntnu.edu.tw
Field of Research/Expertise	- Computer-supported Learning - Learning with Virtual Reality - Epistemic Beliefs - Science Education - Scientific Model and Modeling - Computational Thinking

List of Research

Year	Research Title
2023	**Lee*, S. W.-Y**., Tu, H. Y., Chen, G. L., & Lin, H. M. (2023). Exploring the multifaceted roles of mathematics learning in predicting students' computational thinking competency. *International Journal of STEM Education, 10*(1), 64. https://doi.org/10.1186/s40594-023-00455-2 (SSCI Journal)
2023	**Lee, S. W.-Y**., Liang, J.-C., Hsu*, C.-Y., Chien, F.-P., & Tsai, M.-J. (2023). Exploring potential factors to students' computational thinking: Interactions between gender and ICT-resource differences in Taiwanese junior high schools. *Educational Technology & Society, 26*(3), 176-189. https://doi.org/10.30191/ETS.202307_26(3).0013 (SSCI Journal)
2023	Cheng, K.-H., **Lee*, S. W.-Y**., & Hsu, Y.-T. (2023). The roles of epistemic curiosity and situational interest in students' attitudinal learning in immersive virtual reality environments. *Journal of Educational Computing Research, 61*(2), 494-519. https://doi.org/10.1177/07356331221121284 (SSCI Journal)

Year	Research Title
2023	**Lee, S. W.-Y**., Liang, J.-C., Hsu*, C.-Y., & Tsai, M.-J. (2023). Students' beliefs about computer programming predict their computational thinking and computer programming self-efficacy. *Interactive Learning Environments*, 1-21. https://doi.org/10.1080/10494820.2023.2194929 (SSCI Journal)
2022	**Lee*, S. W.-Y**. (2022). Investigating the effects of explicit instructional approaches on students' understanding of scientific models and modeling. *Research in Science & Technological Education*, 1-17. https://doi.org/10.1080/02635143.2022.2153244 (SSCI Journal)
2022	Chang, H.-Y., Binali, T., Liang, J. -C., Chiou, G. -L., Cheng, K. -H., **Lee, S. W.-Y**., & Tsai, C. -C. (2022). Ten years of augmented reality in education: A meta-analysis of (quasi-) experimental studies to investigate the impact. *Computers & Education, 191*, 104641. https://doi.org/10.1016/j.compedu.2022.104641 (SSCI Journal)
2022	**Lee*, S. W.-Y**., Hsu, Y.-T., & Cheng, K.-H. (2022). Do curious students learn more science in an immersive virtual reality environment? Exploring the impact of advance organizers and epistemic curiosity. *Computers & Education, 182*, 104456. https://doi.org/10.1016/j.compedu.2022.104456 (SSCI Journal)
2021	**Lee*, S. W.-Y**., Luan, H., Lee, M.-H., Chang, H.-Y., Liang, J.-C., Lee, Y.-H., Lin, T.-J., Wu, A.-H., Chiu, Y.-J., & Tsai, C.-C. (2021). Measuring epistemologies in science learning and teaching: A systematic review of the literature. *Science Education, 105*, 880–907. https://doi.org/10.1002/sce.21663 (SSCI Journal)
2021	Wang, Y.-J., **Lee*, S. W.-Y**., Liu, C.-C., Lin, P.-C., & Wen, C.-T. (2021). Investigating the links between students' learning engagement and modeling competence in computer-supported modeling-based activities. *Journal of Science Education and Technology, 30*(6), 751-765. https://doi.org/10.1007/s10956-021-09916-1 (SSCI Journal)
2021	**Lee*, S. W.-Y**., Shih, M., Liang, J.-C., & Tseng, Y.-C. (2021). Investigating learners' engagement and science learning outcomes in different designs of participatory simulated games. *British Journal of Educational Technology, 52*(3), 1197–1214.https://doi.org/10.1111/bjet.13067 (SSCI Journal)

Year	Research Title
2021	**Lee*, S. W.-Y**., Wu, H.-K., & Chang, H.-Y. (2021). Examining secondary school students' views of model evaluation through an integrated framework of personal epistemology. *Instructional Science, 49*(2), 223-248. https://doi.org/10.1007/s11251-021-09534-9 (SSCI Journal)
2018	**Lee*, S. W.-Y**. (2018). Identifying the item hierarchy and charting the progression across grade levels: Surveying Taiwanese students' understanding of scientific models and modeling. *International Journal of Science and Mathematics Education, 16*(8), 1409-1430. https://doi.org/10.1007/s10763-017-9854-y (SSCI Journal)
2017	**Lee*, S. W.-Y**., Chang, H.-Y., Wu, H.-K. (2017). Students' views of scientific models and modeling: Do representational characteristics of models and students' educational levels matter? *Research in Science Education, 47*(2), 305-328. https://doi.org/10.1007/s11165-015-9502-x (SSCI Journal)
2016	**Lee*, S. W.-Y**., Liang, J.-C., & Tsai, C.-C. (2016). Do sophisticated epistemic beliefs predict meaningful learning? Findings from a structural equation model of undergraduate biology learning. I*nternational Journal of Science Education, 38*(15), 2327-2345. https://doi.org/10.1080/09500693.2016.1240384 (SSCI Journal)
2013	**Lee*, S. W.-Y**. (2013). Investigating students' learning approaches, perceptions of online discussions, and students' online and academic performance. *Computers & Education, 68*, 345-352. https://doi.org/10.1016/j.compedu.2013.05.019 (SSCI Journal)
2013	Wu*, H.-K., **Lee, S. W.-Y**., Chang, H.-Y., & Liang, J.-C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers & Education, 62*, 41-49. https://doi.org/10.1016/j.compedu.2012.10.024 (SSCI Journal)
2013	**Lee*, S. W.-Y**. & Tsai, C.-C. (2013). Technology-supported learning in secondary and undergraduate biological education: Observations from literature review. *Journal of Science Education & Technology, 22*(2), 226-233. https://doi.org/10.1007/s10956-012-9388-6 (SSCI Journal)

Year	Research Title
2012	**Lee, S. W.-Y**., Lai, Y.-C., Yu, H.-T. A., & Lin*, Y. K. (2012). Impact of biology laboratory courses on students' science performance and views about laboratory courses in general: Innovative measurements and analyses. *Journal of Biological Education, 46*(3), 173-179. https://doi.org/10.1080/00219266.2011.634017 (SSCI/SCI Journal)
2012	**Lee*, S. W.-Y**., & Tsai, C.-C. (2012). Students' domain-specific scientific epistemological beliefs: A comparison between biology and physics. *Asia-Pacific Education Researcher, 21*(2), 215-229. https://doi.org/10.1007/s11251-010-9131-8 (SSCI Journal)
2011	**Lee*, S. W.-Y**., & Tsai, C.-C. (2011). Identifying patterns of collaborative knowledge exploration in online asynchronous discussions. *Instructional Science, 39*, 321-347. https://doi.org/10.1007/s11251-010-9131-8 (SSCI Journal)
2011	**Lee*, S. W.-Y**., & Tsai, C.-C. (2011). Students' perception of collaboration, self-regulated learning, and information seeking in the context of Internet-based learning and traditional learning. *Computers in Human Behavior, 27*, 905-914. https://doi.org/10.1016/j.chb.2010.11.016 (SSCI Journal)

M.Si Riandi (Indonesia)

Name	Riandi
Position	Professor
Region	Indonesia
Education	Bachelor: Biology Education from The Bandung Institute of Teacher Training and Education (IKIP Bandung), Indonesia Master: Biology from Gadjah Mada University, Indonesia Doctor: Science Education from Universitas Pendidikan Indonesia
Institution	Universitas Pendidikan Indonesia
Email	rian@upi.edu
Field of Research/Expertise	Teachers' professional development

List of Research

Year	Research Title
2018	Transcript Based-Lesson Analysis (TBLA) in Teacher Professional System Activities for Curriculum Improvement
2019	Science, Technology, Engineering and Mathematics (STEM) Through Local Genius Integration to Promote Science Technology and Engineering Literacies
2020	Developing Pre-Service Teacher Professional Learning Based on Japan Experiences to Improve STEM Outcome
2021	Comparing And Developing STEM Literacy Enrichments for Society 5.0 Based on Indonesia and Japan Context
2022	Developing Science Learning Curriculum Based on Lesson Learnt from STEM Literacy Enrichment In Japan And Indonesia Context
2023	Enrichment of Technology And Engineering Literacy Learning (TELL) For STEM Teacher Based on Japan Experiences

Curriculum Vitae: Coach

Prof. Jian-Xin Yao (China)

Name	Jian-Xin Yao
Position	Associate Professor
Region	Mainland China
Education	Bachelor: Sichuan Normal University (2011) Doctor: Beijing Normal University (2016)
Institution	Beijing Normal University
Email	yaojianxin@bnu.edu.cn
Field of Research/Expertise	Physics education

Personal website: http://physicsfaculty.bnu.edu.cn/Public/htm/news/5/1144.html

List of Research (published in English journal)

Year	Research Title
2023	**Jian-Xin Yao**, Yu-Xuan Xiang, Tian Luo, Chu-Fan Deng, Yu-Ying Guo, David Fortus (2023). Disciplinary Learning Motivation and Its External Influencing Factors: Taking Physics in a "Selection Crisis" as an example. ***Research in Science Education***, 53, 823–839.
2023	**Jian-Xin Yao**, Yi-Xuan Liu, Yu-Ying Guo (2023). Learning Progression-Based Design Advancing the Synergetic Development of Energy Understanding and Scientific Explanation. ***Instructional Science***, 51, 397–421.
2022	Tian Luo, Winnie Wing Mui So, Wai Chin Li, **Jian-Xin Yao**. (2021). The Development and Validation of a Survey for Evaluating Primary Students' Self-efficacy in STEM Activities. ***Journal of Science Education and Technology,*** 30: 408-419.
2018	**Jian-Xin Yao**, Yu-Ying Guo (2018). Core Competences and Scientific Literacy: The Recent Reform of the School Science Curriculum in China. ***International Journal of Science Education***, *40* (15): 1913-1933.

Year	Research Title
2018	**Jian-Xin Yao**, Yu-Ying Guo (2018). Validity Evidence for a Learning Progression of Scientific Explanation. ***Journal of Research in Science Teaching***, *55*(2): 299-317.
2017	**Jian-Xin Yao**, Yu-Ying Guo, Knut Neumann (2017). Refining a Learning Progression of Energy. ***International Journal of Science Education***, *39*(17): 2361-2381.

Prof. Tomotaka Kuroda (Japan)

Name	Tomotaka kuroda
Position	Guest Associate Professor (Okayama University of Science) Specially Appointed Assistant Professor (Shizuoka University)
Region	Japan
Education	Bachelor: Bachelor of Science (Mar, 2015, Ehime University) Master: Master of Education (Mar, 2017, Ehime University) Doctor: Doctor of Philosophy (Mar, 2021, Shizuoka University)
Institution	Okayama University of Science Institute for the Advancement of Higher Education Center for Educational Development ==== Shizuoka University Graduate School of Science and Technology, Research Division STEAM Education Institute
Email	kuroda.tomotaka.17@shizuoka.ac.jp
Field of Research/Expertise	System of Education and Education Policy First-Year Experience in higher education STEM/ STEAM Education in higher education STEM/ STEAM community Competence

List of Research

Year	Research Title
Apr, 2022 – Mar, 2026	Competency modeling and Educational system Effectiveness Verification for STEM Human resource community
Jun, 2019 – Jun, 2022	Study on the Perception of Science in Asia - Focusing on the Transformation of Ethics and Philosophy in Science and Engineering Talents -
Nov, 2019 – Aug, 2020	Research on the Scientific Viewpoint and Educational System of Science and Engineering Talents in Higher Education - Focusing on the Cultural Background that Influences the Formation of Scientific Viewpoint -
Aug, 2018 – Feb, 2020	International Comparative Study on the Methods of Cultivating Science and Engineering Talents in Asia and Oceania - Focusing on the Formation Process of Universal Abilities that Support Specialization -
May, 2019 – Oct, 2019	A study of Education Policy and Curriculum Design for Human resource of STEM - Focus on Generic Skills Training –
Nov, 2018 – Aug, 2019	A Study on the Scientific Viewpoints and Versatile Abilities of Human Resources in Science - Focusing on the Elements Required of Human Resources in Science
Apr, 2018 – Oct, 2018	A study of Curriculum Extensions and Evaluation Methods for Human resource of STEM - Focus on Generic Skills Training –

Prof. Heesoo Ha (South Korea)

Name	Heesoo Ha
Position	Postdoctoral researcher
Region	South Korea
Education	03/2016-02/2020 Ph.D., Department of Science Education (Biology major), College of Education, Seoul National University, Seoul, Republic of Korea (Advisor: Prof. Heui-Baik Kim) 03/2012-08/2015 B.S., Department of Biology Education, College of Education, Seoul National University, Seoul, Republic of Korea
Institution	Seoul National University
Email	heesooha719@gmail.com / snudunoy717@snu.ac.kr
Field of Research/Expertise	• Student epistemic agency • Student scientific uncertainty in sense-making • Epistemic practices in the science classroom (Scientific argumentation and modeling) • Epistemic understanding (epistemological framing) • Student scientific uncertainty • Responsive teaching

List of Research (Examples)

Year	Research Title
2023	Ha, H., Park, J., & Chen, Y. –C. (2023). Conceptualizing phases of sensemaking as a trajevtory for grasping better understanding: Coordinating student scientific uncertainty as a pedagogical resource. *Research in Science Education*. https://doi.org/10.1007/s11165-023-10144-3 (SSCI. Journal impact factor: 2.2)
2023	Lee, M. J., & **Ha, H.** (2023). Pedagogical characteristics supporting gifted science students' agentic participation in the scientist-led research and education (R&E) program: Focusing on positioning of instructors and students. *Journal of the Korean Association for Science Education, 43*(4), 351–368. (KCI. In Korean.)
2023	Lee, G. –G., & **Ha, H.** (2023). Multi-level structural equation modelling for factors affecting science achievement of Korean middle school students before and after COVID-19: Based on 2018-2020 national assessment of educational achievement data. *International Journal of Science Education*. https://doi.org/10.1080/09500693.2023.2230534 (SSCI. Journal impact factor: 2.3)
2023	**Ha, H.**, & Choi, Y. (2023). Supporting student use of ecological concepts in field-based modeling of ecological phenomena. *International Journal of Science and Mathematics Education*. https://doi.org/10.1007/s10763-023-10354-1 (SSCI. Journal impact factor: 2.2)
2023	**Ha, H.**, & Choi, Y. (2023). Teaching strategies to support middle school students' epistemic agency in the context of empirical modeling of ecological phenomena. *Biology Education, 51*(1), 94–113. http://dx.doi.org/10.15717/bioedu.2023.51.1.94 (KCI. In Korean. Journal impact factor: 0.83)
2022	**Ha, H.**, Park, W., & Song, J. (2022). Preservice elementary teachers' socioscientific reasoning during a decision-making activity in the context of COVID-19. Science & Education. https://doi.org/10.1007/s11191-022-00359-7 (SSCI. Journal impact factor: 2.8)

Year	Research Title
2022	**Ha, H.** (2022). Knowledge for whom? Inviting students to establish an audience of knowledge and shape their own knowledge construction activities in a biology course. Research in Science Education, 52, 1851–1868. https://doi.org/10.1007/s11165-021-10034-6 (SSCI. Journal impact factor: 2.2)
2022	**Ha, H.,** & Kim, H. –B. (2022). How a marginalized student's attempts to position himself as an accepted member are constrained or afforded in small-group argumentation. Cultural Studies of Science Education, 17, 915–935. https://doi.org/10.1007/s11422-021-10100-5 (SSCI. Journal impact factor: 1.2)
2022	**Ha, H.**, & Ha, M. (2022). Exploring Korean scientists' perceptions of scientific creativity and education for scientific creativity. International Journal of Science Education, 44(11), 1767–1791. https://doi.org/10.1080/09500693.2022.2095680 (SSCI. Journal impact factor: 2.3)
2022	Oh, P. S., **Ha, H.**, Yoo, Y. J. (2022). Epistemological messages in a modeling-based elementary science classroom compared with a traditional classroom. Science Education, 106, 797–829. https://doi.org/10.1002/sce.21724 (SSCI. Journal impact factor: 4.3)
2022	**Ha, H.**, & Choi, Y. H. (2022). Epistemic and conceptual resources for productive engagement in modeling activities including empirical investigations of ecosystems. Biology Education, 50(2), 155–171. http://dx.doi.org/10.15717/bioedu.2022.50.2.155 (KCI. In Korean. Journal impact factor: 0.83)
2022	**Ha, H.**, Hwang, H., Park, J., & Ha, M. (2022). Next-generation researchers' perceptions of social and financial structure of college research communities in science and engineering fields and their suggestions on science education. Journal of Learner-Centered Curriculum and Instruction, 22(8), 1–16. https://doi.org/10.22251/jlcci.2022.22.8.1 (KCI. In Korean. Journal impact factor: 1.75)

Year	Research Title
2022	**Ha, H.**, & Ha, M. (2022). Development of items to measure secondary school students' epistemic agency in science education. Biology Education, 50(1), 81–89. http://dx.doi.org/bioedu.2022.50.1.81 (KCI. In Korean. Journal impact factor: 0.83)

Prof. Xiaojing Weng (Hong Kong)

Name	Xiaojing Weng
Position	Research Assistant Professor
Region	Hong Kong
Education	Bachelor: Northwest Agriculture and Forestry University Master: The University of Hong Kong Doctor: The Chinese University of Hong Kong
Institution	The Education University of Hong Kong
Email	xweng@eduhk.hk
Field of Research/Expertise	Technology-enhanced teaching and learning, instructional design, 21st-century skills

List of Research

Year	Research Title
2023	Developing creativity and entrepreneurship via case-based learning for higher education digital learners
2023	Competency development of pre-service teachers during video-based learning
2022	Creativity development with problem-based digital making and block-based programming for Science, Technology, Engineering, Arts, and Mathematics learning in middle school contexts
2022	Promoting student creativity and entrepreneurship through real-world problem-based Maker education
2022	Characterizing students’ 4C skills development during problem-based digital making
2022	Applying relatedness to explain learning outcomes of STEM maker activities

Prof. Irma Rahma Suwarma (Indonesia)

Name	Irma Rahma Suwarma
Position	Associate Professor/ coach
Region	Indonesia
Education	Bachelor: Physics, Universitas Padjadjaran, Indonesia Master: Science Education, Universitas Pendidikan Indonesia, Indonesia Doctor: Science Education, Shizuoka University, Japan
Institution	Universitas Pendidikan Indonesia
Email	irma.rs@upi.edu
Field of Research/Expertise	STEM Education

List of Research

Year	Research Title
2016	Implementation of STEM (Science Technology Engineering and Mathematics) Education to Answer the Challenges of the Thematic Approach in the KTSP and 2013 Curriculum at the Middle School Level through Engineering Classes
2018	Development of Basic Technology Education (PTD) Electrical Trainers for Middle Schools in an Effort to Enrich Science Tech's Treasures at the UPI National Education Museum
2019	Development of Collaborative Problem Solving (CPS) Instruments
	Development of Science Technology Engineering and Mathematics (STEM) Learning Innovations by Integrating Local Wisdom in Building Science, Technology and Engineering Literacy

Year	Research Title
	Guiding Masters Students in the Implementation of TK2P-Oriented STEM Education Programs (Goals, Policies, Programs and Practices) to Support the Implementation of the 2013 Curriculum
2020	Development of STEM-based Science Modules Using Self-Regulated Learning to Practice 21st Century Skills During and After the Covid-19 Pandemic
2021	Developing Pre-Service Teacher Professional Learning Based On Japan Experiences to Improve STEM Outcome
2022	Comparing And Developing STEM Literacy Enrichment for Society 5.0 Based On Indonesia And Japan Context
2023	Enrichment Of Technology And Engineering Literacy Learning (Tell) For STEM Teacher Based On Japan Experiences

Prof. Miao Hsuan Yen (Taiwan)

Name	Miao-Hsuan Yen
Position	Associate Professor
Region	Taiwan
Education	Bachelor: Department of Physics, National Chung-Cheng University, Taiwan Master: Department of Psychology, National Taiwan University, Taiwan Doctor: Institute of Neuroscience, National Yang-Ming University, Taiwan
Institution	Graduate Institute of Science Education, National Taiwan Normal University
Email	myen@ntnu.edu.tw
Field of Research/Expertise	Socio-scientific issue, science reading, metacognition, eye tracking

List of Research

Year	Research Title
2023	Sui, C.-J., **Yen, M.-H.*** & Chang, C.-Y.* (2023). Investigating effects of perceived technology-enhanced environment on self-regulated learning.
2022	**Yen, M.-H.**, & Wu, Y.-T. (2022). The influences of different online reading tasks on undergraduate students' reading processes and informal reasoning performances regarding a socioscientific issue. In Y.-S. Hsu, R. Tytler, & P. White (Eds.), *Innovative approaches to socioscientific issues and sustainability education: Linking research to practice* (pp. 313-330). Springer.
2021	Wang, H.-S., Chen, S.*, & **Yen, M.-H.** (2021). Effects of metacognitive scaffolding on students' performance and confidence judgments in simulation-based inquiry. Physical Review Physics Education Research*, 17*, 020108.

Year	Research Title
2018	Wang, H.-S., Chen, S., & **Yen, M.-H.*** (2018). Facilitating understanding of image formation through the luminous ray model mediated by virtual simulation. *American Journal of Physics, 86*(10), 777-785.
2018	**Yen, M.-H.**, Chen S.*, Wang C.-Y., Chen, H.-L., Hsu, Y.-S., Liu, T.-C. (2018). A framework for self-regulated digital learning (SRDL). *Journal of Computer Assisted Learning, 34*(5), 580-589.
2018	**Yen, M.-H.**, Wang, C.-Y.*, Chang, W.-H., Chen, S., Hsu, Y.-S., & Liu, T.-C. (2018). Assessing metacognitive components in self-regulated reading of science texts in e-based environments. *International Journal of Science and Mathematics Education, 16*(5), 797-816.
2017	**Yen, M.-H.**, & Wu, Y.-T.* (2017). The role of university students' informal reasoning ability and disposition in their engagement and outcomes of online reading regarding a controversial issue: An eye tracking study. *Computers in Human Behavior, 75*, 14-24.
2017	**Yen, M.-H.**, Han, C.-C., Yu, P.-C., Yang, T.-H., Didino, D., Butterworth, B., & Yen, N.-S.* (2017). The influence of memory updating and number sense on junior high school math attainment. *Learning and Individual Differences, 54*, 30-40.
2016	Lin, J.-W., **Yen, M.-H.**, Liang, J., Chiu, M.-H.*, & Guo, C.-J. (2016). Examining the factors that influence students' science learning processes and their learning outcomes: 30 years of conceptual change research. *Eurasia Journal of Mathematics, Science & Technology Education, 12*(9), 2617-2646.
2016	Hsu, Y.-S., **Yen, M.-H.**, Chang, W.-H., Wang, C.-Y., & Chen, S.* (2016). Content analysis of 1998-2012 empirical studies in science reading using a self-regulated learning lens. *International Journal of Science and Mathematics Education, 14*(Suppl 1), S1-S27.

Prof. Chaninan Pruekpramool (Thailand)

Name	Chaninan Pruekpramool
Position	Assistant Professor
Region	Thailand
Education	Bachelor: Bachelor of Science in Physics from Kasetsart University, Thailand Master: - Graduate Diploma in Teaching Science Profession from Kasetsart University, Thailand - Master of Education in Educational Statistics from Chulalongkorn University, Thailand Doctor: Doctor of Education (Ed.D) in Science Education from Srinakharinwirot University, Thailand (Visiting scholar at State University of New York College at Cortland (SUNY Cortland), New York, USA)
Institution	Srinakharinwirot University
Email	chaninan@g.swu.ac.th
Field of Research/Expertise	Science curriculum learning model development, Assessment in science learning, Quantitative research in science education

List of Research

Year	Research Title
2023	Polymer science in action: Transforming the learning experience for undergraduates with active learning strategies
2022	Promoting scientific imagination of thai lower secondary school students: a comparative study of five different classroom contexts
2022	Using blended mobile learning model for learning on tablets through local science learning stations in Sakaeo province, Thailand

Year	Research Title
2021	Effects of Islamic scientist history on seventh graders' understandings of nature of science in a thai islamic private school
2021	the development of a learning model for enhancing grade 10 students' ability in constructing scientific explanation
2020	Enhancing pedagogical profession and personal improvement for Vietnamese student teachers through reality-experienced internship program in Thailand
2019	Development of a stem education learning unit on geological resources to enhance collaboration skills and learning achievement for eighth grade students

Curriculum Vitae: Student

A

Name	Ananta Ardyansyah
Gender	Male
Region	Indonesia
Degree	Master
Educational Experience	Bachelor: Chemistry Education (Universitas Negeri Malang) Master: Chemistry Education (Universitas Negeri Malang)
Institution	Universitas Negeri Malang
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Field of Research Interest	Learning media, scientific literacy, AI in education

Name	Anisa Puteri
Gender	Female
Region	South Jakarta
Home Address	Jl H Batong RT003/RW 006, Cilandak Barat, Jakarta Selatan
Institution	Pakuan University
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Field of Research	Metacognotive Skill

Name	Angkana Langkawong
Gender	Female
Region	Thailand
Degree	Ph.D. Student Kasetsart University, Bangkok
Educational Experience	M.ED. (Science Education)
Institution	Chiang Mai University
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Field of Research Interest	STEM Education, Culturally Responsive Teaching

Name	Ardiani Mustikasari
Gender	Female
Region	Indonesia
Degree	Master
Educational Experience	Bachelor: Gadjah Mada University Master: Universitas Negeri Jakarta
Institution	Universitas Negeri Semarangf
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Field of Research Interest	Integrated science learning

C

Name	Chanita Butrattana
Gender	Female
Region	Thailand
Degree	Master of Science (M.Sc.), Physics
Educational Experience	Bachelor of Science (B.Sc), Physics, Mahasarakham University Master of Science (M.Sc.), Physics, Mahasarakham University *Currently,* Ph.D. Candidate on Doctor of Philosophy, Science Education, Khon Kaen University
Institution	Khon Kaen University, Thailand
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Field of Research Interest	STEM Education, Computational thinking, Education for Sustainable Development

E

Name	Eliyawati
Gender	Female
Region	Indonesia
Degree	Master Degree in Science Education
Educational Experience	Bachelor: Chemistry Education, Universitas Pendidikan Indonesia Master: Science Education, Universitas Pendidikan Indonesia Doctor: Science Education (On Going), Universitas Pendidikan Indonesia
Institution	Universitas Pendidikan Indonesia
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Field of Research Interest	ESD in Science Education, STEM Based-Learning, Teaching Strategy, Multiple Representation, and Teacher Professional Development.

H

Name	Haejung Ahn
Gender	Female
Region	Kongju
Degree	Bachelor’s degree
Educational Experience	Bachelor: EWHA Womans University, Graduated February 2018
Institution	Kongju National University
Email	Kikiahn93@gmail.com
Field of Research Interest	Education, Chemistry Education

Name	Hiroaki Okada
Gender	Man
Region	Hiroshima, Japan
Degree	Master’s student
Educational Experience	Science teacher at upper secondary school (parttime)
Institution	Graduate School of Humanities and Social Sciences, Master Program, Hiroshima University
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Field of Research Interest	Comparative Education, Chinese Science Education

J

Name	Jaka Afriana
Gender	Male
Region	Indonesia
Degree	Master Science Education
Educational Experience	Bachelor: Physics Education, Universitas Tanjungpura Master: Science Education, Universitas Pendidikan Indonesia Doctor: Student Management Education, Universitas Pakuan
Institution	Universitas Pakuan
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Field of Research Interest	Science Education, Management Education

Name	Jiyun Yang
Gender	Female
Region	South Korea
Degree	Bachelor's degree
Educational Experience	Bachelor: Kyungpook National University, Graduated February 2023
Institution	Kongju National University
Email	yjiyun424@gmail.com
Field of Research Interest	Chemistry Education

Name	Jhuo-Syun Sie
Gender	Male
Region	Taiwan
Degree	Master of Science
Educational Experience	Bachelor: BS, Department of Molecular Biology, DaYeh University Master: Graduate Institute of Science Education, National Changhua University of Education Doctor: PhD student in Graduate Institute of Science Education, National Changhua University of Education
Institution	National Tainan First Senior High School
Email	shasuguru@gmail.com / shasuguru@gm.tnfsh.tn.edu.tw
Field of Research Interest	science language, scientific explanation, biology teaching

Name	Jing Zhang
Gender	Female
Region	HK China
Degree	Master degree （Phd program）
Educational Experience	Bachelor: Applied psychology in Nanjing University Master: Creativity assessment and cultivation in K-12 in BNU Doctor: STEAM education
Institution	Education University of Hong Kong
Email	Trista6285@163.com
Field of Research Interest	STEAM E-learning Motivation

Name	Junye, Gao
Gender	Male
Region	People's republic of China
Degree	Doctoral student (2nd year).
Educational Experience	Bachelor: 2014-2018, Shanghai normal university, China Master: 2020-2022, Hiroshima university, Japan
Institution	Graduate School of Humanities and Social Sciences, Hiroshima University
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Field of Research Interest	History of science education, comparative education, science curriculum

K

Name	Khadeza Yasmin
Gender	Female
Region	Bangladesh
Degree	MSc (Master of Science in Soil Science)
Educational Experience	Master: completed Doctor: PhD (running)
Institution	The Education University of Hong Kong (present here for PhD) and Sylhet Agricultural University, Bangladesh (for research-based masters- completed)
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Field of Research Interest	Soil Pollution, Biochar, Soil-Plant-Nutrient system, Microbiology

Name	Korakoch Tangcharoenlap
Gender	Male
Region	Thailand
Degree	Ed.D. (Science education)
Educational Experience	Bachelor: B.Ed. (Science-biology)
Institution	Srinakharinwirot University
Email	Korakoch.god@g.swu.ac.th
Field of Research Interest	- Scientific media literacy/Media literacy - Scientific literacy - Innovation of Science education/Science teaching

Name	Kousuke Shimada
Gender	Man
Region	Hiroshima, Japan
Degree	Doctor student (First year)
Educational Experience	Master: lower secondary school teacher (part time job) Doctor: lower secondary school teacher (part time job)
Institution	Graduate School of Humanities and Social Sciences, Doctor Program, Hiroshima University
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Field of Research Interest	Nature of Science, History of science education

Name	Kuerbanjiang Jielili
Gender	Male
Region	Mainland China
Degree	Ph.D. Candidate
Educational Experience	Bachelor: Beijing Normal University, Bachelor of Physics Master: Beijing Normal University Doctor: Beijing Normal University, candidate for Doctor's degree
Institution	Department of Physics, Beijing Normal University
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Field of Research Interest	Physics Education

Name	Kusumar Ubonmoung
Gender	Female
Region	Thailand
Degree	Studying Ph.D. degree of Science education, 2023
Educational Experience	Bachelor: Science education
Institution	Kasetsart University
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Field of Research Interest	Science Education: development of Students' Empathetic Problem-Solving Ability through design-based learning

L

Name	Lihua Tan
Gender	Male
Region	China
Degree	Doctor student
Educational Experience	Bachelor: Hunan First Normal College Master: Guangxi Normal university Doctor: University of Macao
Institution	Faculty of Education
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Field of Research Interest	Integrated Science Curriculum; Science Teacher Development; Science Learning Assessment; Data Science In Research of Science Education

M

Name	Muhamad Taufiq
Gender	Male
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Degree	Master of Science Education
Educational Experience	Bachelor: Physics Education, Universitas Negeri Semarang Indonesia (2008) Master: Science Education, Universitas Negeri Semarang Indonesia (2010) Doctor: Doctoral Student, Universitas Pendidikan Indonesia (2022- now)
Institution	Universitas Pendidikan Indonesia (Doctoral student) Universitas Negeri Semarang (Lecturer)
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Field of Research Interest	STEM, STEAM, Science Learning Innovation, ESD, Science Learning Media

N

Name	Nur Ahmad
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Degree	Master of Physics Teaching
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Field of Research Interest	Project Based Learning (PBL) in Science Education STEM Education

P

Name	Mr. Parinya Mutcha
Gender	Male
Region	Thailand
Degree	Ph. D (3rd year)
Educational Experience	**EDUCATIONAL BACKGROUND** 1. Faculty of Education Field Of Study: Chemistry teaching Degree Conferred: Bachelor degree Burapha University, Thailand 2. Faculty of Education Field Of Study: Educational Measurement and Evaluation Degree Conferred: Master degree Khonkaen University, Thailand 3. Faculty of Education (studying) Field Of Study: Science Education Degree Conferred: Ph.D. (Science Education) Kasetsart University, Thailand
Institution	Kasetsart University
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Field of Research Interest	Formative Assessment, Progress map, Cross-cutting concept

Name	Pei-Wan Liu
Gender	Female
Region	Taiwan
Degree	Ph. D.
Educational Experience	Bachelor: National Taipei University of Education Master: National Changhua University of Education Doctor: National Changhua University of Education
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Field of Research Interest	Teacher Professional Learning

R

Name	Dr. Rames Kaewmanee
Gender	Male
Region	Thailand
Degree	Ph.D. Biomedical engineering Studying Ph.D. degree of Science education, 2023
Educational Experience	Bachelor: Rubber and polymer chemistry Master: Polymer chemistry and material science Doctor: Biomedical engineering
Institution	Srinakharinwirot University
Email	rames.kaewmanee@g.swu.ac.th
Field of Research Interest	Chemistry Education; Instructional Tools in Chemistry Teaching; Student Conceptual Development in Chemistry, and Assessment of Learning Outcomes in Chemistry Education

S

Name	Seong-Woo Kim
Gender	Male
Region	Pusan, South Korea
Degree	In the Master program
Educational Experience	Bachelor: 1 year in private academy Master: 1 semester in High School Doctor:
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Field of Research Interest	Biology Education, Environment Education, Curriculum, SDG

Name	Shinetsetseg Gerelkhuu
Gender	Female
Region	Japan, Okayama university
Degree	Master
Educational Experience	Bachelor: Mongolian National University of Education, School of Mathematics and Natural Science Master: Voronezh State University, Faculty of Geography, Geoecology and Tourism Doctor: PhD student
Institution	Graduate School of Humanities and Social Science, Okayama University
Email	Shinetsetseg@msue.edu.mn
Field of Research Interest	Climate change education, Geographical education, Human geography

Name	Shan Lin
Gender	Female
Region	Beijing, China
Degree	Master's degree
Educational Experience	Bachelor: Biological Science, Beijing Normal University Master: Biology Curriculum and Instruction Theory, Beijing Normal University Doctor: Biology Curriculum and Instruction Theory, Beijing Normal University (Doctoral Candidate)
Institution	College of Life Sciences, Beijing Normal University
Email	202331200001@mail.bnu.edu.cn
Advisor	Jian Wang, College of Life Sciences, Beijing Normal University
Field of Research Interest	Biology Education, Pedagogical Content Knowledge

Name	Soyoon Bang
Gender	Female
Region	South Korea
Degree	Master's Degree
Educational Experience	Bachelor: Master: Doctor:
Institution	Gyeongin National University of Education
Email	Bang2320@naver.com
Field of Research Interest	SWH, Physics Education, inquiry-based learning

Name	Sunisa Thapseang
Gender	Female
Region	Thailand
Degree	Studying Ph.D. degree of Science education, 2023
Educational Experience	Bachelor: Science (Chemistry) Master: Science (Chemistry)
Institution	Naresuan University
Email	sunisa.thap@ku.th
Field of Research Interest	Chemistry Education: Instructional model based on active learning in chemistry and Assessment of Learning Outcomes in Chemistry Education

T

Name	Tetsuya Ida
Gender	Male
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Degree	Master 2
Educational Experience	-
Institution	Okayama university
Email	py4t2f48@s.okayama-u.ac.jp
Field of Research Interest	Education of biology and chemistry

V

Name	Vivi Mardian
Position	Master Student
Region	Indonesia
Education	Bachelor: Physics Education (Padang State University or Universitas Negeri Padang) Master: Physics Education (Indonesia University of Education or Universitas Pendidikan Indonesia)
Institution	Indonesia University of Education or Universitas Pendidikan Indonesia
Email	vvmn0123@upi.edu
Field of Research/Expertise	STEM Education and Physics Education

W

Name	Witsanu Suttiwan
Gender	Male
Region	Thailand
Degree	Master of Education (Science Education)
Educational Experience	Bachelor's degree: • Bachelor of Education (General Science), CPRU, Thailand • Bachelor of Education (Guidance Education), STOU, Thailand • Bachelor of Political Science (Public Administration), RU, Thailand Master's degree: • Master of Education (Science Education), MSU, Thailand Doctoral degree: • PhD student in Science Education, Faculty of Education, Khon Kaen University, Thailand
Institution	Khon Kaen University, Thailand
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Field of Research Interest	Transformative Science Education, Education for Sustainable Development, Teaching Science

X

Name	Xiaowan Jin
Gender	Female
Region	Mainland China
Education	Doctoral student
Degree	Master of Education June 2017
Educational Experience	**Doctor: September 2021-Present Beijing, China** ➢ Capital Normal University, School of Education ➢ Major: Comparative Education ➢ Supervisor: Prof. Ding Bangping **Master: Master of Education (June 2017 Beijing, China)** ➢ Capital Normal University, College of Elementary Education ➢ Major: Curriculum and Instruction (Science) **Bachelor: Bachelor of Engineering June 2014 Beijing, China** ➢ Beijing University of Agriculture,College of Food Science and Engineering ➢ Major: Food Engineering
Institution	School of Education, Capital Normal University, Beijing, China,
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Telephone	(86) 151-1796-8154
Field of Research Interest	International comparisons of science education; Science teacher education; STEM education

Y

Name	Yi-Xuan Liu
Gender	Female
Region	Mainland China
Degree	Ph.D. Candidate
Educational Experience	Bachelor: Shandong University, Bachelor of Physics Master: Beijing Normal University Doctor: Beijing Normal University, candidate for Doctor's degree
Institution	Department of Physics, Beijing Normal University
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Telephone	(86) 178-6062-2012
Field of Research Interest	Physics Education

Name	Yusei Nomura
Gender	Man
Region	Hiroshima, Japan
Degree	Doctor student (first year)
Educational Experience	Master: Elementary school teacher (part time job) Doctor: Elementary school teacher (part time job)
Institution	Graduate School of Humanities and Social Sciences, Doctor Program, Hiroshima University, Japan
Email	d230385@hiroshima-u.ac.jp
Field of Research Interest	inquiry, England

Yayasan Pakuan Siliwangi
Universitas Pakuan
Sekolah Pascasarjana
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SURAT TUGAS

Nomor: 049/SPs/Unpak/I/2024

Dekan Sekolah Pascasarjana Universitas Pakuan menugaskan kepada:

No.	Nama	NPM	Jabatan
1.	Jaka Afriana	073123044	Mahasiswa Program Doktor Program Studi Manajemen Pendidikan
2.	Anisa Puteri	072623009	Mahasiswa Program Magister Program Studi Pendidikan IPA

untuk mengikuti kegiatan "***East-Asian Asssociation for Science Education (EASE) Winter School 2023***", yang diselenggarakan oleh Science Education Association (Thailand) pada tanggal 14 sampai dengan 20 Januari 2024.

Demikian surat tugas ini kami buat, untuk dapat dilaksanakan sebagaimana mestinya.

Bogor, 13 Januari 2024
Dekan,

SEKOLAH PASCASARJANA UNIVERSITAS PAKUAN

Prof. Dr. Ing. H. Soewarto Hardhienata
NIP 19581213 198211 1001

E·A·S·E
East-Asian Association for Science Education

CERTIFICATE

OF ATTENDANCE

PROUDLY PRESENTED TO

Anisa Puteri

for outstanding performance and presentation to the EASE Winter School 2023 held in Thailand, on 14-20 January, 2024

Chokchai Yuenyong
SEAT President

Anna Permanasari
EASE President

SCIENCE EDUCATION ASSOCIATION (THAILAND)
Sukhumvit 23, Bangkok, 10110, THAILAND
Tel: 66-2204-2528 Fax 66-2204-2528

December 3rd, 2023

To Professor Riandi, Universitas Pendidikan Indonesia, Indonesia
Invitation Letter for: East-Asian Association for Science Education (EASE) Winter School 2023

Dear Professor Riandi, M.Si.,

As Host Organizing Committee; Science Education Association (Thailand), Srinakharinwirot University, Kasetsart University, Khon Kaen University, Host Organizing Committee; Science Education Association (Thailand), Srinakharinwirot University, Kasetsart University, Khon Kaen University, we will organize EASE Winter School 2023 on January 14-20, 2024. We hope to invite you to deliver one special lecture or workshop, supervise dissertation presentations, and consult collaboratively on research proposal development for the Ph.D. Candidates from 7 countries.

Our EASE EM Thailand will provide accommodation, lunch, coffee break, dinner, transportation from the hotels to the universities and among universities, cultural tours during the stay, and from the hotel to Bangkok or the Airport. It is an apology that you should be responsible for your traveling to Thailand, the Hotel on the Arrival Date, and other expenses needed (see the EASE Winter School 2023 schedule for more details)

We hope you can fit this event into your busy schedule. Please submit an abstract (250-500 words) related to the lecture or workshop topic to chanyah@g.swu.ac.th. The participants and organizers will benefit a lot from your expertise.

Thank you for your great cooperation. We hope our continuous collaboration will bring a great future for science education.

Sincerely,

Chokchai Yuenyong, Ph.D. Associate Professor
President of Science Education Association (Thailand)
e-mail: ychok@kku.ac.th

SCIENCE EDUCATION ASSOCIATION (THAILAND)
Sukhumvit 23, Bangkok, 10110, THAILAND
Tel: 66-2204-2528 Fax 66-2204-2528

December 3rd, 2023

To Professor Anna Permanasari, Universitas Pendidikan Indonesia, Indonesia
Invitation Letter for: East-Asian Association for Science Education (EASE) Winter School 2023

Dear Professor Anna Permanasari

As Host Organizing Committee; Science Education Association (Thailand), Srinakharinwirot University, Kasetsart University, Khon Kaen University, Host Organizing Committee; Science Education Association (Thailand), Srinakharinwirot University, Kasetsart University, Khon Kaen University, we will organize EASE Winter School 2023 on January 14-20, 2024. EASE Winter School aims to provide valuable opportunities for Ph.D. science education students from 7 EASE constituent regions to gain experiences from senior professors, share their research experiences, and develop future research collaboration among the Ph.D. students. EASE EM Thailand welcomes you to participate in the EASE Winter School 2023. As proposed by local coordinators, Indonesian delegation is:

	Name	Institution	E-mail
EASE President	Prof. Anna Permanasari	Universitas Pendidikan Indonesia	anna.permanasari@upi.edu
Professor	Prof. Riandi	Universitas Pendidikan Indonesia	rian@upi.edu
Coach	Prof. Irma Rahma Suwarma	Universitas Pendidikan Indonesia	haninghasbiyati@gmail.com
Ph.D. and M.Ed. students	Eliyawati	Universitas Pendidikan Indonesia	eliyawati@upi.edu
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	Anisa Puteri	Universitas Pakuan	anisaputeru84@guru.smp.belajar.id
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	Nur Ahmad	University of Jember	Masnurauai.fkip@unej.ac.id

Our EASE EM Thailand will provide accommodation, lunch, coffee break, dinner, transportation from the hotels to universities and among universities, cultural tours during the stay, and from the hotel to Bangkok or the Airport. It is an apology that you should be responsible for your traveling to Thailand, the Hotel on the Arrival Date, and other expenses needed (see the EASE Winter School 2023 schedule for more details)

Main Activities

1. Lecture or workshops: senior professors from each region will share their works and experiences in science or STEM education related to education for sustainable development.
2. Dissertation presentation session: students present and discuss their studies in a small group. In addition, students are expected to actively analyze and discuss other students' studies in a supportive environment. A professor and coach will supervise the discussion and provide suggestions to improve their ongoing study. Each presentation and discussion will take about 45 minutes.
3. Collaborative research proposal: students in a small group discuss and develop a cross-region collaborative research proposal. The proposal should be related to science or STEM education related to education for sustainable development issues in Asia and be plausible and valuable in all regions. The proposal should clarify the issue, research questions, literature review, research design and method, and study benefit. Each group will present their proposal to the whole class. One best proposal will be selected by the end of the winter school.
4. Cultural visit: Grand Shadow Play, Tao Hong Tai Ceramics Factory, and Amphawa Floating Market.

We hope you can fit this event into your busy schedule. All participants, please kindly submit a personal information form. The students/participants must submit a 2-page proposal briefly explaining the topic, objectives, background, methods, and expected outcomes to chanyah@g.swu.ac.th before 15 December 2023.

Thank you for your great cooperation. We hope our continuous collaboration will bring a great future for science education.

Sincerely,

Chokchai Yuenyong, Ph.D. Associate Professor
President of Science Education Association (Thailand)
e-mail: ychok@kku.ac.th

Research Proposal EASE Winter School 2024

(Please write down your research proposal for your thesis briefly, around 2 – 4 pages. The proposal will be able to grow during the summer school discussion.)

Title

Development of STEM Learning Media Virtual Reality Based on Self Paced Learning to Improve Metacognitive Skills

Objective

1. Developing innovative STEM learning media in accordance with the principles of self-paced learning that can improve metacognition skills.
2. Measuring the improvement of students' metacognitive skills after using the developed learning media.
3. Obtaining information about the effectiveness of virtual reality-based learning media

Background

Education in the STEM fields (Science, Technology, Engineering, And Mathematics)is essential to producing a new generation capable of advancing society, facing global challenges, and innovating. In addition to offering a comprehensive understanding of scientific and technological ideas, STEM topics foster the development of critical thinking, problem-solving, and creative abilities. Success in STEM domains is largely dependent on metacognitive abilities, which include self-awareness and the capacity to control and supervise learning. These abilities help students create learning plans more successfully, assess how well they comprehend the subject matter, and determine the best approaches to addressing problems. Students who receive STEM education combined with metacognitive skills become not only specialists in science and technology but also capable of handling challenging.

It is commonly known that metacognitive abilities like self-control and introspective thinking are important for developing deep understanding in STEM subjects. A key component of STEM education is metacognition, which is thinking about one's own thinking, being aware of oneself as a problem solver, and planning, organizing, and regulating mental processing.(Saundra Y. McGuire, 2018). The STEM learning approach requires a more student-centered instructional approach, where students explore complex real-world issues and work to develop solutions, emphasizing the need for metacognitive skills such as reflective thinking and self-regulation. (Melinda, 2020)

Studies have indicated that robust metacognitive abilities can aid students in their transition to higher education and are crucial for in-depth learning reinforced by critical thinking and self-assessment abilities, which are especially significant in STEM fields. Therefore, the development of metacognitive skills is key to achieving deep understanding in STEM fields.

Students are often faced with significant challenges in understanding complex STEM concepts. Learning materials in Science, Technology, Engineering and Mathematics often involve abstract and often complex concepts. These challenges can stem from the complexity of mathematical concepts, the intricacy of scientific processes, or even the integration of evolving technologies. In addition, students may feel intimidated by the amount of information that must be understood, as well as the difficulty in connecting these concepts to real-world situations.

The STEM areas dynamic nature poses a challenge for educators and students who need to stay up to date with the most recent advancements. The culture of STEM education, including uninspired teaching and barriers related to departmental, institutional, and national policies, can also hinder students' learning experiences. (Yan Dong et al, 2020). By identifying and understanding these challenges, educators can design more effective learning strategies, facilitate better understanding, and encourage student interest in STEM fields that are so crucial to the future of education and technological development.

The advent of virtual reality (VR) technology offers a substantial chance to improve STEM education. Virtual reality (VR) technologies can help students visualize and understand complicated scientific subjects by providing them with realistic and immersive experiences. Virtual reality (VR) offers students the chance to explore inaccessible places and participate in hands-on learning experiences by imitating real-world environments and activities. These experiences are vital for mastering STEM courses. (Murat Çoban, 2022)

The necessity to accommodate a wide range of student demands and learning styles highlights the urgency of self-paced learning in STEM education. Self-paced learning gives students the freedom to move through the content at a comfortable pace, which enables them to fully comprehend even the most difficult STEM concepts. This method also fosters metacognitive abilities, which are critical for success in STEM professions and include self-regulation and introspective thinking. (Melinda, 2020) Furthermore, self-paced learning can assist in addressing the differences in students' past knowledge and experience in STEM disciplines, enabling each student to establish a solid foundation at their own speed. Self-paced learning is very advantageous in STEM education since it allows students to study abstract and complex concepts at their own pace.

The delivery of STEM education may be hampered by the shortcomings of the current STEM learning materials. There are still issues that need to be resolved even if research indicates that interactive STEM media can be a valuable teaching tool for young children. According to one study, more research is necessary to fully understand the nature of the connection between STEM media and STEM skills, especially on whether media is used in instead of or in addition to discovery and discussion.(Sheehan et al, 2018). Teachers can guarantee that all students have equitable access to high-quality STEM learning opportunities and foster a more inclusive learning environment by addressing constraints in learning media.

In order to help students enhance their metacognitive skills, self-paced learning methods and the utilization of Virtual Reality (VR) technology are highly relevant. The relevance of using virtual reality (VR) and self-paced learning in developing students' metacognitive skills can be explained through the following points: (1) Increasing self-awareness Students can plan, monitor, and test their comprehension while critically conscious of their function as thinkers in VR's authentic and immersive setting, which fosters heightened self-awareness . (2) Personalized and adaptive learning: Virtual reality (VR) can help students improve critical thinking abilities and self-regulation by providing them with personalized and adaptive learning pathways, scaffolds, and prompts. (3) ndividual practice and review: By incorporating virtual reality (VR) experiences into the curriculum, students are provided with chances for individual practice, review, and customized learning assignments, all of which support the development of metacognotive skills. (Cowan et al, 2023)

This research has the potential to contribute significantly to the development of more effective STEM learning media. This research represents a step toward changing how we impart scientific information to future generations, rather than merely being an experiment with new technology, especially in the setting of STEM education, where learning dynamics are always changing. The creation of Virtual Reality (VR)-based learning resources specifically designed for the self-paced learning methodology constitutes the primary contribution of this research. The use of VR technology enhances the educational process by producing realistic and captivating simulations and presenting content in an interactive and immersive style. Self-paced learning offers students freedom and independence in the learning process by creating content that they may access at their own speed.

Method

A. Research Methods and Design

This research method uses research and development with ADDIE. The ADDIE model stands for Analyze, Design, Develop, Implement, and Evaluate. (Branch, 2013).

In this research, the device developed is virtual reality interactive learning media. The research instruments used in this study include validation sheets, student response questionnaires, and observation sheets. This research was conducted with a quasi-experimental design to determine the effectiveness of learning media. This research will analyze the control class and the experimental class. In addition, it will be analyzed quantitatively using SPSS.

B. Location, Population, and Sample Research

   The location of the research will be carried out at SMP IT Al Qalamm, Depok. By taking purposive sampling from the population of class VII junior high school students, which consists of 2 female gender classes and 2 male gender classes

C. Research Instruments

Metacognitive Skill test (Schraw, G. & Dennison, R.S. (1994). Assessing metacognitive awareness. Contemporary Educational Psychology, 19, 460-475.), observation sheets, and meadia learning virtual reality on concept of mixture separation.

D. Research procedure

1. Preliminary Test
2. ADDIE (Analyze, Design, Develop, Implement, and Evaluate)
3. Final Stage (After conducting the assessment, then collecting the data on the results of the assessment and analyzing the results obtained).

E. Data Analysis Techniques

- Test normality and homogeneity.
- The amount of increase before and after learning is calculated by the normalized gain formula developed by (Hake, 1998)

F. Research Product

STEM Learning Media Virtual Reality Based on Self Paced Learning to Improve Metacognitive Skills

Expected Outcome

– STEM Digital Learning Media assisted by Virtual Reality can improve metacognitive skills

- Publication in reputable international journals or national journals SINTA 1

References

Allcoat, D.; von Muhlenen, A. Learning in virtual reality: Effects on performance, emotion and engagement. *Res. Learn. Technol.* **2018**, *26*, 2140.

Amanda Kathryn Nichols Hess, Oakland University Katie Greer. Designing for Engagement: Using the ADDIE Model to Integrate High-Impact Practices into an Online Information Literacy Course. Communications In Information Literacy | Vol. 10, No. 2, 2016

Cooper, G.; Thong, L.P. Implementing Virtual Reality in the Classroom: Envisaging Possibilities in STEM Education. In *STEM Education: An Emerging Field of Inquiry*; Brill: Leiden, The Netherlands, 2019.

Cowan, P.; Farrell, R. Using Virtual Reality to Support Retrieval Practice in Blended Learning: An Interdisciplinary Professional Development Collaboration between Novice and Expert Teachers. *Digital* **2023**, *3*, 251-272. https://doi.org/10.3390/digital3030016

Dong, Y., Wang, J., Yang, Y. *et al.* Understanding intrinsic challenges to STEM instructional practices for Chinese teachers based on their beliefs and knowledge base. *IJ STEM Ed* **7**, 47 (2020). https://doi.org/10.1186/s40594-020-00245-0

Hamilton, D.; McKechnie, J.; Edgerton, E.; Wilson, C. Immersive Virtual Reality as a Pedagogical Tool in Education: A Systematic Literature Review of Quantitative Learning Outcomes and Experimental Design. *J. Comput. Educ.* **2021**, *8*, 1–32.

Knowledge Management & E-Learning, Vol.14, No.3. Sep 2022 Using virtual reality technologies in STEM education: ICT pre-service teachers' perceptions Murat Çoban Nilüfer Okur Akçay İsmail Çelik Agri Ibrahim Cecen University, Turkey

Schraw, G. & Dennison, R.S. (1994). Assessing metacognitive awareness. Contemporary Educational Psychology, 19, 460-475.

Sheehan KJ, Hightower B, Lauricella AR, Wartella E. STEM Media in the Family Context: The Effect of STEM Career and Media Use on Preschoolers' Science and Math Skills. *European Journal of STEM Education*. 2018;3(3), 17. https://doi.org/10.20897/ejsteme/3877