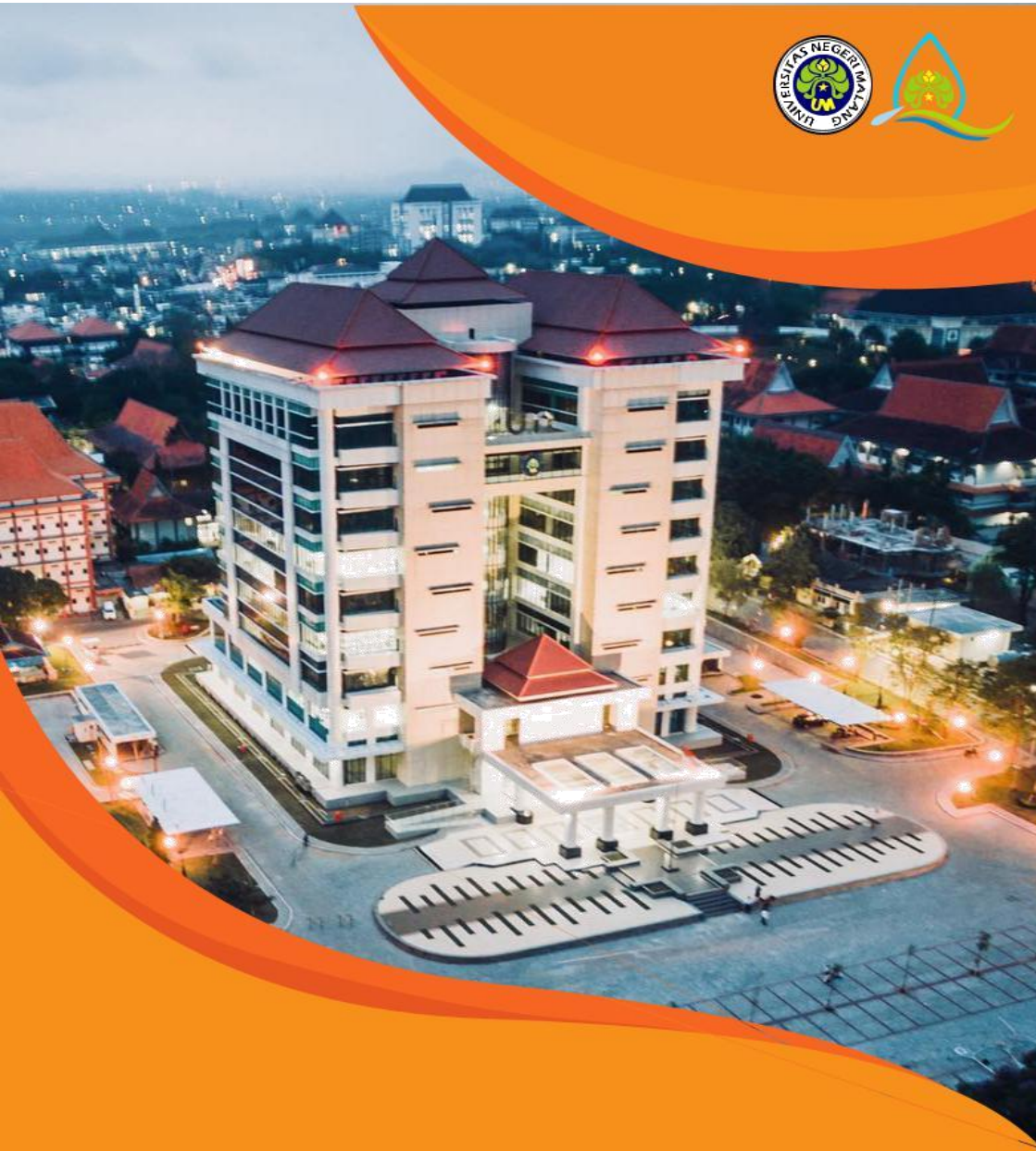

Contents

Welcome Addresses

The International Conference on Mathematics and Science Education, ICoMSE 2018

Chairman's Speech

Dear distinguished guests, respected colleagues, ladies, and gentlemen,
It is a great honor for me to welcome all of you to Malang. On behalf of the organizers of **the 2nd International Conference on Mathematics and Science Education 2018** I would like to express my most gratitude for your presence in this opening ceremony as the gateway to initiation to our scientific program.

In particular, I would like to extend my gratitude to distinguished guests from abroad. First of all, please allow me to express my sincere appreciation for coming to our campus for:

1. Dr. Hadi Susanto
   Department of Mathematical Sciences, Faculty of Science and Health, University of Essex, UK.
2. Dr. Zainudin bin Hassan
   Department of Educational Foundation, Faculty of Education, Universiti Teknologi Malaysia
3. Dr. Lilla Adulyasas
   Faculty of Science Technology and Agriculture, Yala Rajabhat University, Thailand,
4. Prof. Sri Rahayu, M.Ed., Ph.D
   Department of Chemistry, Universitas Negeri Malang, Indonesia.

I welcome all of you and hope this conference will serve as a catalyst in strengthening national as well as international cooperation for sharing research and knowledge in mathematics and science education.

Ladies and gentlemen, mathematics, science, and education have gained huge attention from the Indonesian government because of their potential role in the strategic development direction of the country. As the consequence,

mathematics and science education research, as well as all activities which promote its results like the ICoMSE 2018 possess a pivotal role in the development of universities and the country accordingly.

In addition, I am most thankful for the tireless efforts shown by staff and faculty members of Faculty of Mathematics and Natural Sciences UM, all cooperating institutions as well as the sponsors which are now with us in the booths.

We at Universitas Negeri Malang have been working on things which have been the common concern of the world's leading universities: innovation, internationalization, and publication from interdisciplinary research. Taking an example, we are developing research centers, the center of innovation which is being funded by IDB are among the process to reach the goals. However, all the results from any research should be published and shared so everyone who shares the common interests can follow, develop and discuss it. This ICoMSE is designated to promote our research interests, knowledge sharing, and transfer, as well as to improve our common ground of science and technology.

I would like to take this opportunity to report some formal information related to the ICoMSE 2018. The committee has already accepted up to 200 abstracts and manuscripts. These abstracts have been distributed in 5 main topics. The submitted papers are coming from 6 countries, 211 authors. The ICoMSE 2018 will be organized as 2 conference days from 28th to 29th of August 2018 including 4 plenary sessions, 26 parallel sessions.

Last but not least, I strongly hope that all of the distinguished guests gathered here today will be kindly offering generous support and encouragement for the successful conference and to foster the growth of Mathematics and Science Education community.

I am most grateful for your participation and supports. Thank you very much. Enjoy your stay in Malang and enjoy the conference. I am greatly honored and pleased to welcome you all to the 2nd ICoMSE 2018.

Thank you.

Chairman of ICoMSE 2018,
Prof. Dr. Toto Nusantara, M.Si

Organizing Committee

Chairman: Prof. Dr. Toto Nusantara, M.Si (Scopus ID : 55337998100)
Co-Chairman: Dr. Sukoriyanto, M.Si

Member:

1. Syaiful Hamzah Nasution (UM, Indonesia)
2. Nur Atikah (UM, Indonesia)
3. Sudirman (UM, Indonesia)
4. Ery Hidayanto (UM, Indonesia)
5. Tjang Daniel Candra (UM, Indonesia)
6. I Made Sulandra (UM, Indonesia)

Conference Program

Day 1, August 28th 2018		
07.00 - 08.00	**Registration Open**	Committee
08.00 - 08.10	**Opening**	MC
08.10 - 08.20	**Anthem Indonesia Raya**	Cahaya Fitri
08.20 - 08.40	**Welcome Dance : Tari Malangan**	
08.40 - 08.50	**Conference Report by** Chairman of The 2nd ICoMSE Organizing Committee	Prof. Toto Nusantara, M. Si
08.50 - 09.20	**Opening Speech by** Rector Universitas Negeri Malang	Rector
09.20 - 09.25	**Recitation of Du'a**	Dr. Hery Susanto, M. Si
09.25 - 09.45	Coffee Break	Committee
09.45 - 10.45	**Plenary Session 1** Dr. Hadi Susanto, University of Essex, England Tittle: Formation of blooms and patterns in phytoplankton models	Prof. Dr. Toto Nusantara, M. Si
10.50 - 11.50	**Plenary Session 2** Dr. Zainuddin bin Hasan UTM Malaysia Tittle: Implementing the Four Cs of 21st Century Skills in classrooms: Do Malaysian primary teachers understand?	Dr. A R. As'ari, M. Pd., M. A.
11.50-13.00	**Praying Time and Lunch**	
13.00 - 16.00	**Parallel Sessions &** **Coffee Break**	Committee

Day 2, August 29th 2018		
07.30 - 08.30	**Registration**	Committee
08.30 - 09.30	**Plenary Session 3** Prof. Dr. Lila Adulyasas Yala Rajabat University, Thailand	Prof. Drs. Purwanto, Ph.D
09.30 - 10.00	**Coffee Break**	Committee
10.00 - 11.00	**Plenary Session 4** Prof. Sri Rahayu, M.Ed, Ph.D Universitas Negeri Malang, Indonesia Tittle: Socioscientific Issues (SSI) in Chemistry Education : Enhancing Both Students Chemical Literacy & Transferable Skills.	Prof. Drs. Gatot Muhsetyo, M. Sc
11.00-12.30	**Praying Time and Lunch**	
12.30 - 15.00	**Parallel Sessions &** **Coffee Break**	Committee

Parallel Session – Day 1

Tuesday, August 28th 2018

PRESENTATION SCHEDULE

ROOM O8.201
Category : Chemistry Education (CE)
PIC : Moh. Yasin, S.Kom. M.Kom
Time : 13.00-16.00

No	Tittle	Authors
1	Virtual Chemistry Laboratory As Pre-Lab Experiences: Stimulating Student's Prediction Skill	Yenni Kurniawati
2	Electronic Properties Of Silicon Carbide Fiber As Electronic Semiconductor	Masripah, S.Si, Dr. Jan Setiawan, Dr. Rer.Nat. Agustino Zulys
3	Multi-Level Representation Ability Of Students To Write Teaching Materials In Voltaic Cell Subject	Dewi Nurdiyanti, Anna Permanasari, Sri Mulyani, Hernani.
4	Student Respone To Monitoring Chemical Project Activities Through Whatsapp Group	Hidmi Gramatolina Ramdhayani.
5	Analysis Of The Causes Of Indonesian Students Low Science Literacy By The Result Of Pisa	Geby Riyanti Utami
6	Chemistry Teachers' Views about Scientific Inquiry: A Study in a Regency of East Java Province	Muntholib, Parlan, Yahmin

ROOM O8.202
Category : Biology Education (BE)
PIC : Dr. Hery Susanto, M.Si.
Time : 13.00-16.00

No	Tittle	Authors
1	Instrument Design Higher Order Thinking Skills (Hots) In Biology Learning	Khairunnisa Abdurrachman
2	Empowering Student's Metacognitive Skill Through Cirsa Learning	Refirman Djamahar, Rizhal Hendi Ristanto, Nurmasari Sartono, Ilmi Zajuli Ichsan, Ericka Darmawan
3	Identification Of Students' Misconceptions On Teratology Course By Using Certainty Of Response Index (Cri) Method	Amy Tenzer
4	Bryophyta Misconception Study With Concept Approach In High School Biology Textbook	Sunarmi, Triastono Imam Prasetyo, Dwi Arianita Wulan Sari
5	The Students' Interest Of Learning Science Based On Learning Style Instruction	Kasman Arifin
6	The Effectiveness Of Guided Inquiry Learning Based On Local Potential Of Ujong Blang Lhokseumawe Beach To Improve Critical Thinking Skills Of Fisheries And Marine Vocational Students	Dini Annisha, Ibrohim, Fatchur Rohman
7	Need Analysis Of Materials And Media Biology Teaching For High School Students Around Location 8Of People Gold Mining	Muhammad Syamsussabri, Sueb, Suhadi
8	Need Analysis Of Materials And Media Teaching On Topic Of Environmental Pollution At SMAN 1 Sekotong	Baiq Khandra Muliya, Sueb, Suhadi

9	The Use Of Lesson Study For Learning Community To Teach Life Based-Learning For Biology Education Students	Herawati Susilo, Sueb

ROOM O8.203
Category : Biology Education (BE)
PIC : Dra. Santi Irawati, M.Si, Ph. D.
Time : 13.00-16.00

No	Tittle	Authors
1	Integrating The Collaborative Learning And The Science Literacy On Introductory Biology To Improve Science Generic Skills On Prospective Of Madrasah Ibtidaiyah Teachers	Dr. Eni Setyowati, S.Pd., Mm
2	Implementation Of Predict Observe Explain (Poe) And Project Based Learning (Pjbl) Learning Models To Enhance Communication, Collaboration And Creative Thinking Skills On Senior High School Students	Christine Apriyani, Herawati Susilo, Sueb
3	Implementation of guided inquiry learning with scaffolding strategy to increase critical thinking skills of biology students in 21st century learning course based on lesson study	Warni Makmur, Herawati Susilo, Sri Endah Indriwati
4	The Implementation Of Problem Based Learning (Pbl) Model For Improving Students' Oral Communication Skill Through Lesson Study	Amalia Ainun Najah, Herawati Susilo, Aida Fitriatur Rohmah, Usratussyarifah
5	Implementation Of Guided Inquiry And Discussion Method To Enhance 4cs On Environmental Change Topic Through Peer Teaching Practices In The Teaching Biology In English Course	Dita Perdana , Herawati Susilo, Sueb

6	The Implementation Of Science Literacy Skill Assessment Based On Lesson Study To Increase Learning Outcome Of Biology Teachers Candidates	Murni Sapta Sari, Sunarmi, Eko Sri Sulasmi, Kuni Mawaddah
7	The Implementation Of Project Based Learning Model In Evolution Materials To Stimulate The Critical Thinking Skill And Creativity Of Biology Pre Service Teachers	Jirana, Mohamad Amin, Endang Suarsini, Betty Lukiati

ROOM O8.205
Category : Physic Education (PE)
PIC : Dr. Swasono Rahardjo, M.Si.
Time : 13.00-16.00

No	Tittle	Authors
1	Development Of Physics Interactive Learning Media For XI Grade Students Of SMA Negeri 9 Makassar	Siti Zahra Mulianti Natsir, Nurhayati, Ahmad Yani
2	Developing Learning Tools Guided Discovery Models Assisted Phet Simulations For Trainning Critical Thinking Skills High School Students.	Ubaid Habibi Thohari
3	Development Of Test Instruments To Measure Diagram And Argumentation Representation Skills In Newton's Law	Andi Nurfitri Syarif, Heru Kuswanto
4	Physics Learning Using Direct Instruction Model Assisted By Plickers Application To Measure Problem Solving Ability.	Mardhiyyatin Naqiyah, Jumadi, Insih Wilujeng
5	The Development Of Physics Learning Based On Guided Discovery Learning Model To Improve Students Physics Concept And Students Learning Result On Kinetic Theory With Phet Simulation Programmed	Puspita Widyagarini
6	CAKA As Physics Learning Media Based On Android Apps In Smart Phone	Heribertus Didik Kurniawan, Heru Kuswanto

7	Implementing inquiry learning model to improve primary school students' critical thinking on earth and universe concept	Nelda Azriani, Ernawulan Syaodih, Andi Suhandi, Khoiro Mahbubah, Hany Handayani, Neni Hermita, Achmad Samsudin
8	Development Practicum Tools On Doppler Effect Material To Improve Student Learning Outcomes	Lisda Hadiani Al Fitri
9	The Increase Of Students' Scientific Literacy Through Guided Inquiry Learning – STEM In The Topic Of Optical Instrument	Parno, Lia Yuliati, Nuril Munfaridah, Lulut Citra Dewi
10	Analyse Of Student Literacy Capabilities Through Use Of E-Book Based On Science, Technology, Engineering, And Mathematic (Stem) On Global Warming Material Class XI	Devi Nurrahma Wulandari

ROOM O8.206
Category : Science Education (SE)
PIC : Indriati Nurul H. S.Pd. M.Si.
Time : 13.00-16.00

No	Tittle	Authors
1	The Effectiveness Of Contextual Teaching And Learning Science Worksheet To Improve The Process Skill For Primary Student	Noviardani Kartika Prameswari, Margaretha Ordo Servitri
2	The Development Of Adobe Flash-Based Geography Learning Media To Increase The Students Curiosity	Wahid Yuda Rejeki
3	The Correlation Between Adversity Quotient With Geography Learning Outcomes Of Students In Class X At SMAN 1 Kasihan Yogyakarta	Yuliana Ria Ariska.
4	Practicality Of Development Interactive Cd Media Based On Characters In Perkembangan Peserta Didik Subject	Fifi Yasmi, Ellbert Hutabri, Asril
5	Learning Implementation Of Scientific Critical Thinking Model (Sct): Train Critical Thinking Skill And Self Efficacy Candidate Teacher Chemistry	Rusmansyah, Leny Yuanita, Muslimin Ibrahim, Isnawati
6	Learning Implementation Of Collaborative Science Based Learning (Cbsl) Models: Train Critical Thinking Skills And Responsibility Of Student	Isnawati, Muslimin Ibrahim, Tanjdrakirana, Rusmansyah
7	Improving High Order Thinking Skills (HOTS) On The Learning Content Of Natural Science Through Student Facilitator And Explaining Learning Method (Action Research On 4th Grade Students At Tunas Mandiri Islamic Elementary School)	Nurul Hikmah

8	Discovery Learning To Enhancing Students' Science Process Skills And Cognitive Learning Outcome	Erwinsyah Satria
9	Development Of Practicum Instructions For Junior Haigh School Students: Formalin Test Using Natural Indicators	Nanang Rahman

ROOM O8.207
Category : Science Education (SE)
PIC : Drs. Slamet, M.Si
Time : 13.00-16.00

No	Tittle	Authors
1	Accumulation Of Heavy Metal (Mercury And Plumbum) In Two Fish Species In Sipin And Teluk Lake, Jambi Province	Siswanta Kaban
2	Science Learning For Students With Visually Impaired: A Literature Review	Ediyanto, Norimune Kawai
3	Science-Domain-Integrated-With-Local-Potential-Based Learning Video As Interactive Media In The 21th Century Learning	Jumriani, Zuhdan Kun Prasetyo, Insih Wilujeng
4	The Study Of Problem Solving Skills Of Junior High School Students On Natural Science Lesson Based On Levels Of School	Fitriana Nur Astuti
5	Improving Cognitive Learning Outcomes Through Science Learning Video Integrated With Local Potency	Sofyan Dwi Nugroho, Insih Wilujeng
6	Analysis Of Items Using The Assessment Instrument Based On The Structure Of Observed Learning Outcome About Buffer	Ahmad Nasrulloh

7	Teachers And Students Understanding' Of The Nature Of Science At Elementary Schools In West Sumatera	Erwinsyah Satria
8	Implementation Of Scientific Critical Thinking (Sct) Learning Model: Training Critical Thinking Skills And Efficacy Self Candidate Chemistry Teacher	Rusmansyah, Leny Yuanita, Muslimin Ibrahim, Isnawati

ROOM O8.301
Category : Mathematics Education (ME)
PIC : Dr. Edy Bambang Irawan, M.Pd.
Time : 13.00-16.00

No	Tittle	Authors
1	Perception Of Primary Mathematics Teachers On Stem-Oriented Teaching And Learning	Afian Akhbar Bin Mustam, Mazlini Adnan
2	A Comparison Between Discovery And Expository Methods Of Teaching Mathematics Amongst Secondary School Students In Nassarawa Local Government Area Of Kano State, Nigeria.	Surajo Isa Gaya
3	Analogy Reasoning In Solving Pictorial Representation Problem A Case Study	Muniroh Novisa, Subanji
4	Analysis Of Inquiry Processes For Finding Unfolding Cube And Beams In Fifth Grade Elementary School Student	Safirdha Nilam Wardah , Prof. Drs. Gatot Muhsetyo, M.Sc, Dr. Edy Bambang Irawan, M.Pd
5	An Analysis Of The Thinking Creatively Of Student Grade 4 In Solving Open Ended Problem	Ratna Nurul Wardani
6	Mathematical Representations Of Students With Special Needs In	Ahmad Farid Haebah, Subanji

	Mathematics Problem Solving In Inclusive School	
7	Teacher's Effort In Showing Mathematical Disposition Of Students In Class Separating Gender	Yesy Puspitasari, Subanji
8	Students' Creative Thinking In Solving Open Ended Problems	Dewi Sri Lestari, Subanji
9	Ability Of Mathematical Literacy Teacher At The Basic Education	Rizqi Annisavitri, Subanji

ROOM O8.302
Category : Mathematics Education (ME)
PIC : Dr. Subanji, M.Si.
Time : 13.00-16.00

No	Tittle	Authors
1	Newman Mistake Analysis On Whole Number Material Reviewed From Cognitive Style	Luluk Wahyu Nengsih, Subanji
2	Students' Error Toward Concept In Resolving Math Problem	Mona Muleka
3	Analysis Of Student Error In Representing Fractions On The Number Line	Eka Tandi Langi, Erry Hidayanto, Sudirman
4	The Analysis Of Dificulties Of Students Class Vii In Solving Material Equation And Linear Inequality One Variable	Rui Alegria, Purwanto, Abadio
5	An Analysis Of Difficulty In Making Indicators Competency Achievement	Bakher Nenotaek, Imam Sujadi, Sri Subanti.
6	Scaffolding Based On Cognitive Conflict In Correcting The Students' Algebra Errors	Indah Puspitasari Maharani, Subanji
7	Secondary Students Of Difficulties In Mathematical Problems Solving	Tatang Herman, Samsul Hadi.

8	The Analysis Of Students' Misconception In The Material Of Definite Integrals	Ratih Dewi Rahmawati
9	Misconception Analyses Computational Operations Materials Of Algebra On Procedural Aspect Student At Junior High School In Indonesia	Nurika Miftahuljannah

ROOM O8.303
Category : Mathematics Education (ME)
PIC : Dr. Erry Hidayanto, M.Si.
Time : 13.00-16.00

No	Tittle	Authors
1	The Process Of Elementary School Students Metacognition In Mathematical Problem Solving Based Polya	Kistin Restu Perdana, Subanji
2	Plausible Reasoning Elementary Students In Resolving The Question Of Problem Solving	Anton Budi Jatmiko, Subanji, Ery Hidayanto
3	The Process Of Students' Metacognition In Solving The Mathematical Problems Based On Vak Learning Styles (Visual, Auditory, And Kinaesthetic)	Rachmad Abubakar Lamowa, Subanji
4	Using Local Potential Of Kefamenanu Community In Their Experiences Of Junior High School Teachers Of Mathematics For Increases Creativity	Stanislaus Amsikan
5	Design Of Teaching Materials Scaffolding-Based Interactive To Develop Reflective Thinking Skills In Mathematics Pre-Service Teachers	Yuyu Yuhana , Hepsi Nindiasari, Novaliyosi
6	Teaching Guide For Functional Thinkings In Primary School Students	Bagus Ardi Saputro, Didi Suryadi, Rizky Rosjanuardi, Bana G. Kartasasmita.

7	Algebraic Thinking Of Junior High School Students In Solving Numbers' Pattern Problem Based On Mathematics Ability	Ni Putu Novianty Kartika Sari, Yusuf Fuad, Rooselyna Ekawati
8	The Level Of Student's Mathematical Literacy Ability Of Junior High School Students On Geometry	Pangestika Sumadianing Saputri, Mardiyana, Triyanto
9	Development Of Mathematics Learning Material Devices Based On Ethnomathematics In Character Learning Student Levels Of Junior High School	Ririn Dwi Agustin, Mika Ambarawati, Era Dewi Kartika

ROOM O8.304
Category : Mathematics Education (ME)
PIC : Drs. Dwiyana, M.Pd. Ph.D
Time : 13.00-16.00

No	Tittle	Authors
1	Students Thinking Process In Problem Solving Mix Operations Using The Meaning Equal Sign	Astia Ningsih
2	Thinking Process Of Mathematics Students With Introvert Learning Style In Solving Mathematics Problems	Dede Ngadino, Subanji
3	Students' Mathematical Communications In Solving Combination Problem	Sukoriyanto
4	Students' Translation Ability Of Mathematical Representations Based On Their Learning Styles	Imam Setiadi
5	Preliminary Design Of Ilc-Based Multimedia On Base Of Number Concept	Gustimal Witri, Syahrilfuddin, Guslinda, Khoiro Mahbubah, Neni Hermita

6	Defragmentation Of Reflective Student's Thinking Structure On Solving Linear Programming Word Problem	Anita Dwi Septian, Tjang Daniel Chandra, Dwiyana
7	Creative Thinking Process In Mathematics Problem Solving On Fi And Fd Students	Ika Setyana
8	Students Mathematical Thinking Process Involving Equal Signs Agosto Olo Tome,	Purwanto, Cholis Sadijah
9	Interference Thinking Students Understand The Function	Erry Hidayanto

ROOM O8.305

Category : Mathematics Education (ME)
PIC : Drs. Tjang Daniel Chandra, Ph.D
Time : 13.00-16.00

No	Tittle	Authors
1	Mathematical Representation Students Reviewed From Types Of Understanding	Ahmad Didik Zakariya, Subanji
2	Student's Quantitative Reasoning In Problem Solving Based On The Cognitive Style	Fajriyah Rachmatika
3	Exploring Students' Mathematical Reasoning Using Concept Map	Rita Pramujiyanti Khotimah, Masduki, Christina Kartika Sari
4	Self-Concept Student In Mathematics Problem Solving	Wahyu Septi Rahma Yus Sultra

5	Student Algebraic Reasoning To Solve Quadratic Equation Problem	Nia Wahyu Damayanti, Purwanto, I Nengah Parta And Tjang Daniel
6	Analysis Of Students Of Mathematical Representation Ability In Terms Of Self-Regulated Learning	Noor Hidayati
7	Elementary Graders' Spatial-Mathematical Reasoning On Plane Area	Mufarrahatus Syarifah
8	The Visual Representation Skill In Solving Fraction Problem	Royyan Faradiba, Dr. Subanji, M.Si..
9	Training Of Trainer For High School Teachers On Mathematical Olympiad In Mgmp Kabupaten Banyuwangi	Tjang Daniel Chandra, Santi Irawati , Nur Atikah, Dahlliatul Hasanah

ROOM O8.306
Category : Mathematics Education (ME)
PIC : Dra. Etty Tejo D.C. M.Pd.
Time : 13.00-16.00

No	Tittle	Authors
1	Strengthening Character Education In Learning Mathematics Using Insana Motive Woven For Primary School Teachers	Yohanis Ndapa Deda
2	Validity Assessment Of A Multimedia Based On Cognitive Load Theory For Learning Undergraduate Plane Geometry	Mukhlas Triono, Endah Retnowati
3	The Ability Of Deaf Pupils In Solving Mathematic Problem	Samuel Igo Leton, Wahyudin, Darhim
4	Influence Of Education Background And Pathway On Entry Students Based	Edi Irawan

	Mathematics	
5	Shadow Supervisor Strategy On Student With Adhd In Mathematics Learning Activity For Inclusive Secondary Class Of Elementary School	Rosy Marlina, Budiyanto, Budi Usodo
6	The Effect Of The Elpsa Framework On Student's Ability To Solve Function Problems	Ita Chairun Nissa, Sanapiah, Yuntawati
7	MENGLITIK as A Mathematics Learning Media On Circle	Robert Syarifudin, Latifah Mustofa Lestyanto
8	Teachers' Strategy To Develop Student's Mathematical Competence In Teaching Algebra	Masduki, St. Suwarsono, Mega Teguh Budiarto
9	Students' Relational Understanding Of Algebraic Fraction Problem	Matilde Niis Molo, Siti Maghfirotun Amin, Tatag Yuli Eko Siswono

ROOM O8.307
Category : Mathematics Education (ME)
PIC : Dr. Susiswo, M.Si.
Time : 13.00-16.00

No	Tittle	Authors
1	Implementation Of Creative Problem Solving (Cps) Model Using E-Learning In Applied Graph Theory Course	Sapti Wahyuningsih, Darmawan Satyananda, Lucky Tri Octoviana, Rini Nurhakiki

2	The Folding Back And Pseudo-Folding Back Of The Students When Solving The Limit Problems	Susiswo, Subanji, Tjang Daniel Chandra, Purwanto, Sudirman
3	Undergraduate Students' Creative Thinking Skill In Making Open-Ended Mathematical Problems Through Semi-Structured Problem Posing	Eni Titikusumawati, Cholis Sa'dijah, Abdur Rahman As'ari, Hery Susanto.
4	Visualizer And Verbalizer Cognitive Style In Mathematics Problem-Solving	Edi Irawan, Alfiyatu Rahmawatiningrum.
5	Affect Of Adversity Quotiens In Mathemathics Problem Solving	Luthfi Nur Pamungkas
6	Relational Thinking Process In Junior High School Students In Solving Contextual Mathematics Problem Based On Gender Differences	Didik Hermanto, I Ketut Budayasa, Agung Lukito
7	Epistemic Cognition Of Student In Solving Mathematical Problem	Anggik Yulianto
8	Probabilistic Thinking Of Senior High School Students In Solving Probability Tasks	Rita Raya, St. Suwarsono, Agung Lukito
9	Student Metacognition Process In Open-Ended Problems Solving Agus Alamsyah.	Matilde Niis Molo, Siti Maghfirotun Amin, Tatag Yuli Eko Siswono

Parallel Session – Day 2
Wednesday, August 29th 2018

PRESENTATION SCHEDULE

ROOM O8.201
Category : Chemistry Education (CE)
PIC : Dra. Susy Kuspambudi A., M.Kom
Time : 12.30-15.00

No	Tittle	Authors
1	Generic Science Skills Profile Of Pre-Service Chemistry Teachers On Atomic Structure And Chemical Bonding ToPICs	Indah Langitasari
2	The Increase In Learning Outcomes Chemical X Grade Students By Using A Model Learning Cooperative Type Student Achievement Division Teams (Stad)	Elferida Sormin, Tina M Sababalat
3	The Development Of Performance Assessment Rubrics For Assessing The Science Process Skills Of High School Students In Exothermic And Endothermic Reactions Laboratory Work.	Maulana Yusuf
4	Mapping Chemistry And Automotive Concepts For Building Synergistic Curriculum To Be Implemented At Vocational High School	Pancayani Dinihari, M. Pd, Prof. Drs. Effendy, M.Pd, Ph.D., Prof. Dra. Sri Rahayu, M.Ed., Ph.D, Drs. I Wayan Dasna, M.Si, M.Ed., Ph.D
5	Effects Of The Metacognitive Learning Strategy On Prospective Chemistry Teacher's Academic Achievement	Parlan

6	The Effect Of Multiple Representation To Prospective Chemistry Teachers' Undestanding On Intermolecular Force Concept	Hayuni Retno Widarti, Siti Marfu'ah , Parlan

ROOM O8.202
Category : Biology Education (BE)
PIC : Darmawan S. S.T,M.T.
Time : 12.30-15.00

No	Tittle	Authors
1	Developing Performance Assessment Base Habits Of Mind In A Guided Inquiry Learning Keanekaragaman Tumbuhan ToPIC For Measuring Scientific Writing Students At X Mia Man 1 Kabupaten Malang	Anggun Risma Atika
2	Promoting Karmana Problem Based Learning Model To Train Problem Solving Skills And Environmental Pollution Concept Mastery	I.W. Karmana, M. Ibrahim, E. Susantini
3	The Development Of Biochemistry Teaching Materials Based On Group Investigation	Muhammad Mifta Fausan, Mesra Damayanti, Indah Panca Pujiastuti, Muhiddin Palennari, Muhammad Danial
4	The Development Of Interactive Multimedia Based On Guided Discovery Learning (Gdl) On Human Movement System Material For Eighth Grade Student Of Junior High School	Ayuda Arie Aprilia, Prof. Dr. Rer.Nat. Sajidan, M.Si., Puguh Karyanto, M.Si., Ph.D
5	Developing A Module Of Ecosystem Of Lombang Beach Sumenep With Guided Inquiry Approach To Improve Scientific	Khairunisa

	Literacy Of Science And Science Process Skills Of Students	
6	Development Of Plant Learning Materials And Environmental Changes In Sma With Using Local Potential As A Resource Of Learning	Triastono Imam Prasetyo

ROOM O8.203
Category : Biology Education (BE)
PIC : Dr.Ir. Hendro Permadi, M.Si.
Time : 12.30-15.00

No	Tittle	Authors
1	The Effectiveness of Extension Booklet Based on Melon Farmer Skills Level in Nata de Melon Making Process	Yossie Ulfa Nuzalifa, Utami Sri Hastuti, Sueb
2	Student Information Processing Skills On Cell Biology Lectures With VARK Approach	Nengsih Juanengsih, Adi Rahmat, Ana Ratna Wulan, Taufik Rahman
3	Traditional Knowledge of Local Wisdom of Kampung Pulo Indigenous peoples (West Jawa) about Environmental Ethics	amaludin Abdul Ghani, Nuryani Rustaman, Hertien Koosbandiah Surtikanti
4	Virtual Lab Development In Genetics Courses: Theoretical Review, Student Perception, Response And Expectations	Dewi Murni, Mohamad Amin, Umie Lestari, Sri Endah Indriwati
5	Design Of Plant Development Practice Manual As A Support Device For Project-Based Learning Model That Accommodate Cognitive Styles: Develop Critical Thinking Skills	Imas Cintamulya, Warli, Lilik Mawartiningsih
6	Implementation Of Problem Based Learning Combined With Think Pair Share In Enhancing Students' Scientific Literacy And Communication Skill Through Teaching Biology In English Course Peerteaching	Rido Sigit, Herawati Susilo, Sueb

7	The Application of Project Based Learning (PjBL) and Think Pair Share (TPS) model to Improve the Communication and Collaboration Skills Through Lesson Study at Senior High School	Purwaning Rohmah, Herawati Susilo, Sueb

ROOM O8.205
Category : Physic Education (PE)
PIC : Trianingsih Eny L., S.Si, M.Si.
Time : 12.30-15.00

No	Tittle	Authors
1	Effect Of Instructional Materials On Academic Performance In Heat Transfer Concept Among Secondary School Physics Students In Fagge Educational Zone, Kano State, Nigeria	Shehu Aliyu
2	Understanding Thermodynamics Through Science Process Skills	Syella Ayunisa Rani, Mundilarto
3	Physics Learning Development Of Problem Based Learning Models With Scientific Approach To Increase Understanding Student Concept	Taufiq Ansori
4	Reducing Misconsepse Students Using Strategy Of Cognitive Conflict Approach In Static Fluid Material	Gigih Besar Mukti Raharja
5	Implementation Worksheet Approach Stem For Improve Physics Learning Achievement	Sujito, Hestiningtyas Y.P, Hari Wisodo, Sentot Kusairi

ROOM O8.206
Category : Science Education (SE)
PIC : Mohammad Agung, S.Si. M.Si.
Time : 12.30-15.00

No	Tittle	Authors
1	Pre-Service Science Teachers' Imagination Of Electron Concept	Nurdiana Abdullah, Johari Surif , Sri Rahayu
2	"The Artxotic Book" Local Culture Based Mandala Art Therapy To Improve Student Concentration.	Dyakza Hadi Pramestika Putri, Fitri Azizah, Pratidina Debora
3	Identification Ability Of Student Analysis In Science Learning	Yoga Prastowo Mukti, M. Masykuri, Widha Sunarno
4	High Order Thinking Skills Profiles In Science Learning	Ulin Nuha Rosyida, Sukarmin, Widha Sunarno
5	STEM Aprroach Aplication In Devoloping Natural Science Subject Teaching Tools For Junior High School Level In Order To Improve Sudents Critical Thinking Skill And Science Process Skill	Yustina Novi Kurniati
6	Profile Of Students' Scientific Inquiry Literacy Based On Scinqlit	Dian Kurvayanti Innatesari

ROOM O8.207

Category : Science Education (SE)
PIC : Dr. Sukoriyanto, M.Si
Time : 12.30-15.00

No	Tittle	Authors
1	Mapping Of Land Use Change In Grogol Sub-District, Sukoharjo Regency In The Year 2007 And 2017	Indri Gulani
2	TASC: Training Student's Problem-Solving Ability At Junior High School In Madura	Irsad Rosidi, Yunin Hidayati, Wiwin Puspita Hadi, Ana Nur Azizah
3	The Identification Problem-Solving Abilities Based on Gender: Implementation Teaching Science Trough Guided Discovery Model's in Bangkalan District	Yunin Hidayati, Irsad Rosidi, Wiwin Puspita Had
4	Next Generation Science Standard In Science Learning To Improve Practical Skill	Eka Adytianto, I Gusti Putu Suryadarma, Insih Wilujeng, Anti Kolonial Projosantoso
5	Argumentation Skills Profile Of Junior High School Students In Science Learning	Puji Hendarto, Maridi, Baskoro Adi Prayitno
6	Energy Awareness Profile Of Junior High School Student In Sragen	Wahyu Adhi Nugroho, Sajidan, Maridi
7	TPACK Ability Of Chemistry Teacher In Framework Of Pedagogical Content Knowledge For Science Teaching On Hydrocarbon And Petroleum	M. Fakhrurrazi, Mohammad Masykuri, Sarwanto

ROOM O8.301
Category : Mathematics Education (ME)
PIC : Dr. Abd. Qohar, M.T
Time : 12.30-15.00

No	Tittle	Authors
1	Development Of Android Based Instructional Media Of Algebraic Tiles For Quadratic Equation	Oriza Febri Irianti, Abd. Qohar
2	Development Of Interactive Problem Subject Rectangle Area To Reduce Anxiety Of Secondary Students In Solving Mathematics Problems	Syaiful Hamzah Nasution
3	The Development Of Assessment For Learning Model With Goformative And Pen Tablet	Toto Suwanda, Dr. Imam Sudaji M.Si, Dr. Ikrar Pramudya M.Si
4	Development Of Module Of Learning Geometry Based On Van Hiele Theory	Deshinta Puspa Ayu Dwi Argaswari
5	Development Of Math Comic Learning Media On The Subject Of Algebraic Expressions For Seventh Grade Of Junior High School Students.	Fathimatuzzahra, Indriati Nurul Hidayah
6	Development Of Instructional Media “Game Math Comic Story” Based Android On Number	Wahyu Sulistio, Abd . Qohar
7	Android-Based Mathematics Learning Games That are Interesting for Junior High School Students	Abd Qohar, Susiswo, Syaiful Hamzah Nasution, Angela Merici

ROOM O8.302
Category : Mathematics Education (ME)
PIC : Drs. Eddy Budiono, M.Pd.
Time : 12.30-15.00

No	Tittle	Authors
1	Development And Evaluation Of Ubiquitous Geometry Learning In Authentic Contexts With Experience Api	Yan Amal Abdilah
2	Developing Mathematics Learning Model Using Realistic Approach And Outdoor Environment For Elementary School Students	Sunardi, Titik Sugiarti, Didik Sugeng Pambudi
3	The Cooperative Learning Model Application Of Tps With The Help Of Module To Improve 4c's Student Character	Endang Suprapti, Himmatul Mursyidah, Siti Inganah, Baiduri.
4	The Effect Of Contextual Approach Aided By Vba For Powerpoint On The Ability Of Self-Understanding And Self-Confidence Of Junior Secondary School Students	Martin Bernard, Siti Chotimah, Sukma Murni, Siti Ruqoyyah
5	Cooperative Learning Models Based On Peer Assessment To Grow Critical And Creative Thinking Ability Of Students In Department Of Mathematics	Hendro Permadi, Eddy Budiono, Dinda Dwi Nugraheni , Ariesqi Dinda Putri
6	Development Statistic Text Book For Sport And Health Education To Increase Motivation And Consept Understanding Of Sport Collage Students In Budi Utomo Malang Collage	Amy Nilam Wardathi

ROOM O8.303
Category : Mathematics Education (ME)
PIC : Dr. Rustanto Rahardi, M.Si.
Time : 12.30-15.00

No	Tittle	Authors
1	Level Of Statistical Resoning Student On Statistical Problem Based On Sex Differences	Luthfaturrohmah, Rooselyna Ekawati, Endah Budi Rahaju
2	Mental Rotation Of Junior High School Students In Terms Of Differences Sex	Ervi Anisatul Awalah, Mega T. Budiarto, Elly Matul Imah.
3	Mathematical Representation Of Cerebral Palsy Students In Constructing The Concept Of Plane Geometry Based On Apos Theory	Elis Dwi Wulandari, Erry Hidayanto, Subanji, Rustanto Rahardi
4	Learning Achievement Profile Of Students With High Initial Abilities With Problem Based Learning Model Using Realistic Mathematics Education Approach On Algebra Materials	Diana Tri Purnamasari, Riyadi, Sri Subanti
5	Interference Thinking Students In Understanding Functions	Erry Hidayanto
6	Students' Written Mathematical Communication Through Providing Linear Programming Word Problem In Group Discussion	Pradina Parameswari, Tjang Daniel Chandra, Susiswo
7	The Abstract Thinking Ability of Mathematics Undergraduate Students in Doing Proving or Disproving Problems	Santi Irawati, Indriati Nurul Hidayah

ROOM O8.304
Category : Mathematics Education (ME)
PIC : Dr. I. Nengah Parta, M.Pd.
Time : 12.30-15.00

No	Tittle	Authors
1	Analysis Of Students' Difficulties In Proving Convergent Sequence	Edwin Kristianto, Mardiyana, Dewi Retno Sari Saputro
2	The Role Of Mathematic Reasoning As The Means To Achieve The 21th Century Skills: Learning And Innovation	Fitria Irdayani
3	Mathematic Learning Outcomes In Geometry Viewed From Spatial Intelligence	Indah Werdiningsih, Budiyono, Hasih Pratiwi
4	Mathematics Learning Difficulties Of Slow Learners On A Circle	Shinta Metikasari, Mardiyana, Triyanto
5	Level Of Students Creative Thinking In Solid Geometry	Suci Utami, Budi Usodo, Ikrar Pramudya
6	Analysis Of Students' Geometry Skills With Cognitive Field Dependent	Widi Candika Pakaya, Dr. Subanji, M.Si

ROOM O8.305
Category : Mathematics Education (ME)
PIC : Dra. Sapti Wahyuningsih, M.Si.
Time : 12.30-15.00

No	Tittle	Authors
1	Profile Of Mathematics Anxiety Of Final Grade Students	Terri Murizki Anugrah, Tri Atmojo Kusmayadi, Laila Fitriana
2	Early Identification Of Preservice Teachers' Ability In Mathematical Literacy	Ani Afifah, Miftahul Khoiri, Nur Qomaria
3	Analysis Of Concepts Understanding Of Class X Trigonometry Material	Rita Pramujiyanti Khotimah, Masduki, Christina Kartika Sari
4	Ethnomathematics In Traditional Dance Of Surakarta	Della Narulita, Mardiyana, Dewi Retno Sari Saputro
5	Building And Structuring Of Students' Mathematical Knowledge: Review From The Cognitive Development Theory	Sudirman
6	Some Consequences Of The Definitions Of Trapezoid	Purwanto

ROOM O8.306
Category : Mathematics Education (ME)
PIC : Rissa Asdianti, S.Si., M.Si.
Time : 12.30-15.00

No	Tittle	Authors
1	The Use Of Ict In Learning Mathematics At Community Learning Centers Harapan Bangsa, Tanjungpinang.	Desi Rahmatina
2	Team Assisted Individualization To Improve Self Confidence Of Student In Mathematics Learning	Resvita Febrima, Jailani
3	Learning Styles Affect Students Mathematical Critical Thinking Skills	Ela Ulfiana
4	The Scaffolding Approach To Enhance Senior High School Student's Statistical Literacy Ability	Rofiq Robithulloh Murod, Nanang Priatna, Bambang Avip Priatna Martadiputra
5	Guided Inquiry Method Realistic Mathematic Education With Mobile Learning	Mahmuddin Yunus, Rustanto Rahardi, Susy Kuspambudi A
6	Creating A Recurrence Relation Model For Findingthe General Form Of A Specific Integer Sequence Generated By Arithmetic Sequences With K Representing The First Term And B Representing The Difference	Gatot Muhsetyo

ROOM O8.307
Category : Mathematics Education (ME)
PIC : Dr. I. Made Sulandra, M.Si
Time : 12.30-15.00

No	Tittle	Authors
1	Relationship Between Impulsive-Reflective Cognitive Style And Problem Solving In Mathematics	Dian Rizki Nuraini
2	An Analysis Of Mathematical Problem-Solving Process Based On Learning Style	Susana Labuem
3	Learning From Irme Course: Inviting Prospective Teacher To Prepare Better Teaching Practice	Anisa Fatwa Sari, Agustin Ernawati, Zainal Abidin
4	Imperfect Understanding Of Triangle Concept: An Epistemological Mathematics Belief Overview	Rahaju, Purwanto, I Nengah Parta, Swasono Rahardjo
5	Spatial Ability Of Seventh Grade Students In Completing Geometry Tasks	Shinta Wulandari, Cholis Sa'dijah, Edy Bambang Irawan, I Made Sulandra
6	Mathematical Communication In A Cooperative Learning Model Based On Peer Assessment For Mathematics Department Students	Hendro Permadi, Susy Kuspambudi Andaini , Sabila Okta Syarafina, Muhammad Awwalul Ikhtiar

The Keynote Speaker Articles of The 2nd ICoMSE

Implementing the Four Cs of 21st Century Skills in classrooms: Do Malaysian primary teachers understand?

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Abstract

The implementation of 21st century skills in schools remarked the essential importance of teachers' self-development that leads to the excellence of teaching in the classroom. Thus, mastering the four Cs skills within 21st century skills strategies definitely help teachers in choosing the best teaching strategies to effectively integrate in the classroom. Therefore, this study conducted to explore the understanding of primary language teachers especially in relation to communication, collaboration, critical thinking and creativity. The aim of this study is to (i) to explore teachers' critical thinking in four Cs skills (ii) to explore communication in four Cs skills (iii) to explore collaboration in four Cs skills and (iv) to explore creativity in four Cs skills among primary school teachers in Malaysia. This qualitative study employed interviewing with seven primary teachers to obtain a strong overview of teachers' understanding of the 4Cs skills among 21st century's skills. The findings show that teachers have an understanding of the four Cs skills of 21st century and frequently implemented these skills in their daily routines. In addition, they also share their ideas, thoughts, questions, and solutions with related sources. They also work in groups where the teamwork takes them to a higher level of efficiencies. The teachers engage themselves in different creative styles of teaching and learning. The implications and recommendations for future research discussed in this study.

Keywords : 21st Century Skills, Critical Thinking, Communication, Collaboration, Creativity, primary teachers

1.0 Introduction

In general, the 21st century skills are the term that connected with a broad set of essentials such as comprehension, ability, work habits, and personality qualities which are believed to be seriously substantial to perform well in today's modernise society (Farisi, 2016; Pheeraphan, 2013). Through the 21st century learning approach, teachers are expected to play their active roles in preparing future generation in our exciting global community (Greenhill, 2010). In this sense, relevant parties such as principals, colleague professors, workers, and others are imperative individuals that able to support teachers in learning, understanding and mastering their 21st Century learning skills which consisted on three major elements; learning skills, literacy skills and life skills (Lamb, Maire & Doecke, 2017). Apart from this, Dede (2009) states that 21st century skills are a sequence of complex judgmental skills, abilities, and learning placement which have been recognize as being essential in realising 21st century skills. Due to the rapid changes within the educational system, 21 Century skills are grouped into three major titles which are learning and innovation skills, digital literacy skills and career and life skills (Turiman, Omar, Mohd Daud & Osman, 2012). According to scholars, the four Cs which listed as part of learning and innovation skills which comprised of the 4Cs have the potential to develop teachers' performance in teaching and learning in line with recently introduced teaching and learning skills required within the information age (Thoughtful learning, 2016; Trilling, Bernie, Fadel & Charles, 2009). The 4Cs listed in this study is defined through the acronym of critical thinking, communication, collaboration, and creativity. Thus, the skills are timeless and highly valued not only within the classroom context, but in all professions which were gained through experiences.

2.0 Reserach Background

Recognising the importance of teachers in understand and their willingness to make changes in teaching and learning accorded to the 21st century learning and teaching requirement, the Ministry of Education Malaysia has launched a pilot study in 2014 an initiative strategy for learning which has been labelled as the 21st Century strategy. In 2015, official implementation of the 21st Century learning commenced and introduced to all school (Budhai, 2016).

In many years before, teachers are currently facing difficulties in assimilate technology into the curriculum and instructions in conjunction with the extra time to integrate it (Nagel, 2013). For the best learning and teaching

process, the teachers need to deliberately know how to do a job collaboratively with other teachers and also know how to appreciate their colleagues. As teachers, they must able communicate productively, both orally and in writing and to figure out the role of effective communication as learning facilitators. Within the 21st century focus, the teachers desire to be imaginative and innovative so they explore new and various ways of teaching, work on problems and do not apprehensive of risk. As a critical thinker, they can effectively explore through and understand the pile of information accessible at their fingertips.

In the 21st century teaching and learning process, many skills need to master by the teacher. According to Zamri (2011), there is often a failure to implement different styles of pedagogies for a teacher who taught a variety of skills, especially the skills of the 21st millennium. There are always new skills to learn and techniques to adopt. In addition, teachers also need to turn to some aspects, as the process of learning and teaching for the 21st century is very challenging. In that sense, school teachers for the 21st century are required to have their mastery within the required specific features such as the following: (i) the substance of mastering the curriculum content; (b) high level of proficiency and qualified pedagogy styles in learning and teaching, (c) understand improvement of students and their love, (d) understand the behaviorism of learning to enhance their counselling skills and also passion on using the latest technology is not about teaching and learning during or outside of the session.

From the perspective of 21st century learning, the skills that being emphasised are creativities skill, civilizing consciousness, problem solving, innovation, national engagement, communication, productivity, collaboration, accountability, exploration, initiative, and creativity. The teacher as an important tool must create the classroom as dynamic as the world around them. “An effective teacher who does not direct his/her learners drives in the house of his intelligence, but rather bid them to the doorway of their own” (Gibran, 2007).

Admittedly, this study has two fold purposes; firstly, this study aims to explore primary teachers’ critical thinking, communication, collaboration, and creativity in four Cs skills among Malaysia primary school teachers. Secondly, to create a framework of Four Cs of 21st century skills among Malaysia primary school teachers as a reference.

3.0 Literature Review

In addressing the issue of 21 Century learning**,** Mayuddin (2004) emphasised that teachers should have clear understanding and master the thinking skills to enhance students' creativities and their higher order thinking skills. As teacher, they should educate to acquire this skill in order to form the generation who can think critically and creatively. Therefore, critical thinking is a complex teaching process that should integrated in the teaching process when analysis, synthesis and evaluation of the Bloom Taxonomy (Duran, Limbach &Waugh, 2006). Earlier, Chaffee (2003) in his research defines critical thinking as "making sense of the world by carefully examines the thinking process, as well as to clarify and improve our understanding." In this sense, they also promoted the rote memory approaches and normal questions skills together with the way of students' thinking process which later promotes the 'how' and 'why' forms of thinking.

According to Berlo (1960) communication is an interaction process to exchange ideas between the communicator and the receiver. The communication here happens to arrive at a common understanding for mutual benefit. Later, Keyton (2011) sees communication as a transmitting process where information and common understanding arise from one person to another. As MacDonald (2018) explains from her speech about communication states that teachers' overall effectiveness across the curriculum can improved if the teachers' self-esteem, confidence, communication skills or stress levels improved. Next, the element of collaboration is defined as doing a job together to achieve a target and joining capabilities, expertise, and smart to work. Through collaboration, it enables each person to perform in a team to achieve a defined and common goal (Marinez-Mayano, 2006). According to AIIM (2006), collaboration consists in two forms. The first one called as synchronous. It is where everyone interacts in real time, as in online meetings through instant messaging or via Skype. Another form is asynchronous. Asynchronous is where the interaction can be time-shifted, as when uploading documents or annotations to shared workspaces or making contributions to a wiki, an application that let users freely create, edit and reorganize content using a Web browser. Based on the statement, Wikis are the best thought of as online encyclopedias or "how-to" manuals.

Lastly, the element of creativity is defined as a process of trying new approaches to get things done equals innovation and invention. The term "creativity" has not only used for more than 140 years but is still emphasis until

today's 21st century education. According to Stein (1953), creativity is a "novel work that is accepted as tenable or useful or satisfying by a group in some point in time". "Creativity is an important in education as literacy and we should treat it with the same status (Robinson, 2006)

Previous local studies

Admittedly, research on teachers 21st Century learning skills is considered as limited. Nevertheless, a few noted studies revealed various findings in studying the 21st Century learning skills. For instance, Arbaa (2017) conducts a research on four teachers who carry out student-centered teaching. Findings showed that the key elements that determine the success of applying this 21st century skill are professional teachers' wisdom. Another reseacher, Nurzarina (2016) conduct a study on teachers' understanding in 21st century skills in exploring the understanding of Mathematics teachers especially regarding 21st century skills Findings indicated that teachers have a clear understanding about 21st century skills learning skills.

4.0 Methodology

This study uses a qualitative case study design through the data collection process of interviewing seven primary teachers who highly involved in the 4C approach. Therefore, data that being used and analysis within this context of a study primarily depends on the words and meanings given by the primary teachers during the interview series which related to their understandings within 21st century skills.

As for sampling purpose, seven primary teachers were purposely selected based on certain criteria such as they were English language teachers and also their willingness and consent to share their experiences.

5.0. Findings

Results from interviewed showed that there are four themes of skills that are understood by teachers as part of as 21st century learning and teaching skills. The four themes that emerged are critical thinking, communication, creativity and collaboration skills which were presented below:

Critical Thinking

From the interviews, teachers emphasised that the recent educational system in Malaysia has been increasingly gearing towards getting the students to do more cognitive works rather than memorising information. The national education system emphasises on the element of critical thinking skills among the students which need throughout their lives therefore teachers are now required to improve student thinking beyond the traditional teaching strategies they have ever used. As such, teachers need to be proficient in that skill and use it in their learning and teaching effectively.

> *"Critical thinking is important to teachers so it will help teachers to find better solutions for any problems. Teachers will be able to consider any problems in a thoughtful way. With critical thinking, teachers will be able to recognise problems. They can find workable needs for those problems then they can gather information to solve the problems and they can clarify and interpret the data they gathered to make a conclusion."* **(P3/F/12)**

Another primary teachers stressed on the element;

> *"Definitely, because the current 4Cs of 21st century learning and teaching emphasise the teachers to own a wide range of knowledge on critical thinking the clients need to be justified and evaluated at all the time. Their teaching should consist of critical thinking as the teaching element as the client requires skills to be included as part of their learning. The teacher has to have this knowledge to explore more in his/her career."* **(P6/M/25)**

Communication

Through interviews, teachers highlighted that communication is a sharing process whereby teachers share their thoughts, questions, ideas, and solutions in the content of school. 21st teacher is commonly called as a good communicator. Three teachers provided their definitions on the concept of communication;

"Communication is ways for people to interact with other people in various ways. At last, they reach a mutual understanding by exchange information, ideas and feelings." **(P4/F/2)**

"Communication is a two way process. At last, the process expected to reach a mutual understanding, in which participants exchange information, ideas and feelings. Apart from these, they also indirectly create and share meanings." **(P5/F/9)**

Communication means network. Teachers need network among them to discuss, to communicate, to seek advice and ideas to improve their classroom performance. Thus, communication is another supportive teaching and learning tool for teachers" **)P6/M/25(**

Creativity

Based on teachers understanding related to creativity, teachers mentioned that there are four assessors in creativity skills among primary school teachers. The teachers produce something new innovatively and think beyond the ordinary. The behaviours on learning this skill is increasingly and continuously in primary schools. Teachers become creative and knowledgeable person by practicing this skill.

"Creativity is where a product is usual and unique from other. It should have a commercial value. Knowledge is used to create or to invent a method or a thing to solve problems. Mostly, creativity is a form of problem solver. **)P6/M/5(**

"Creativity is a unique skill it is characterized by the ability to see the world differently in multiple ways, to find connections, to associate unrelated ones and find solutions." **)P4/F/2(**

Collaboration

Lastly, primary teachers defined the process of collaboration is a professional culture that essential to create a team work culture among teachers. In this sense, teachers need to have willingness to share, support and excel together with others. As a result, education system needs teachers who can work with others to achieve a goal by working together.

"Students or even teachers are expected to cooperate as a member of a group, to interact smoothly with others and to work together with one or more people to achieve a goal." **)P1/F/28(**

"Collaboration is of working together to achieve a task collectively. Every member in the group is respected. All members to discuss, plan, and perform with the approval of the members. Collaboration occurs at group levels where tasks are given and the members themselves think and find ways to solve a teaching and learning problem at the end." **(P6/M/25).**

The suggested framework

The framework below is the suggested framework based on session of interviews with primary school teachers related to the four Cs of 21st century and labelled as Figure 1:

<table>
<tr><td rowspan="2">CREATIVITY
• Produce new things
• Creative
• Personal initiatives</td><td colspan="2">CRITICAL THINKING
• Looking for better solutions
• Thinking by thinking
• Make a logic and acceptable way</td></tr>
<tr><td>Four Cs of 21st century skills</td><td>COMMUNICATION
• Share meanings
• Exchange information
• Happens in group</td></tr>
</table>

Figure 1. Framework of Four Cs of 21st Century Skills for a primary school teachers

The framework of four Cs has four parts that were hypothetically combined within its elements. The four Cs relates and practices by primary school teachers. Based on the framework, critical thinking is an important skill for 21st century teachers. Critical thinking helps primary teachers to search for better solutions for any problems in any situations internally or externally of a classrooms context. This learning skill makes teachers think by think which enhanced teachers' logical and acceptable remarks.

Besides that, primary school teachers also are good communicators. They always share their ideas, thoughts, questions, and solutions with colleagues and their counterparts. Frequently, teachers communicate to not only convey a message but also create and share meanings. Through teachers' opinions, views and lessons effectively translated and understand meaningfully. They exchange the information with other teacher using various types of networks such as *telegram*, *whatsapps* and many more channels that brought teachers to communicate in-groups for their individual benefits. Apart from these skills, collaboration is another important skill for primary teachers to work together with other teachers in their school or other schools as a team. In conjunction, this teamwork takes them to a higher level efficiently. Collaboration makes primary teachers success in their teaching by helps them to achieve their goal and vision.

Finally, primary teachers are considered as a creative individual that able to produce a new thing that unique which sometimes has the commercial value. In this sense, primary teachers engage themselves in different teaching styles in understanding the new world context from various perspectives, to find hidden patterns, to find the relations between seemingly unrelated and to develop solutions. Self-characters, stamina, willingness to grow, acknowledgement of new experiences, self-confidence, sense of humor, curiosity, depth of ideas, imagination, experiences of development and education, brainstorming between classmates are the personal initiatives that Johor teachers have. These factors influence creative teaching.

6.0. Conclusion

Based on the findings which related to primary teachers' views on the importance of four Cs of 21st century skills, it is clear that 21st century skills interpreted well by teachers and being practiced within the daily routines of the

primary school teachers in Malaysia. Understanding the concept of that 21st century skills are learning skills is considered as imperative to teachers as the learning approach and application of these skills were highly emphasised by the Ministry of Education within the school's learning and teaching process. Note that the task of delivering critical educators is not a simple effort, but requires time, energy and commitment and support from the ministry and educational authorities. Various parties, including ministries and educators, should work together to polish this potential by engaging in knowledge. Professionally acquired knowledge on 21st century skills, and the application of these skills amongst students will be more successfully when a teacher can integrate teaching methods.

In this sense, technological developments also help the teachers to build their 21st century skills (Farisi, 2016). The use of technology is capable of supporting teachers' learning by combining various media elements (Pheeraphan, 2013). To ensure that this initiative is ongoing, educators need environment support even from administrators, colleagues, students and complete facilities. If the atmosphere of thinking has been cultured from within and beyond, Malaysia will be able to effectively implement learning skills lessons. In future Teachers, can refer to this developed model of four Cs of 21st century skills as a reference or overview on what are the important elements of learning skills.

References

Ab.Aziz Yusuf (2003). *Komunikasi Untuk Pengurus.* Kuala Lumpur : Utusan .

Abdul Rahman Abdul Aziz (2000). *Kemahiran Sosial Asas*. Kuala Lumpur : Utusan .

mmAhmad Atroy Hussin (1986). *Tingkah Laku Organisasi Dalam Pengurusan Moden*. Dewan Bahasa Dan Pustaka, Kuala Lumpur.

Ainon Mohammad & Abdullah Hassan (2010). *Komunikasi berkesan*. Kuala Lumpur: Fajar Bakti.

Ainon Mohd & Abdullah Hassan (2002). *Mendorong Diri Sendiri*. PTS

Akbar Ibrahim (2004). *Penyelidikan Kualitatif*: Satu Pengenalan Ringkas. Kuching. PROFES.

Anderson, L. W. & Krathwohl, D. (Eds.). (2001*). A taxonomy for learning, and assessing: A revision of Bloom's Taxonomy of educational objectives.* New York: Longman.

Angle, B. (1996). Five steps to collaborative teaching and enrichment remediation. *Teaching Exceptional Children*, 29(1), 8-10.

Arbaa, R., Jamil, H., & Ahmad, M.Z. (2017). Model Bersepadu Penerapan Kemahiran Abad Ke-21 dalam Pengajaran dan Pembelajaran. *Jurnal Pendidikan Malaysia*, *42* (1). 1-11.

Asmah (1994) ; Kartini (1998) ; Lam Kah Kei (1994) ; Rajendran (1998) ; Rosmani (2001) ; Suhailah (2000). *Pelaksanaan Kemahiran Berfikir dalam KBSM di daerah Hulu Langat.* Tesis: Sarjana, Universiti Putra Malaysia.

Businesstopia (2018) Interactive Model of Communivation Retrieved from https://www.businesstopia.net/communication/interactive-model-communication

Businesstopia (2018) Lasswell's Communication Model Retrieved from https://www.businesstopia.net/communication/lasswell-communication-model

Chan Shin Woan (2013). Epistemology Belief and Science Teachers' Creativity Tesis: Sarjana, Universiti Teknologi Malaysia.

Craft, A., Jeffery, B. , & Leibling, M. (2001). *Creativity in Education*. London.

Craig D. Jerald. (2009) *Defining a 21st Century Education*. Center For Public Education.

Farisi, M.I. (2016). Developing 21st Century social studies learning skills through technology integration. *Turkish Online Journal of Distance Education-TOJDE*, 17 (1), 16 – 30.

Greenhill, V. (2010). 21 st Century knowledge and skills for educator preparation. A report prepared as part of a collaborative project by the American Association of Colleges of Teacher Education and the Partnership for 21st Century Skills (P21).

Kementerian Pendidikan Malaysia (2011) *Modul Komuniti Pembelajaran Profesional*. Bahagian Pendidikan Guru.

Lamb, S., Maire, Q., & Doecke, E. (2017). Key skills for 21st Century: an evidence-based review. A report prepared for the News South Wales Department of Education. Centre for International Research on Educational System, Victoria University, Melbourne.

Lisa, S. (2014). *4Cs of Digital Age Skills*. Coaching Digital Learners.

Maimunah Osman (2000). *Komunikasi Berkesan, Perhubungan Interpersonal*. Kuala Lumpur: Institut Tadbiran Awam Negara (INTAN).

Mansor, R. & Shawaluddin (1998) *Penghantar Komunikasi.* Pulau Pinang: Universiti Sains Malaysia.

Mohammad Najib Abdul Ghafar (1999). *Penyelidikan Pendidikan*. Skudai: Penerbit Universiti Teknologi Malaysia.

Mohd Khairuddin Abdullah, Khalid Hj Johari, Ag Yusof Ag Chuchu & Halimah Laji (2014). *Komunikasi Guru Dalam Bilik Darjah Dan Tingkah Laku Delinkuen Murid Sekolah*

Formation of blooms and patterns in phytoplankton models

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We study a two-species predator-prey plankton model, modelling the interactions of microzooplankton and phytoplankton. The system is analyzed in order to explain the conditions for phytoplankton bloom formation and to explore system bifurcations. When a spatial diffusion term is included, we obtain a reaction–diffusion system that is investigated by determining the Turing space of the model. Thereafter, a bifurcation analysis of specific pattern formation is explored. The system is shown to exhibit the potential for temporally varying spatial patterns.

Socioscientific Issues (SSI) in Chemistry Education: Enhancing Both Students' Chemical Literacy & Transferable Skills

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Abstract: chemistry education has tasks to guide students to be future employment within the field of science and enginnering and also to provide societies with many opprotunities for chemistry-related career. However, there are some challenges faced by chemistry education, such as lack of transferable skills of chemistry graduates, education reform on the need for scientifically literate citizens and for reducing the shortage in participation and interest of young people in science and engineering. One possible way to solve such challenges is that we could use socioscientific issues (SSI) as a context to be integrated in a chemistry instruction. Through socioscientific issues related chemistry, both scientific literacy and transferrable skills could be enhanced. This paper discuss potency socioscientific issues in developing the skills and how to incorporate it in the instruction.

Keywords: Socioscientific Issues, Chemical Literacy, Transferable Skill

1. INTRODUCTION

Chemistry is the study of matter and its properties, the changes that matter undergoes, and the energy associated with those changes (Silberberg, 2010). It is essential for many aspects in our daily lives and has many unexpected potential benefit for our future. An understanding of chemistry allows us to make sense of and explain phenomena happened around us. Through chemistry, we need to develop basic knowledge of how to live in this world, how to cope with daily life issues and how to act as individuals. For examples: how metal corrodes when it expose into air; how we can identify, choose, and use materials with respect to their properties; how we understand any potentials and risks of many modern chemistry related products and technologies. Futhermore, contemporary societies are increasingly confronted with questions underpinned by science (chemistry) with associated benefits, uncertainties and risks. For example: how to use wisely energy resources, how to secure sustainability in drinking water supply, how to deal with climate change challenges. It is obvious, then, these developments are significant to modern societies. They, in the future, individually or in groups will be asked critically reflect upon these issues, to contribute to societal debate related, and to make important scientifically-based decisions. Such issues that involve a science (including chemistry) dimension and that also raise a wide range of societal, political, economic and ethical considerations are often termed socioscientific issues (SSI) (Ratcliffe & Grace, 2003).

Chemistry also provide societies with many opprotunities for chemistry-related career. Therefore, chemistry education should guide students to reach potential future employment within the field of science and enginnering. Students need to have good knowledge in chemistry and about current trends in chemistry. Chemistry subject is not just important for careers within the field of science and engineering, but also for people who are working in law, economy or trade, who often deal with the issues of chemistry and its relationship to ecology, economy, or society(Eilks & Hofstein, 2013). However, there are some challenges faced by chemistry education.

- A growing body of evidence has shown that most chemistry graduates lack of generic/transferable skills that are essential for being efficient and productive members of the workplace (Ashraf et al, 2011, Ministry of Research, Technology and Higher Education, 2017). These set of skills may include such as: problem solving, critical thinking, communication, team working, time management, independent learning (Dearing, 1995; Leitch, 2006). Furthermore, there has been little studies conducted on the development of these skills within the chemistry curriculum although the fact that these issues have been well known for many years. Much of the chemistry education research literature still focuses on enhancing the knowledge and understanding of chemistry itself rather than developing those skills through the study of chemistry (Overton & McGarvey, 2017).

- There has been a wide spread reform on science education in general and chemistry teaching in particular. The goals of such reform are the need for scientifically literate citizens (Deboer, 2000) and for reducing the shortage in participation and interest of young people in science and engineering (e.g see Bøe et al, 2011). The need in both fields was supported by several comprehensive reports regarding the state of science education in many countries e.g., in *Before it is too late* in 2000 (USA) by the John Glenn or *Beyond 2000 (*UK) in by Robin Millar and Jonathan Osborne.

According to Eilks & Hofstein (2013), learning in chemistry allows for the development of a lot of general (transferable) skills and the chemistry itself should be taught in the best way possible to all students at secondary school level and at university level at the end. Therefore, to address the above issues (lack of transferable skills, the need for scientific literacy citizen and less interest of young people in science and engiinering) we could maximize the chemistry in the classroom. One of possible ways is to incorporate issues related chemistry such as socioscientific issues into chemistry teaching. This paper discuss about the potency of socioscientific issues for addressing the above issues and its connection to improve scientific literacy, transferable skills and affective dimension and for meeting its challenges.

2. DISCUSSION

2.1. The Important of Transferrable Skills In Chemistry Education

Skills can be defined as capabilities that individu should master for in a particular occupation or activity. There are many different kinds of skills needed in the 21st century. Leitch (2006) categorise those skills into **Basic skills** (e.g literacy and numeracy) and **Generic/Transferable skills** (e.g team working and communication). Whereas, the World Economic Forum (2015 cited in Rahayu, 2017) identified 16 skills/capabilities and those 21st century skills grouped into three broad category, namely: (1) **Foundational/basic** literacies represent how students apply core skills to everyday tasks (e.g. literacy, numeracy, scientific literacy, ICT literacy; finantial literacy, cultural and civic literacy); (2) **Competencies** describe how students approach complex challenges (e,g critical thinking, problem solving, creativity, communication & collaboration); (3) **Character qualities** describe how students approach their changing environment (e.g. curiosity, innitiative, persistence/grit, adaptability, leadership, social and cultural awareness). Common generic/transferable/competency skills appear in the literature are critical thinking, problem solving, communication (oral & written), and collaboration. American Chemical Society (ACS) (2018) share similar generic/transfferable skills that should be developed by chemistry undergradute students (e.g critical thinking, problem solving, working in a team, oral & written communication skills), besides other specific transferable skills such as laboratory safety skills. Most occupations use a mix of different kinds of skills and within each skill there are different levels of ability.

A study **was** conducted at the Year one and two chemistry undergraduate students (N=155) of university of Leicester on the perceptions of transferable and workplace skills development. The result showed that over 60% of respondents agreed that chemistry graduate should have all skills included in the questionnaire (i.e. The skills consisted of 20 skills divided of theoretical, practical & transferrable skills). Students (N=119) believed that most developed skills after experiencing a series of Context and Problem Based Learning (C/PBL) activities were problem solving, time management, working in a team and oral communication. The study also provided evidence to suggest that students believe that the "contextualized, real-world" problem was considered as an important aspect in determining the skills development (Williams & Handa, 2016). Therefore, a contextualized and real world problem is neccessary to be included in any chemistry instruction that is intended to develop those generic/transferable skills. In this case, socioscientific issues (SSI) can be used as a context or real world problem included in an inquiry learning to achieve the purpose.

2.2 Chemical Literacy As The Goal of Chemistry Education

Education is an activity that is oriented towards the future. One of the education aims in the 21st century is to prepare individuals to live better and to become future workers (Stevens, 2012). In the field of science education, including chemistry education, its aim is to develop students to become educated citizens who have the ability and skills such as knowledge in the field of study (content knowledge), learning skills and thinking skills (Herscovitz et al, 2012; Robert & Bybee, 2014) and the realization of a society with scientific literacy (Norris & Philips, 2003). Therefore, it is inevitable that educational practices must focus on efforts to improve student

skills in scientific literacy (Cigdemoglu, Arslan & Cam, 2017) and identify the various capabilities needed by students in facing 21st century challenges such as challenges in the economic, social, technological and health fields (Stevens, 2012). In addition, trends in science education policies emphasize the importance of scientific literacy as a transferable outcome (Fives et al, 2014). Therefore, the development of scientific literacy in students has become a top priority in the field of science education (Sadler 2004; Tytler 2007). Regardless the fact that the practice of science learning in various countries ignores the social dimension of science education and the promotion to develop skills needed by the students to be able to participate actively in society (Hofstein, Eilks & Bybee, 2011).

Scientific literacy is described in various ways (for example, see Holbrook & Rannikmae, 2009; Gräber et al, 2001 and Rychen & Salganik, 2003). However, in general, the descriptions of scientific literacy cover three domains, namely: (1) knowledge about concepts and scientific ideas, (2) understanding of the process of scientific inquiry and the nature of knowledge produced (nature of science), (3) awareness of the influence of scientific activities on the social context in which the activity is carried out, and vice versa, the effects of everyday life, personal and social decisions on scientific ideas and practices (Ratcliffe & Millar, 2009; Roth & Lee, 2004). Chemical literacy is part of scientific literacy. Shwartz, Ben-Zvi, and Hofstein (2006a, 2006b) define chemical literacy through the domains of content, context, skills, and attitudes. They describe that chemically literate individuals should understand:

1. General Scientific Ideas: Chemistry is an experimental dicipline in which chemists conduct scientific inquiry and provides knowledge used to explain phenomena in other areas.
2. Characteristics of Chemistry: a) explains phenomena in terms of macroscopic, submicroscopic and symbolic representations; b) investigates the dynamics of processes & reactions and the energy changes during a chemical reaction; c) aims to understand and explain life in terms of chemical structures and processes of living systems; d) use a specific language.
3. Chemistry in Context: a) understand the importance of chemical knowledge in explaining everyday phenomena and relationship between chemistry innovations and sociological processes; b) use their understandings of chemistry in their daily life, in decision-making, and in participating in a social debate regarding chemistry-related issues.
4. High-Order Learning Skills: able to raise a question, searching information, analyze the advantages and disadvantages associated with a position in any debate. This skills are similar to inquiry skills.
5. Affective Aspects (e.g. curiosity, leadership, social and cultural awareness)

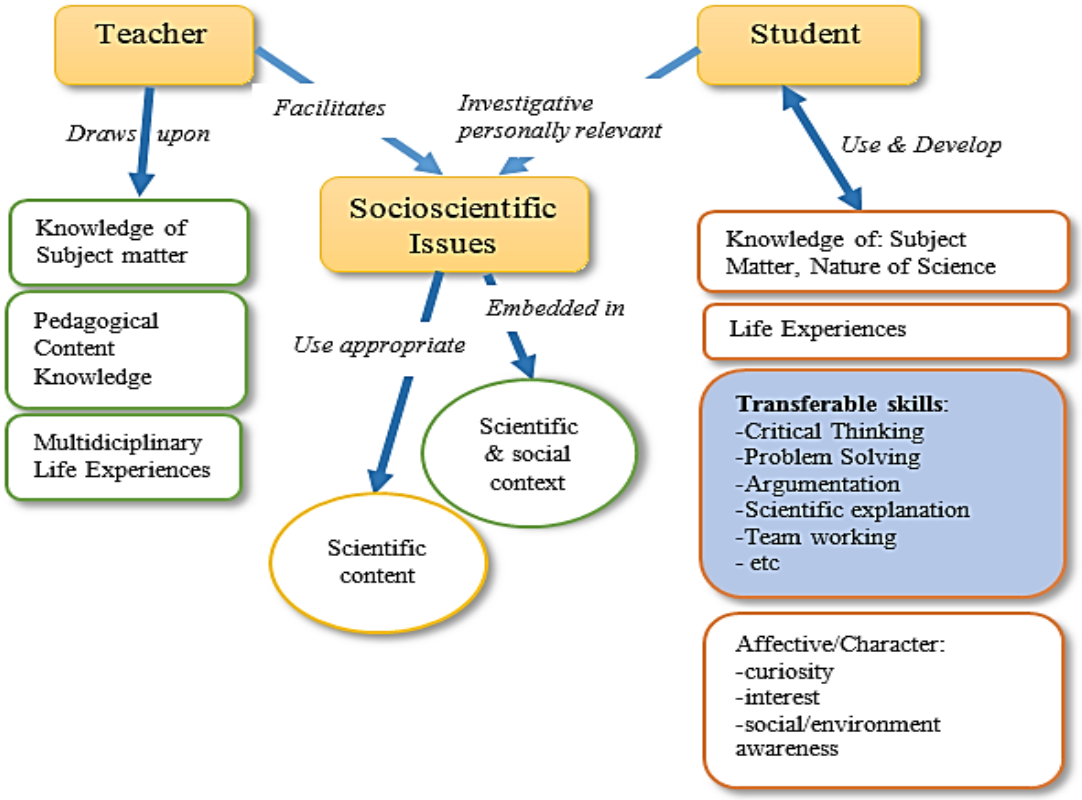
Scientific/chemical literacy provides aspirations for curriculum development, teaching materials and assessment practices, so that if materials and science/chemistry learning are facilitated with the domains mentioned above, students' scientific/chemistry literacy will develop (Shwartz et.al, 2005; Roberts, 2007). Within the domains, there are some transferable skills students should master to be a scientific literate citizen in the future, for example: inquiry skill, critical thinking skill, oral and written communication skill (argumentation, scientific explanation), problem solving skill, team working skill.

2.3 Socioscientific Issues Related Chemistry and Its Teaching

Chemistry is basically about the abstract concept of the atomic theory of matter. A student has to potray the concept at various levels of representations (macroscopic, submicroscopic and symbolic representations) as described by Johnstone (2000, 2010) and this multi-representational structure is very important in studying chemistry (Gilbert and Treagust, 2009). Students start to study chemistry at secondary school level. However, there is a common criticism on the lack of connectedness of chemistry with the real world and the lives of the learners (Gabel 1998) and this situation is reinforced by the traditional chemical content and teaching approaches that are resistent to change. Generally, in the traditional classroom, chemistry is taught by memorisation of definitions and solving algorithmic type problems and the teacher rely most on the chemistry textbook. In order to develop scientific/chemical literacy of students, teaching approach should be active learning that use open-ended challenges requiring application of chemistry concepts and problem solving. A learning context is needed for application of concepts and problem solving activity.

Science educators have progressively promoted socioscientific issue (SSI) as a learning context. SSI related chemistry is an important issue that develop in society that is conceptually related to chemistry. Socioscientific issues (SSI) involve the purposive use of scientific (chemistry) topics in the instruction that obligate students to participate in dialogue, discussion, and debate. The characteristics of the issues are controversial and have the added component that need a degree of moral reasoning or the evaluation of ethical concerns in the process of justifying and finding possible solution of those issues (Zeidler & Nichols, 2009). Both inquiry activity and scientific knowledge are useful in the SSI negotiation process, because if only scientific

activity implemented it will not be able to solve the SSI problem. Therefore, inquiry and SSI negotiation require the integration of scientific concepts and processes with social practices. Many educators argue that smart SSI negotiations are the foundation of modern scientific literacy for the nation and socioscientific issue is an important element in current science learning (eg, Driver, Newton, & Osborne, 2000; Zeidler, Walker, Ackett, & Simmons, 2002). In the process of discussion, debate or dialoge on the SSI issues, the students use and develop some capabilities/skills and affective dimension. Transferable skills that could be used and developed in that learning context, for example: team working, oral & written communication (scientific explanation and argumentation), critical thinking, inquiry skills, problem solving. The following Picture 1 shows pedagogical relationship between teacher and students' SSI discourse (Adapted from Zeidler et al.,2009). A chemistry teacher has competencies of subject matter and pedagogical content knowledge (PCK) and multidiciplinary life experiences. By drawn upon these competencies and experiences she/he could facilitate socioscientific issues related chemistry to be presented to students in the classroom. The socioscientific issues itself use appropriate scientific chemistry content that must be embedded in scientific and social context. The student, then, investigates personally relevant socioscientific issues and discuss, debate or construct argument/explanation to solve the issues. Through some phases of learning the student could use and develop: knowledge of subject matter & nature of science (NOS), life experiences, some transferrable kills and affective dimestion.



Picture 1. Pedagogical relationship between teacher and student' SSI discourse (Adapted from Zeidler et al., 2009)

Table 1 shows some examples of SSI which can be derived from High School Curriculum (in Indonesia). The socioscientific issues related chemistry have been developed such as alcohol, MSG, Natrium benzoat, Acidification, DDT and Acid Rain. The controversial aspect in the SSI is varied.

Tabel 1. Examples of Socioscientific Issues Related Chemistry Derived from High School Curriculum

Socioscientific Issues	Scientific Context	Chemistry Content and Concepts
Alcohol	Medical benefit	Reaction rate
Monosodium Glutamat (MSG)	Medical benefit	Hydrolysis
Natrium Benzoat	Food preservatives	Buffer
Asidification	Asidification of Mediteranine Sea	Acid base
Acid Rain	Acid Rain in Local Area	Acid, base, netralisation
Diklorodifeniltrikloroetana (DDT)	Epidemic of Disease	Polarity of Chemical Bonds

Implementation of teaching chemistry concepts by incorporating context of socioscientific issues can be varied. However, in order to maximize scientific literacy skills and/or transferable skills, a teacher essentially should incorporate inquiry approach, explisit nature of science, socioscientific issues related chemistry concepts that are studying. As illustration, in the activity regarding the use of natrium benzoat as preservatives, students are provided an opportunity to discover the active ingredient of a food preservatives, chemical reaction of natrium benzoat and its effects on specific area of brain and health. Furthermore, the involvement in classroom debates and discussion encouraged students to deal with their beliefs about the benefit use of natrium benzoat as preservatives and their personal danger. In this kind of activity, students will actively involved in finding credible sources. They will read and evaluate critically conflicting evidence from credible sources and negotiating their conclusions within and against other groups of students. This type of activity also provides chance to observe the criteria students use in their selection of credible evidence. Through several phases of the classroom experience, students will be required to work individually, in small groups, and interact as a whole class. Their challenges will be in the form of reading articles with contradictory evidence from diverse sources, identifying crucial data and arguments, ranking the prominent of evidence, form group consensus positions, debate of positions, and evaluating other groups' presentation of positions and evidence. The transferable skills involve in this phase will be inquiry skills (asking question, collecting data and evidence, analysing data, making conclusion), critical thinking, team working, communication (argumentation/scientific explanation), problem solving. Another skills could be used and developed such as independent learning and time management. Affective dimension use and develop could be curiosity, interest, moral awareness.

3. CONCLUSION

Enhancing scientific literacy skills, transferrable skills and young students' interest towards science is a challenge for chemistry education. A study suggests the need to include a contextualized and real world problem~~s~~ in any chemistry instruction that is intended to develop those skills and affective dimension. By drawn upon competencies and experiences a chemistry teacher could facilitate socioscientific issues related chemistry to students in the classroom. The socioscientific issues itself use appropriate scientific chemistry content that must be embedded in scientific and social context. The student, then, investigates personally relevant socioscientific issues and discuss, debate or construct argument/explanation to solve the issues. Through some phases of learning the student could use and develop: knowledge of subject matter & nature of science (NOS), life experiences, some transferrable kills and affective dimestion. Examples of SSI related chemistry developed here are alcohol, MSG, Natrium benzoat, Acidification, DDT and Acid Rain.

REFERENCES

American Chemical Society (ACS). (2018). *Development of Student Skills for Academic and Professional Success*. Online. https://www.acs.org/content/acs/en/education/policies/twoyearcollege/7--development-of-student-skills-for-academic-and-professional-s.html. (retrieved July 20, 2018)

Ashraf, S. S., Marzouk, S. A. M., Shehadi, I. A. and Brian, M. M. (2011). An integrated professional and transferable skills course for undergraduate chemistry students. *Journal of Chemical Education*, *88*(1), 44-48.

Bøe, M.V, Henriksen, E. K., Lyons, T., Schreiner, C. (2011). Participation in science and technology: young people's achievement-related choices in late-modern societies. *Studies in Science Education*, *47*(1), 37-72

Chittleborough, G. (2014). The development of Theoretical Frameworks for Understanding the Learning Chemistry. In I. Deventak & S. A. Glazar (eds.), *Learning with Understanding in the chemistry classroom* (pp. 25-40). Dordrecht, The Nederlands: Springer.

Cigdemoglu, C., Arslan, H. O., & Cam, A. (2017). Argumentation to foster pre-service science teachers' knowledge, competency, and attitude on the domains of chemical literacy of acids and bases. *Chemistry Education Research and Practice*, *18*(2), 288-303

Dearing R. (1995). *Skills For Graduates In The 21st Century*. Cambridge: The Association Of Graduate Employers

DeBoer, G. E. (2000). Scientific Literacy: Another Look at Its Historical and Contemporary Meanings and Its Relationship to Science Education Reform. *Journal of Research in Science Teaching, 37*(6), 582 – 601

Driver, R, Newton, P & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education, 84*(3), 287 – 312.

Eilks, I., Rauch,F., Ralle, B., & Hofstein, A. (2013). How to allocate the chemistry curriculum between science and society (p. 1- 36). In Ingo Eilks, I & Avi Hofstein (Eds.). *Teaching Chemistry – A Studybook: A Practical Guide and Textbook for Student Teachers, Teacher Trainees and Teachers*. Rotterdam, the Netherlands: Sense publishers

Fives, H., Huebner, W., Birnbaum, A. S., & Nicoloch, M. (2014). Developing a measure of scientific literacy for middle school students. *Science Education, 98*, 549-580

Gabel, D. L. (1998). The complexity of chemistry and implications for teaching. In B. J. Fraser & K. G. Tobin (Eds.), International handbook of science education (pp. 233–248). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Herscovitz, O., Kaberman, Z., Saar, L., & Dori, Y.J. (2012). The Relationship Between Metacognition and the Ability to Pose Questions in Chemical Education. In Zohar, Anat, Dori, Yehudit Judy (Eds.). *Metacognition in Science Education: Trends in Current Research* (pp.165-195). Nederland: Springer.

Hofstein, A., Eilks, I., & Bybee, R. 2011. Societal Issues and their importance for contemporary science education: a pedagogical justification and the state of the art in Israel, Germany and the USA. *International Journal of Science and Mathematics Education, 9* (6), 1459-1483

Johnstone, A. H. (2000). The presentation of chemistry—Logical or psychological? *Chemistry Education Research and Practice*, 1(1), 9–15.

Johnstone, A. H. (2010). You can't get there from here. Journal of Chemical Education, 87(1), 22–27. Gilbert, J. K., & Treagust, D. F. (Eds.) (2009). *Multiple representations in chemical education*. Dordrecht: Springer.

Leitch, S. (2006). Leitch Review of Skills: Prosperity for all in the Global Economy – World Class Skills. Online. dera.ioe.ac.uk/6322/1/leitch_finalreport051206.pdf (Retrieved July 30, 2018)

Ministry of Research, Technology & Higher Education. (2017). Lampiran Peraturan Pemerintah No 50 Tahun 2017. Renstra Kemenristekdikti Tahun 2015-2019. Online. http://www.kopertis12.or.id/2017/09/04/permenristekdikti-no-50-tahun-2017-tentang-renstra-kemenristekdikti-tahun-2015-2019.html [Attachment of Government Regulation No 50 Year 2017 on Strategy Planning of Ministry of Research, Technology & Higher Education Year 2015-2019]

Norris S.P., & Phillips, L.M. (2003). How literacy in its fundamental sense is central to scientific literacy. *Science Education, 87*, 224-240.

Overton, T. and Mcgarvey, D. J. (2017). Development of Key Skills And Attributes In Chemistry. *Chemistry Educational Research and Practice, 18*, 401-402

Rahayu, S. (2017). Promoting the 21st Century Scientific Literacy Skills through Innovative Chemistry Instruction. *AIP Conference Proceedings **1911***, 020025 (2017); doi: 10.1063/1.5016018. https://aip.scitation.org/doi/abs/10.1063/1.5016018

Ratcliffe, M., & Grace, M. (2003). *Science Education for Citizenship*. Milton Keynes: Open University Press.

Roberts, D. (2007). Scientific literacy/science literacy: threats and opportunities. in Abell S. K. and Lederman N. G. (Eds.), *Handbook of research on science education (* pp. 729–780). Mahwah, New Jersey: Lawrence Erlbaum Associates

Roberts, D. A., & Bybee, R. W. (2014). Scientific literacy, science literacy, and science education. In N. G. Lederman & S. K. Abell (Eds.), *Handbook of research on science education* (Vol. 2, pp. 545-558). New York: Routledge.

Roth, W. M., & Lee S. (2004). Science Education as/for participation in the community. *Science Education, 88*, 263-291

Sadler, T. D. (2004). Moral and ethical dimensions of socioscientific decision-making as integral components of scientific literacy. *Science Educator, 13*, 39–48.

Shwartz Y., Ben-Zvi R. and Hofstein A. (2005). The importance of involving high-school chemistry teachers in the process of defining the operational meaning of 'chemical literacy'. *International Journal of Science Education, 27*(3), 323–344

Shwartz Y., Ben-Zvi R. and Hofstein A. (2006a). Chemical literacy: what it means to scientists and school teachers? *Journal of Chemical Education, 83*, 1557-1561.

Shwartz Y., Bez-Zvi R. and Hofstein A. (2006b). The use of scientific literacy taxonomy for assessing the development of chemical literacy among high-school students. *Chemistry Education Research & Practice, 7*(4), 203–225.

Silberberg, M. S. (2010). *Principles of General Chemistry (2nd Ed).* New York: McGraw-Hill

Stevens, R. (2012). 'Identifying 21st century capabilities', *International Journal of Learning and Change*, 6 (3/4), 123–137.

Tytler, R. 2007. Re-imagining science education: engaging students in science for Australia's future. *Australian Council for Educational Research*. Retrieved 20 July, 2007 from: http://www.acer.edu.au/documents/AER51_ReimaginingSciEdu.pdf

Williams, D. P. & Handa, S. (2016). Chemistry Student Perceptions of Transferable & Workplace Skills Development New Directions in the Teaching of Physical Sciences, 11 (1). Online. *https://journals.le.ac.uk/ojs1/index.php/new-irections/article/download/584/556*

World Economic Forum. (2015). New Vision for Education Unlocking the Potential of Technology. Online. Http://www3.weforum.org/docs/WEFUSA_NewVisionforEducation_Report2015.pdf (Retrived 1st August 2017.)

Zeidler, D. L. & Nichols, B. H. (2009). Socioscientific Issues: Theory and Practice. *Journal of Elementary Science Education*, 21(2), 49-58.

Zeidler, D. L., Sadler, T. D., Applebaum, S., & Callahan, B. E. (2009). Advancing reflective judgment through socioscientific issues. *Journal of Research in Science Teaching, 46*(1), 74-101.

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.