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This certificate is awarded to

Neni Mariana

as a Keynote Speaker

in the 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools (SAMSES) 2020. Universitas Pendidikan Indonesia, 8 October 2020.



Prof. Dr. H. Adang Suherman, MA. Vice Rector for Research, Partnership, and Business Universitas Pendidikan Indonesia



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The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

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The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

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Rundown SAMSES 2020

Time	Event	
07.00-08.00	Login Zoom	TIN
08.00-09.00	Opening CeremonyChairman of SAMSES 2020Rector of UPI	U H
09.00-12.00	Plenary Session Keynote I Dr. I Gusti Darmawan Keynote II Prof. Dr. Didi Suryadi, M.Ed. Keynote III Assoc. Prof. Wang Qiyun	
	Discussion	
12.00-13.00	Break	
13.00-15.00	Oral Session I	
15.30-17.30	Oral Session II	
	Closing	

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Parallel Session I Schedule

									1	
Venue Time	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
13.00-13.15	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
	58	121	132	109	102	54	66	143	17	30
13.15-13.30	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
	16	73	152	39	99	83	144	87	47	139
13.30-13.45	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
	42	85	78	94	148	110	86	153	128	5
13.45-14.00	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
	135	25	96	67	193	59	176	118	100	40
14.00-14.15	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
	70	90	97	23	98	50	62	56	179	75
14.15-14.30	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
	131	22	149	119	108	150	103	31	115	92
14.30-14.45	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
	15	130	165	1	53	63	26	27	129	182
14.45-15.00	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
	160	38	156	12	49	37	45	64	80	4
15.00-15.15	ABS- 11	ABS- 183								

Information:

- R1 = Computer Programming for Kids & Computer-Based Learning
- R2 = Computer-Based Learning
- R3 = Computer-Based Learning
- R4 = Computer-Based Learning
- R5 = Computer-Based Learning
- R6 = Computer-Based Learning
- R7 = Computer-Based Learning
- R8 = Computer-Based Learning
- R9 = Computer-Based Learning
- R10 = Computer-Based Learning & Electronics for Kids

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Parallel Session II Schedule

	-							1	1	
Venue Time	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10
15 20 15 45	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
15.30-15.45	175	170	88	33	61	164	51	46	18	142
15 45 16 00	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
15.45-16.00	21	189	81	169	172	84	158	65	74	29
16 00 16 15	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
10.00-10.12	163	138	173	93	177	181	3	113	106	68
16 15 16 20	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
10.12-10.30	174	145	82	151	122	166	48	116	112	72
16 20 16 45	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
10.30-10.45	2	123	55	191	7	6	124	147	19	104
16 45 17 00	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
10.45-17.00	168	141	20	76	32	52	136	161	188	178
17 00 17 15	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
17.00-17.15	44	71	187	10	171	57	137	35	105	101
17 15 17 20	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-	ABS-
17.15-17.30	8	154	9	186	60	159	157	107	125	28
17 20 17 45	ABS-	ABS-								
17.30-17.45	134	140								

Information:

- R1 = Educational Studies in Mathematics
- R2 = Educational Studies in Mathematics
- R3 = Educational Studies in Mathematics
- R4 = Educational Studies in Mathematics
- R5 = Educational Studies in Mathematics
- R6 = Educational Studies in Mathematics & Physics Education
- R7 = Engineering for Kids & Robotic and Game Teaching in Elementary School
- R8 = Foundations of Engineering, Technology, and Robotics
- R9 = Science Teaching Kit
- R10 = Science Teaching Kit

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Table of Abstracts

Торіс	Title	Page			
	Computer Programming for Kids				
Computer Programming for Kids	[ABS-16] Stability and Balance Training Application to Achieve Better Learning Outcomes of Balance Learning for Primary School Students Anggi Setia Lengkana1*, Tatang Muhtar2, Encep Sudirjo3, Tedi Supriyadi4, Aam Ali Rahman5, Muhammad Nur Alif6	K			
Computer Programming for Kids	[ABS-42] Digital Traditional Games Application as Play Therapy for Children with Attachment Disorder <i>Endah Silawati, Winti Ananthia, Mirawati, Margaretha Sri</i> <i>Yuliariatiningsih, Solihin Ichas Hamid, Dian Anggraini</i>	2			
Computer Programming for Kids	[ABS-58] DEVELOPING INTERACTIVE MULTIMEDIA TO FACILITATE THE FINANCIAL LITERATION OF EARLY CHILDHOOD Agni Fadilah, Taopik Rahman, Elan	3			
Computer Programming for Kids	[ABS-70] Developing Android-Based Mobile Learning Application for Introducing Young Children to Local Culture Taopik Rahman, Silmi Qurota Aeni, Elan, Asep Nuryadin	4			
Computer Programming for Kids	[ABS-131] Methods Of Fat Percentage Reduction In Certain Body Areas Through Workout Training Applications In Basic School Students W Kusumah (a*), Y Akin (a), Y Nurcahya (a)	5			
Computer Programming for Kids	[ABS-135] THE INFLUENCE OF "AHOEYY" EDUCATIONAL GAME MEDIA ON STUDENTS UNDERSTANDING AND LEARNING MOTIVATION IN SOCIAL SUBJECT Neni Nadiroti Muslihah1, Eko Fajar Suryaningrat 2, Abdul Hakim 3	6			
	Computer-based Learning				

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Computer-based Learning	[ABS-1] Aku Senang Membaca: An Application for Interactive-Multimedia-Aided Social-Cognitive Model for Early Reading Learning Indah Nurmahanani, Munir, Yeti Mulyati, Andoyo Sastromiharjo	
Computer-based Learning	[ABS-5] Preliminary Design of An Android-Based Voltage Divider Calculator to Support Extracurricular Program in Elementary School Sadam Fauzi, Syifaul Fuada*, Nadia Tiara Antik Sari, Titania Emaniar	8
Computer-based Learning	[ABS-11] DEVELOPMENT OF DIGITAL MATHEMATICS TEACHING MATERIALS IN ELEMENTARY SCHOOLS USING WHITEBOARD ANIMATION FOR PRIMARY TEACHER EDUCATION STUDENTS STKIP PGRI LUBUKLINGGAU Akmal Rijal (a), Azimi (b)	9
Computer-based Learning	[ABS-12] 3D Visualization and Animation as Content Development for Digital Learning Materials for Traditional Indonesian Cloth: Songket Palembang based on Cloud Intan Permata Sari(a*), Fahmi Candra Permana(a), Feri Hidayatullah Firmansyah(a), Asep Herry Hernawan(b)	10
Computer-based Learning	[ABS-15] Lifestyle Exercises to Prospective Physical Education Teachers Through Application to Exercise at Home without Equipment Anggi Setia Lengkana1*, Aam Ali Rahman2, Muhammad Nur Alif3, Rizal Ahmad Fauzi4, Gumilar Mulya5, Defri Mulyana6	11
Computer-based Learning	[ABS-17] Web-Based Active Learning for Elementary Physical Education Prospective Teachers Program Tatang Muhtar1*, Anggi Setia Lengkana 2, Herman Subarjah3, Adang Sudrazat4 Aam Ali Rahman5, Dede Nurodin6	12
Computer-based Learning	[ABS-22] Teaching IC Timer Through Simulation for Future STEM Teacher Devi Puspita Dewi (a*), Syifaul Fuada (b), Prihantoro Tri Nugroho (c), Zamzam Kholidatuzzahra (d), Dina Afionita (e)	13

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Computer-based Learning	[ABS-23] The Use of Social Media Technology in Research at Covid-19 Time: Accounts and Problems Herli Salim (a), Muhammad Hanif (b*)	
Computer-based Learning	[ABS-25] Ciletuh Palabuan Ratu UNESCO Global Geopark Digital Map for ESD Asep Herry Hernawan, Prihantini, Mochamad Iqbal Ardimansyah, M Ridwan Sutisna	15
Computer-based Learning	[ABS-26] Elementary Teacher Readiness in Online Learning During Pandemic; Prospects and Facts Nunung Siti Sukaesih, Hikmat Pramajati, Sri Wulan Lindasari, Emi Lindayani	16
Computer-based Learning	[ABS-27] The Application of Augmented Reality in Childrens Stories Seni Apriliya, Mohamad Feri Faerullah Fauzi	17
Computer-based Learning	[ABS-30] Parents Perspective over Use of Digital Classroom for Elementary Student <i>Y Ariani, Y Helsa, S Ahmad, M Zainil, AK Kenedi, M Ghazali</i>	18
Computer-based Learning	[ABS-31] Improving Elementary Students Conceptual Understanding on Science through In-Blended Learning Yuyu Hendawati, Suko Pratomo, Fitri Nuraeni, Rahmatia Nuraisah	19
Computer-based Learning	[ABS-37] Ketimbang Main: Augmented Reality-Based Application to Improve Students 4Cs <i>N W A Majid, E S Titiana, B Yolandini, R Nurhanifa, R Akbar , and T</i> <i>Sumiati</i>	20
Computer-based Learning	[ABS-38] Identify the level of study computer science at the begining of semester in university Dian Permata Sari, Suprih Widodo, Rizki Hikmawan, Nuur Wahid Abdul Majid, Raihan Irsyad Tumbuan	21
Computer-based Learning	[ABS-39] Development of Instrument to Measure Understanding Sex Education for Early Childhood Students	22

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
	Based On Digital Kahoot Games Gartika Dwi Jayanti (a), Cahya Karisma Pertiwi (b), Aan Yuliyanto (c), Risty Justicia (a), Syifaul Fuada (d)	
Computer-based Learning	[ABS-45] Metaanalysis: The Correlation Between E Module And Hybrid Learning With Information and Communication of Technology (ICT) Skills Nur Rohmah Utami (a**), Rindang Adi Winahyu (a), Maria Regelinda Tahan (a), Akhmad Jufriadi (a*), Hena Dian Ayu(a)	24
Computer-based Learning	[ABS-47] Opportunities and challenges make Bigbook to Digital Version as Language Learning Media <i>Taufik Ridwan(1), Endang Hidayat (2), Ahmad Fauzi(3), Fiqhi</i> <i>Zuhda Fathi Falah(4)</i>	25
Computer-based Learning	[ABS-49] The Analysis of Distribution Map of Physical Education Learning Motivation through Rasch Modeling towards Elementary School Students L Nur (a)*, E A Mashudi (a), R N Ramdhani (a), A Yulianto (a), A Budiman (a), E Nur'aeni (a), R Giyartini (a), A Mulyadiprana (a), A A Malik (b)	26
Computer-based Learning	[ABS-50] Design of a Web-Based Digital Learning Resource Center to Assist Online Learning with Mathematics Content in Primary Schools <i>M Ridwan Sutisna, Yeni Yuniarti, Husen Windayana, Hendriyana</i>	27
Computer-based Learning	[ABS-53] The Analysis of Student Response Patterns to Physical Education Learning Motivation through Rasch Modeling in Elementary Schools L Nur (a)*, S Juditya (b), E Kastrena (c), R N Ramdhani (a), A Budiman (a), H Y Muslihin (a), A Yulianto (a), R Wibowo (a), T Haryono (a), R Giyartini (a), A A Malik (d)	28
Computer-based Learning	[ABS-54] Using Technology of Learning Style and Creativity for Social Studies Preservice Teachers	30

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
	Muh. Husen Arifin, Nana Supriatna, Tin Rustini, Yona Wahyuningsih	
Computer-based Learning	[ABS-56] Youtube Video: Developing Film-Based Instructional Media for Elementary School Student S Juditya(a)*, L Nur (b), D A Zakaria(a), R M Rizal(a), Y M Rizal(a), Sutiswo(a), A Sobarna(a).	31
Computer-based Learning	[ABS-59] Development of Online Learning Media Based on Telegram Chatbot (Case Studies : Programming Courses) Mochamad Iqbal Ardimansyah (a*), Mochammad Haldi Widianto (b)	32
Computer-based Learning	[ABS-62] Can Virtual Learning Guide and Train Pre-Service Teachers to Write Lesson Plan? Novi Yanthi, Yeni Yuniarti, Rendi Restiana Sukardi, Dede Trie Kurniawan	33
Computer-based Learning	[ABS-63] Applying Mobile Learning in the Elementary Social Studies Teaching <i>Muh. Husen Arifin, Tin Rustini, Yona Wahyuningsih</i>	34
Computer-based Learning	[ABS-64] How to Strengthen Local Wisdom of Ethno- Science through Eco-Citizenship? Solihin Ichas Hamid	35
Computer-based Learning	[ABS-66] The Potential of Digital Children Storybook Platforms in Developing Literacy Competence of Elementary School Students during and after CoVid 19 Outbreak Nadia Tiara Antik Sari (a*), Gilang Rajasa (b), Neneng Sri Wulan (c), Syifaul Fuada (d), Choiry Nurul As Tarte (e), Bella Shabrina Priyadi (f), Ghea Sandra Pratiwi (g)	36

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Computer-based Learning	[ABS-67] Data Infrastructure and Information Design of E- Learning in Primary School Hendriyana (a*) and M. Ridwan Sutisna (b)	J)
Computer-based Learning	[ABS-73] POPULAR DIGITAL LEARNING CONTENT IN THE CONTEXT OF ELEMENTARY EDUCATION IN INDONESIA Amanda Puspanditaning Sejati, Deddy Suryana, Sifa Rini Handayani, Dedah Ningrum, Emi Lindayani	38
Computer-based Learning	[ABS-78] Technology Literacy for Prospective Physical Education Teachers Entan Saptani, Anin Rukmana, Tedi Supriyadi, N N Afidah	39
Computer-based Learning	[ABS-80] Technology Integration in Hadith Learning Tedi Supriyadi, J Julia, Wawan Hermawan, Agus Fakhruddin. M I Firmansyah	40
Computer-based Learning	[ABS-83] The Use of Interactive Multimedia Based on The Science-Technology-Society (STS) Approach on The Pedagogy Ability of Elementary School Teacher Education Students Mareyke Jessy Tanod, Reza Rachmadtullah	41
Computer-based Learning	[ABS-85] Development of Electronic Teaching Materials Based Flip Book Makers for Language Skills in Elementary Schools Andri Wicaksono (a*), (b) Supriyono, (c) Fitria Akhyar	42
Computer-based Learning	[ABS-86] Technology in learning dance education to preparing prospective elementary school teacher for the future Non Dwihiera C.A, Sendi Fauzi Giwangsa	43
Computer-based Learning	[ABS-87] Developing of EDGIV Web Application to Support Voluntary Teaching Program	44

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
	Raditya Muhammad (a*), Mochamad Iqbal Ardimansyah (a), Hendriyana (a), Yayang Furi Furnamasari (b)	
Computer-based Learning	[ABS-90] USABILITY TESTING OF DIGITAL MAP APLICATION USING HAND GESTURE RECOGNITION AS A HISTORICAL LEARNING MEDIA FOR ELEMENTARY SCHOOL Ayung Candra Padmasari, Asep Herry Hernawan, Deti Rostika, Yona Wahyuningtyas	45
Computer-based Learning	[ABS-94] COMPUTER GAME-ASSISTED INTRUCTIONAL MODEL FOR TEACHING SCIENCE IN ELEMENTARY SCHOOL H Hernawan1, W Rifqiana2, DBI Taofik3, and LS Mulyani4	46
Computer-based Learning	[ABS-96] Video Project Assessment as a Way of Promoting Students' Speaking Skill during Emergency Remote Teaching Erwin Rahayu Saputra	47
Computer-based Learning	[ABS-97] Students' experience of online game-based assessment tool during emergency remote teaching Erwin Rahayu Saputra; Nandang Rusmana	48
Computer-based Learning	[ABS-98] Creating Songs Using Online Software J. Julia, Prana Dwija Iswara, Tedi Supriyadi	49
Computer-based Learning	[ABS-99] Making Media for Learning Musical Instruments Using the Scratch Application J. Julia (a*), Sandie Gunara (b), Prana Dwija Iswara (a)	50
Computer-based Learning	[ABS-100] The Use of Google Classroom for Teaching Elementary School Students Tommy Hastomo*, Febriyantina Istiara, Eva Nurchurifiani	51
Computer-based Learning	[ABS-102] Application of Youtube-Based Virtual Blended Learning as a Learning Media for Basic Movement Skills in Elementary Schools	52

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
	L Nur (a)*, M S Taufik (b), A Rahadian (b), A H Kosasih (c), H Y Muslihin (a), Y Akin (a), A A Malik (d)	
Computer-based Learning	[ABS-103] THE DEVELOPMENT OF ANDROID BASED COUNSELING GUIDANCE MEDIA FOR ELEMENTARY SCHOOL STUDENTS Noviana Diswantika, Risna Rogamelia, Mareyke Jessy Tanod	53
Computer-based Learning	[ABS-108] The Development of Interactive Learning Multimedia in Teaching Mathematics (Integer Number) to Junior High School Students K A N Imania(*), Y Purwanti, S H Bariah, I Nasrulloh, N Nurazizah	54
Computer-based Learning	[ABS-109] Learning Device in the "STEMpedia" Mobile Learning Application G Hamdu (a*), A Mulyadiprana (a), H Mukti (a), A Yulianto (a), Karlimah (a)	55
Computer-based Learning	[ABS-110] Social Studies Pre-service Teachers Perceptions about Designing Learning Games: Impact of Creativity and Technology Literacy Muh. Husen Arifin, Nana Supriatna, Tin Rustini, Yona Wahyuningsih	56
Computer-based Learning	[ABS-115] GOOGLE CLASSROOM BASED ONLINE LEARNING MANAGEMENT IN THE PANDEMIC PERIOD IN INCREASING LEARNING INTEREST IN ELEMENTARY SCHOOL Wayan Satria Jaya (a*), Nurdin Hidayat (b), Siswo Edi Wibowo (c), Nur Fitria (d)	57
Computer-based Learning	[ABS-118] Development of traditional wayang arts using recycled waste material and new information technology as a creative learning media Rival Ramadhan(a*), Cahya Karisma Pertiwi (b*), Deden Eka Purwanto (a), Fadel Daulatullail (b), Rifa Nurhanifa (b), Hafiziani Eka Putri (b*), Hayani Wulandari (c)	58
Computer-based Learning	[ABS-119] A Comparative Study of CTL Approach Using Interactive Multimedia and Cooperative Approaches in	60

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
	Improving Mathematical Understanding I Nasrulloh (a*), D Rahadian (a), N A Hamdani (a), Y Purwanti (a), F B R Rikaldi (a)	Ø
Computer-based Learning	[ABS-121] Enhancing Cultural Awareness using ICT in ELT: Indonesian Elementary School Teachers Perspective Aksendro Maximilian (a*), Galuh Dwi Ajeng (a), Hajjah Zulianti (a)	61
Computer-based Learning	[ABS-128] INTEREST IN LEARNING PHYSICAL EDUCATION USING THE GOOGLE FORM APPLICATION ON GADGET Y Akin (a*), M R Sentani (a), L Nur (a), A R Kurniawan (b)	62
Computer-based Learning	[ABS-129] THE EFFECTIVENESS OF LEARNING MEDIA THROUGH ANIMATED VIDEO IN LEARNING PHYSICAL EDUCATION Y Akin (a*), A R Kurniawan (b), M R Sentani (a)	63
Computer-based Learning	[ABS-130] Teaching Students to Write Research Reports Through Writing Class Collaboration Model Dian Indihadi	64
Computer-based Learning	[ABS-132] THE EFFECT CIVIC EDUCATION COMPUTER- BASED LEARNING AND DIGITAL LITERACY ON STUDENT LEARNING OUTCOMES DINIE ANGGRAENI DEWI (a*) ASEP ANGGI BULDANI (b)	65
Computer-based Learning	[ABS-139] Application of Youtube Social Media as Audio Visual During Covid-19 Pandemic Period in IPI Garut Information System Study Program Y Nugraha (a*), N N Muslihah (a), D D Bhakti (a), N A Hamdani (b), Z N Ainina (a).	66
Computer-based Learning	[ABS-143] Synchronous or asynchronous? Various online learning platforms studied in Indonesia 2015-2020	67

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
	Pidi Mohamad Setiadi (a*), Dwi Alia (b), Sumardi (c), Resa Respati (d), Lutfi Nur (e)	
Computer-based Learning	[ABS-144] The Use of Digital Children's Literature in Family Literacy Program: How to Improve Children's Reading Literacy Neneng Sri Wulan, Endang Hidayat, Nadia Tiara Antik Sari, Indah Nurmaharani	68
Computer-based Learning	[ABS-148] An Electronic Rubric for Collaboration Skill Assessment in Outbound Activities L Nur (a)*, B Agustan (b), E Kastrena (c), I Nurzaman (a), E Solihati (a), A Yulianto (a), A Hamidi (a), P M Setiadi (a), A A Malik (d)	69
Computer-based Learning	[ABS-149] Development of Interactive Learning Multimedia for Mathematics Subjects for Grade 5 Elementary Schools <i>Feri Hidayatullah Firmansyah (a*), Intan Purnama Sari (a), Fahmi</i> <i>Candra Permana (a), Dian Rinjani (a)</i>	70
Computer-based Learning	[ABS-150] Learning Dance In The Digital Era: The Integration Of Technology In Learning Dance In Elementary School Mela Darmayanti, Non Dwishiera C.A	71
Computer-based Learning	[ABS-152] Developing Civic Education E-Module Based on Project Based Learning to Improve Students civic Literacy Dinie Anggraeni Dewi, M.Pd (a*), Prof. Dr. Dasim Budimansyah, M.Si. (b), Prof. Dr. Ace Suryadi, M.Sc., Ph.D. (c), Dr. Dadang Sundawa, M.Pd. (d)	72
Computer-based Learning	[ABS-153] THE DEVELOPMENT OF INDONESIAN LANGUAGE TEACHING MATERIALS BASED ON MOBILE LEARNING FOR ELEMENTARY SCHOOL STUDENTS Riska alfiawati (a), Dian Permanasari (a), Sri Wahyuningsih (a), Dudu suhandi saputra (b)	73

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Computer-based Learning	[ABS-156] Comic Maker App for Enjoyable Learning Fully Rakhmayanti, M.Pd.	
Computer-based Learning	[ABS-160] Self-efficacy and perspective of parents in elementary school of online learning during COVID-19 Aan Yuliyanto(a*), Idat Muqodas (b*), Yani Fitriyani (c), Nuur Wachid Abdul Majid (d)	73
Computer-based Learning	[ABS-165] Pedagogical Potentials of Mobile Augmented Reality for Early Literacy Introduction Finita Dewi, Suci Utami Putri, Fisca Azhar Silfanny	76
Computer-based Learning	[ABS-176] TeachersAcceptance of Google Forms as a Media for Online Learning Evaluation Novi Sofia Fitriasari, Dhea Rahma Azhari, M.Saleh	77
Computer-based Learning	[ABS-179] Digital Phonemic Awareness; Disseminate an Interactive Learning via Compact Disc on Deaf Student Wagino, Wulan Patria Saroinsong, Yatim Riyanto, Bachtiar Syaiful Bachri	78
Computer-based Learning	[ABS-183] Improving the listening and speaking abilities of students with hearing impairments in inclusive primary schools through the computer-based learning Endang Pudjiastuti Sartinah, Eryana Fatimasari Retno Budiati, Muhammad Nurul Ashar	79
Computer-based Learning	[ABS-193] Exploring Digital Storytelling Potentials in Primary Classrooms Irena Y. Maureen, Khusnul Khotimah, Utari Dewi, Citra Fitri	80
	Educational Studies in Mathematics	
Educational Studies in Mathematics	[ABS-2] The mathematical self-efficacy instruments for elementary school students Aan Yuliyanto (a), Turmudi (b*), Hafiziani Eka Putri (c), Idat Muqodas (d), and Puji Rahayu (e)	81

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Educational Studies in Mathematics	[ABS-7] A Study of Mathematical Understanding in Fraction by Applying Gamification S Widodo, P Rahayu, S Sidiq	82
Educational Studies in Mathematics	[ABS-8] Integrating The Concept of Plane in The Grand Mosque of Old Banten Using The ADDIE Model As an Alternative Media of Mathematics Learning Andika Arisetyawan (a*), Erlangga Kusuma Yuda (b), Indra Permana(c)	83
Educational Studies in Mathematics	[ABS-9] Creating Mathematical Situation using Ethnomathematics I. Isrokatun (a*), Budi Sigit Purwono (b)	84
Educational Studies in Mathematics	[ABS-10] Development of spatial sense abilities of elementary school students in geometry class P Rahayu, S Widodo, W S Nurlaeni	85
Educational Studies in Mathematics	[ABS-20] The instrument for measuring logical- mathematical intelligence of low-grade elementary school students Idat Muqodas; Aan Yuliyanto	86
Educational Studies in Mathematics	[ABS-21] Correlation of mathematics learning outcomes and self-regulated learning of elementary school students during the Covid-19 pandemic 1H E Putri, 1A S Sasqia, 1A Abdulloh, 2S Fuada, 3I Muqodas,4N W A Majid	87
Educational Studies in Mathematics	[ABS-32] Elementary School Students: Didactical Design Analysis of Ethnomathematics Learning S. Supriadi, M. Adha, and E. Mahpudin,	89
Educational Studies in Mathematics	[ABS-33] A STORYBOARD OF MOTION COMIC BASED ON DIGITAL LITERATION AND MATHEMATICAL ABILITIES FOR ELEMENTARY SCHOOL IN NEW NORMAL COVID-19 ERA Karlimah (1), Ghullam Hamdu(2), Vira Pratiwi(3), Helmi Herdiansah(4), Dedi Kurniawan(5).	90

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Educational Studies in Mathematics	[ABS-44] Sainsmatika Story Book: Connecting Open-Ended Problems to Stories As a Tool to Develop Students' Mathematical Creativity Agnestasia Ramadhanni Putri, M.Pd, Dr. Ali Mustadi, M.Pd, Dr. Muhammad Nur Wangid, M.PSi	
Educational Studies in Mathematics	[ABS-55] Bibliometric analysis of situation-based learning model publication trends (2010-2019) I Isrokatun, C S Haryani* and N I Rahmi	92
Educational Studies in Mathematics	[ABS-60] A Meta-Analysis of The Effect of Problem-Based Learning in Improving The mathematical Abilities of Elementary School Students Suparman (1*), Yunita (2), Dadang Juandi (3), Dwi Fikriah (4)	93
Educational Studies in Mathematics	[ABS-61] Solve the Problem of Learning Fractions in Mathematics through Scaffolding Prihantini, Deti Rostika, Nurul Hidayah Indonesia University of Education	94
Educational Studies in Mathematics	[ABS-71] Didactic Design of Circumference of a Circle Concept based on Singing, Playing, Analyzing, Discussing, and Evaluating (SPADE) Learning Model E Nuraeni (a*), A Y Suryati (b), O H Pranata (c); I F Apriani (d), M R W Muharram (e); L Nur (f)	95
Educational Studies in Mathematics	[ABS-76] How Does Rasch Modeling Reveal the Difficulty and Conformity Level of Test Item? Karlimah (a*), G Hamdu (a), A Yulianto (a)	96
Educational Studies in Mathematics	[ABS-81] Learning Obstacle of Addition Operation Whole Number in Elementary Schools G S Sidik (*a);Turmudi (b)	97
Educational Studies in Mathematics	[ABS-82] Problem Solving Ability of Prospective Elementary School Teacher I F Apriani (a*); Turmudi (b); E Nuraeni (c)	98

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Educational Studies in Mathematics	[ABS-84] Exploration of Self-regulated Learning Mathematics through Edmodo Trisniawati (a*), Mahmudah Titi Muanifah (a), Nelly Rhosyida (a), Ida Megawati (a), Martalia Ardiyaningrum (b), Beti Istanti Suwandayani (c)	99
Educational Studies in Mathematics	[ABS-88] Comparison of Two Scoring Models in the Multiple Choice Math Test Erdawaty Kamaruddin, Erwin Sulaeman, Liza Nurita, and Lisa Dwi Ningtyas	100
Educational Studies in Mathematics	[ABS-93] Reciprocal Teaching Approach towards Mathematics Learning Outcome of Elementary School Teacher Education Students Mahmudah Titi Muanifah (a*), Nelly Rhosyida (a), Trisniawati (a), Retno Anggraheni (b), Niswatul Maghfiroh (c), Anita Kurniasih(d), Halimah Sadiyah (e)	101
Educational Studies in Mathematics	[ABS-122] UTILIZING SMARTPHONE AS A DIAGNOSTIC TOOL TO DETERMINE PROSPECTIVE TEACHERS ERRORS IN SOLVING MATHEMATICAL PROBLEMS Rostina Sundayana	102
Educational Studies in Mathematics	[ABS-123] The achievement of mathematical creative thinking abilities and the curiosity of prospective teachers <i>E A Afriansyah, T Herman, Turmudi, J A Dahlan, R Sundayana, S S Madio, D Sofyan, C N Haq, Basuki, and N A Hamdani</i>	103
Educational Studies in Mathematics	[ABS-134] THE INFLUENCE OF GEOGEBRA MEDIA USE TO STUDENTS MATHEMATICS PROBLEM SOLVING ABILITY Arinta Rara Kirana (a*); Yulita Dwi Lestari (b*); Ristika(c*)	104
Educational Studies in Mathematics	[ABS-138] The effectiveness of the use of interactive multimedia on the initial mathematics abilities of low grade students in elementary schools Dharlinda Suri, Reza Rachmadtullah	105

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Educational Studies in Mathematics	[ABS-140] Realistic Mathematics Education Approach on Teaching Geometry in Primary Schools: Collaborative Action Research Ejen Jenal Mutaqin1, Moh Salimi2, Lutfi Asyari3, Nizar Alam Hamdani4	106
Educational Studies in Mathematics	[ABS-141] Mathematical Learning Trajectory in Primary School Ejen Jenal Mutaqin1, Lutfi Asyari2, Tetep3, Nizar Alam Hamdani4	107
Educational Studies in Mathematics	[ABS-145] The Development of Attitude Assessment Instrument in STEM Learning in Fifth Grade Elementary Schools Dindin Abdul Muiz Lidinillah., Dena Sapna Sabillah, Karlimah	108
Educational Studies in Mathematics	[ABS-151] Realistic Mathematics Education (RME) Approach to Increase Students Problem Solving Skill in Elementary School Muhammad Nurjamaludin (a*), Dani Gunawan (b), Rajji K Adireja(c), Nabella Alani (d)	109
Educational Studies in Mathematics	[ABS-154] THE INFLUENCE OF LEARNING MEDIA LECTORA INSPIRE BASED INTERACTIVE ON STUDENTS LEARNING MOTIVATION AND MATHEMATICAL REASONING ABILITIES IN PRIMARY SCHOOLS Eko Fajar Suryaningrat (a*), Neni Nadiroti Muslihah (b), Dea Asri Pujiasti (b), Rajji K. Adiredja (b),	110
Educational Studies in Mathematics	[ABS-163] Analysis of Mathematics Literacy Ability of Elementary School Teacher Education Students 1Maryati,I. 2Sri Sumartini,T. 3Sritresna, T	111
Educational Studies in Mathematics	[ABS-164] Correlation of Self Efficacy on Mathematical Communication Skills for Prospective Primary School Teachers Tina Sri Sumartini (*), Iyam Maryati, Teni Sritresna	112

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Educational Studies in Mathematics	[ABS-166] Analysis of Mathematical Connection Ability of Elementary School Students Tina Sri Sumartini (a*), Nizar Alam Hamdani (b), Iyam Maryati (a)	113
Educational Studies in Mathematics	[ABS-168] The Influence of Constructivism Approach on Student Confidence Character ?: Learning Mathematics in Primary Schools in Bima Regency Adi Apriadi Adiansha (a*), Syahrir (b), Eva Nursa'ban (c), Fathurrahmaniah (c), Reza Rachmadtullah (d)	114
Educational Studies in Mathematics	[ABS-169] Integration of the Establishment of Independence Character Value ?: Mathematics Learning of Elementary School Students in the Industrial Era 4.0 Lutfin Haryanto (a), Arwan (a), Muarif Islamiah (a), Adi Apriadi Adiansha (b*), Reza Rachmadtullah (c)	115
Educational Studies in Mathematics	[ABS-170] Bain Based Learning Model: How does it affect Emotional Intelligence and Mathematics Learning Outcomes of Elementary School Students? Berti Mandala putra (a), Lisda Ramdhani (a), Azra Fauzi (a), Adi Apriadi Adiansha (b*), Reza Rachmadtullah (c)	116
Educational Studies in Mathematics	[ABS-171] Brain Based Learning: Formation of Mathematical Critical Thinking Skills in terms of Inductive Reasoning Suci Nujul Hayati (a), Nurul Istiqomah (a), Ewisahrani (a), Adi Apriadi Adiansha (b*), Reza Rachmadtullah (c)	117
Educational Studies in Mathematics	[ABS-172] The Influence of the Missouri Mathematics Project Model on Mathematical Creativity of Elementary School Students Randi Ardiansyah (a), Rostati (a), Suharti (a), Adi Apriadi Adiansha (b*), Reza Rachmadtullah (c)	118
Educational Studies in Mathematics	[ABS-173] APPLICATION OF INTEGRATED MATHEMATICS, DESIGN AND STORY STORYTELLING, MATERIAL STORIES OF SMALLEST FELLOWSHIP FACTORS AND THE LARGEST	119

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
	FELLOWSHIP FACTORS IN THE BASIC SCHOOL Heru Subrata, Neni Mariana, Suprayitno, Wiryanto	
Educational Studies in Mathematics	[ABS-174] STUDENT DIFFICULTY ANALYSIS ASSESSED FROM HABITS OF MIND IN COMPLETING EXPLORATION TYPE PROBLEMS IN MATHEMATICS OLYMPIADES COURSES 1Sritresna, T. 2Maryati, I. 3Sri Sumartini,T.	120
Educational Studies in Mathematics	[ABS-175] How to Improve The Mathematical Literacy Ability of Elementary School Teacher Education Student *I Maryati, N A Hamdani, T S Sumartini	121
Educational Studies in Mathematics	[ABS-177] Students mathematical self-efficacy abilities in solving mathematical problems Rosida Marasabessy	122
Educational Studies in Mathematics	[ABS-181] ANALYSIS OF THE USE OF MATHEMATIC ANIMATION VIDEO AS A LINE LEARNING ALTERNATIVE TO LEARNING MOTIVATION Wiryanto; Neni Mariana; Budiyono; Ika Rahmawati; Delia Indrawati; Putri Rachmadiyanti; Mintohari	123
Educational Studies in Mathematics	[ABS-186] The Effect Of Cooperative Learning Make A Match Type on the Mathematics learning outcomes In Elementary School Muhammad Nurjamaludin, Widdy Sukma Nugraha, Eko Fajar Suryaningrat, Nabella Alani	124
Educational Studies in Mathematics	[ABS-187] Edu-Game Media Based on Android to Learn Least Common Multiplication (LCM) and Great Common Divisor (GCD) for the 4th Graders Ika Rahmawati, Nur Qurrota Ayun, Neni Mariana, Delia Indrawati, Wiryanto, Budiyono, Farida Istianah	125
Educational Studies in Mathematics	[ABS-189] Ethnomathematics On Surabaya Regional Song Notation Delia Indrawati (a*), Amalia Husna Zahrotus Septiana (b), Ika	126

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
	Rahmawati(c), Dwi Anggraeni Siwi (d), Neni Mariana(e), Wiryanto(f), Farida Istianah (g)	D
Educational Studies in Mathematics	[ABS-191] In-Service Teachers Perception on Implementing RME in Their Best Practice Neni Mariana, Silvi Amaliatus Sholihah, Riski, Ika Rahmawati, Wiryanto, Delia Indrawati, Budiyono	127
	Electronics for kids	
Engineering for Kids	[ABS-4] Teaching A Simple AC/DC Converter Through Simulation for Elementary Students Sadam Fauzi, Syifaul Fuada, Jennyta Caturiasari	128
Engineering for Kids	[ABS-75] HANDPHONE USAGE ASSISTANCE IMPROVING CHARACTER OF CONFIDENCE, SHARING AND RESPONSIBILITY FOR A TEN YEARS OLD CHILD Effy Mulyasari, Mohammad Ali, Dadang Sukirman	129
Engineering for Kids	[ABS-92] Quizizz Application As Game Based Learning To Add New Vocabulary In Elementary School S. Nailul Muna Aljamaliah (a*), Tanzilia Nur Fajriati (b), Deden Much. Darmadi (b)	130
Engineering for Kids	[ABS-182] The Information and Communication Technology (ICT) in Thematic Learning Model Classroom Resources for Hyperactive Students in Inclusive Primary School Sri Joeda Andajani, Pamuji, Endang Purbaningrum	131
Engineering for Kids	[ABS-51] STEAM-Project: Developing Early Childhood Students' Level of Problem Solving Skills Suci Utami Putri, Finita Dewi, Abdurrohman Ahmad Taqiuddin	132
Engineering for Kids	[ABS-158] Diftion Apps: Android Based Communication Media For Hundreds Of Funny Chandra Motilal, Robby Akbar, Fitri Nurbadriah, Syifaul Fuada, S.Pd., M.T.	133

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Foundations of Engineering, Technology, and Robotics		
Foundations of Engineering, Technology, and Robotics	[ABS-46] PBL-STEM TO PROMOTE ENVIRONMENTAL PROBLEM SOLVING SKILLS Suko Pratomo, Yuyu Hendawati, Fitri Nuraeni, Andhika Wiyata Pratama	134
Foundations of Engineering, Technology, and Robotics	[ABS-65] ICT Competency Needs for Rural Elementary School Teachers Aah Ahmad Syahid*, Dinn Wahyudin and Asep Herry Hernawan	135
Foundations of Engineering, Technology, and Robotics	[ABS-113] Technology utilization during covid-19 pandemic in online learning on the seminar of islamic studies in the course of elementary school teacher education Ani Nur Aeni (a*), Nurdinah Hanifah (a), Dety Amelia Karlina (a), Cucun Cunaengsih (a), Maulana (a)	136
Foundations of Engineering, Technology, and Robotics	[ABS-116] INTERNET TECHNOLOGY IN THE CLASSROOM: WHAT IS DIGITAL LITERACY? Nurdinah Hanifah, Ani Nur Aeni, Dadan Djuanda, Dadang Kurnia, Regina Lichteria Panjaitan	137
Foundations of Engineering, Technology, and Robotics	[ABS-147] Enhanced Competence in Designing Optical Fiber Access Network using Optisystem Ahmad Fauzi(a*), Taufik Ridwan (b)	138
	Physics Education	
Physics Education	[ABS-6] Teaching Sine Wave Concept Through Simulation for Elementary Students Devi Puspita Dewi, Syifaul Fuada, Hafiziani Eka Putri, Fauziyah Rhaudatul Jannah, Prihantori Tri Nugroho, Farah Wardatul Zanah	139
Physics Education	[ABS-52] Guided inquiry based on online learning solutions during the covid-19 pandemic to optimize understanding of vibration and wave matter Syelvy Erine Mustika (a*), Hena Dian Ayu (b), Akhmad Jufriadi (b)	140

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Physics Education	[ABS-57] Hybrid Project Based Learning: Implications for critical thinking skills and Information Comunication Of Technologye Ahmad Muttaqin, Hena Dian Ayu, Akhmad Jufriadi	141
Physics Education	[ABS-159] Application of GUI Matlab in Physics: Planetary Motion (Keplers Law) Lasmita Sari1, Nhela Guspita2 dan Wahyu Srigutomo2, Irma.F.Amalia1, Rizal Adimayuda1	142
Robotic and ga	me teaching in elementary school	
Robotic and Game Teaching in Elementary School	[ABS-3] Teaching Analog Line-Follower (LF) Robot Concept Through Simulation for Elementary Students Fauziyah Rhaudhatul Jannah, Syifaul Fuada, Hafiziani Eka Putri, Farah Wardatul Zannah, Winda Pratiwi	143
Robotic and Game Teaching in Elementary School	[ABS-48] Research on the Development of Edu Games as Learning Media for Geometry and Arithmetic in Elementary School Children 1)Taufik Ridwan, 2)Endang Hidayat, 3)Rizki Hikmawan, 4)Aldi Yasin	144
Robotic and Game Teaching in Elementary School	[ABS-124] THE DEVELOPMENT OF ROBOTIC-BASED LEARNING MEDIA IN IMPROVING CRITICAL THINKING ABILITIES AND LEARNING OUTCOMES OF ELEMENTARY STUDENTS Widdy Sukma Nugraha (a*), Dea Pujiasti (b), Muhammad Nurjamaludin (b), Abdul Hakim (b)	145
Robotic and Game Teaching in Elementary School	[ABS-136] FIRE SAFETY EDUCATION FOR ELEMENTARY SCHOOL STUDENTS (Development of Learning Tools on Fire Hazard and Self-Rescue Materials) Jafar Amiruddin, Rizky Aferdiansyah, Ratu Amilia A.	146
Robotic and Game Teaching in	[ABS-137] THE EFFECT OF "DOMINO AND HAPPY" GAME MEDIA ON THE ABILITY TO UNDERSTAND THE BASIC	147

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Elementary School	CONCEPT OF MULTIPLICATION Neni Nadiroti Muslihah , Ejen Jenal Mutaqin , Risma Nuriyanti , Resti Wahyuni	Ø
Robotic and Game Teaching in Elementary School	[ABS-157] THE USE OF TALKING TOYS IN REDUCING THE COGNITIVE LOADS OF ELEMENTARY SCHOOL STUDENTS IN SCIENCE LEARNING Widdy Sukma Nugraha (a*), Eko Fajar Suryaningrat(b), Yenni Indriyanti Widyaningsih (b), Tetep (b)	148
Science Teachir	ng Kit	
Science Teaching Kit	[ABS-18] The Effect of Using Digital Variety Media on Distance Learning on Increasing Digital Literacy in Grade 2 Students of SDIT Cendekia Dr. Agus Muharam, M.Pd., Wina Mustikaati, S.Pd., M.Pd., Aprilia Sanny, Fitri Yani, Kikit Wiriyanti	149
Science Teaching Kit	[ABS-19] Implementation of the 4Cs-Based Tahfizh Favorite Program at The SDIT Cendekia Purwakarta Dr. Agus Muharam, M.Pd., Wina Mustikaati, S.Pd., M.Pd., Aprilia Sanny, Fitri Yani, Kikit Wiriyanti	150
Science Teaching Kit	[ABS-28] EFFECTIVENESS OF PHYSICAL EDUCATION EVALUATION USING INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) Rizal Ahmad Fauzi (a*), Respati Mulyanto (a), Indra Safari (a), Yogi Akin (a), Tedi Supriyadi (a)	151
Science Teaching Kit	[ABS-29] THE USE OF SMARTPHONE'S SPORT MOTION ANALYSIS APPLICATION IN IMPROVING ROUND-OFF AND BACK EXTENSION LEARNING RESULT Rizal Ahmad Fauzi (a*), Anin Rukmana (a), Indra Safari (a), Dewi Susilawati (a), Tedi Supriyadi (a)	152
Science Teaching Kit	[ABS-35] Introducing SFH (STEM From Home) through Webinar Program: A Descriptive Study	153

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
	Yeni Yuniarti, Novi Yanthi, Hana Yunansah, Dede Trie Kurniawan, RR Sukardi	
Science Teaching Kit	[ABS-40] Preliminary Design of Simple IoT-based Smart Home Trainer for Kids Syifaul Fuada, Hendriyana, Hafiziani Eka Putri, Jennyta Caturiasari, Fauziyah Rhaudhatul Jannah	154
Science Teaching Kit	[ABS-68] Reduce, Reuse, and Recycle (3R) Waste Activities in the School Environment for Elementary School Students Rudiyanto, Euis Kurniati, Andhin Dyas Fitriani, Ira Rengganis, Mirawati, Risty Justicia	155
Science Teaching Kit	[ABS-72] STUDENTS' COMMUNICATION COMPETENCE AT SCIENCE LEARNING Sri Wuryastuti, Tatang Suratno, Rista Nurfilaily	156
Science Teaching Kit	[ABS-74] Analysis of 2010-2019 Trends of Environmental Awareness Publication Using VOSviewer Application Asep Kurnia Jayadinata (1*), Kama Abdul Hakam (2), Achmad Munandar (3), Herman Subarjah (4), J.Julia (1), Tedi Supriyadi (5).	157
Science Teaching Kit	[ABS-101] Suitability Analysis of Textbook with 2013 Curriculum T R Anggraini (a*), F M Rachmasisca (b), and Hastuti(c)	159
Science Teaching Kit	[ABS-104] Local Culture Based-Learning Media Development with Prezi Application in Elementary School Supriyono (a*), Ambyah Harjanto (b), Putut Wisnu Kurniawan (c), Connyta Elvadola (d)	160
Science Teaching Kit	[ABS-105] Virtual Scuba Diving Activities for Elementary Student to Enhance Their Ocean Literacy Ferry Dwi Cahyadi*, Daniel Julianto Tarigan, Agung Setyo Sasongko, Kukuh Prakoso, Kukuh Widiyanto	161

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page
Science Teaching Kit	[ABS-106] Coastal Environmental Education: Plastic Pollution Awareness at Elementary Student Kebon, Kasemen District, Serang City, Banten Daniel Julianto Tarigan, Agung Setyo Sasongko, Ferry Dwi Cahyadi, Kukuh Prakoso, Kukuh Widiyanto	162
Science Teaching Kit	[ABS-107] The Needs Analysis of Social Science Instructional Materials Based Lampung Culture for Elementary School Yulia Siska (a*), Ambyah Harjanto (b), Deri Ciciria (c)	163
Science Teaching Kit	[ABS-112] The Development of Modular Object Oriented Dynamic Learning Environment (Moodle) on Writing Lesson in Elementary School Dian Indihadi	164
Science Teaching Kit	[ABS-125] IMPLMENTATION OF MOTOR COGNITIVE COORDINATION TRAINING PROGRAM TO WORKING MEMORY M R Sentani (a*), Y Akin (a) , A R Kurniawan (b)	165
Science Teaching Kit	[ABS-142] STEM and The Telly: What Kids Watch to Learn STEM Novi Yanthi a*), Hana Yunansah a), Margaretha Sri Yuliariatiningsih, a), Rendi Restiana Sukardi a)	166
Science Teaching Kit	[ABS-161] The influence of inquiry learning models on primary students activity in science lesson at Rancabango Garut Tati Kristianti, Rohani, Lutfi Asyari, Tetep, Sabrina Dewi Septiani	167
Science Teaching Kit	[ABS-178] Ethnoscience-based Science Learning in Elementary Schools Suryanti*, Binar Kurnia Prahani, Wahono Widodo, Mintohari, Farida Istianah, Julianto, Yoyok Yermiandhoko	168
Science Teaching Kit	[ABS-188] Science Learning by Applying Actively Planting During the Pandemic to Improve the character of love the environment for students of Elementary School	169

The 2nd Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools

Торіс	Title	Page	~
	Farida Istianah, Ika Rahmawati, Suryanti, Mintohari, Julianto, Delia Indrawati, Neni Mariana		
		T	$ \land $

Tab	le	of	cor	nter	nts

Volume 1987 2021

Previous issue
 Next issue

Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools (SAMSES) 2020, 8 October 2020, Jawa Barat, Indonesia

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Preface			
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Preface			
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Peer review decla	aration		
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Computer-base	ed learning		
OPEN ACCESS Preliminary desig support extracurr	n of an Android-I ricular program ir	based Voltage Divider Calculator to elementary school	012001
S Fauzi, S Fuada, N	T A Sari and T Ema	niar	
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Development of c schools using wh PGRI Lubuklingga	digital mathemati iiteboard animati au	cs teaching materials in elementary on for primary teacher education students ST	ΓΚΙΡ
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development for digital learning materials for traditional Indonesian of Palembang)	cloth (Songket
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D P Dewi, S Fuada, P T Nugroho, Z Kholidatuzzahra and D Afionita	
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R Muhammad, H Hendriyana, M I Ardimansyah and Y F Furnamasari	
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In-service teachers' perception on implementing realistic mathematics education approach in their best practices

N Mariana^{1,*}, S A Sholihah¹, R Riski², I Rahmawati¹, W Wiryanto¹, D Indrawati¹ and B Budiyono¹

¹ Elementary School Teacher Education, Universitas Negeri Surabaya, Indonesia ² SDN Sidotopo I/48, Surabaya, Indonesia

*nenimariana@unesa.ac.id

Abstract. This paper aims to portray elementary teachers' perception of implementing the Realistic Mathematics Education (RME) approach in their best practice after training in a series of RME workshops. The perceptions captured in the study include (1) teachers' confidence in understanding RME and its implementation in their best practices; (2) RME criteria, which teachers found most challenging during the planning and the implementation. The subject of this study is 296 elementary teachers who have attended the training. The workshop series provided RME materials, simulation during the workshop, implementation in teachers' best practices, and the workshop to discuss their experience. There are two findings in this study. Firstly, most teachers have a better understanding of RME characteristics. However, most teacher believe that the RME approach in their best practices. Secondly, teachers found that the most challenging when planned the RME lesson was finding suitable media related to mathematics topics. Moreover, during the implementation, teachers found it most challenging to lead students to formal mathematics. These results suggest that the most impactful workshop is better, followed by best practices and participants' reflection afterward.

1. Introduction

One of the mathematics education problems in Indonesia is the teachers use conventional learning such as explaining and solving mathematics problems based on the previously given formula, while students simply copy their teacher's solution and strategy and remain passive [1]. Teachers need to increase knowledge competencies to teach mathematics learning especially in primary school. If teachers cannot be able to develop the initial mathematics ability of students in primary school level, that will affect students' daily life and career in the future [2]. Therefore, mathematics teachers in elementary school need to bring contextual learning in the class with an approach such as Realistic Mathematics Education (RME).

RME initially comes from the Netherlands and a Freudenthal's fundamental idea to theorize "mathematics as a human activity" [3]. Realistic Mathematics Education (RME) is an approach in teaching children mathematics, in which the teacher designs series of mathematical activities as an educational task [4]. Within the task, the teacher sets learning goals including mathematical goals and social norm goals. Treffers [5] mentions that the goals set base on pedagogical theories and are written in detail mathematics instructions. In the classroom, the principles of RME are that students should be active to revitalize mathematical concept and the learning process must be interactive.

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According to Treffers [6], there are three principles of RME which are guided reinvention and progressive mathematizing, didactical phenomenology, and self-developed models. Guided reinvention comes from the philosophy of the emergence of mathematics concepts developed gradually. Freudenthal believed that by nature mathematics is progressively rediscovery [7]. Then, mathematics in the classroom can be moved progressively too, from informal students' knowledge to formal mathematics. Phenomenon surrounding the children as contextual mathematics problems can be explored during the lesson. It is called didactical phenomenology. After the phenomenology exploration, children need to develop model of the situation to the model for solving the problem shown as self-developed models. In order to implement these three principles of RME, the role of teachers is essential to guide students throughout the learning process in each principle.

The process of guided reinvention and progressive mathematizing in the classroom lead by the teacher by posing guiding questions. As a consequence, the teacher should be able to arrange questions during planning the lesson to help students finding the concept. Moreover, during the lesson the teacher can ask the guided questions to help them finding the correct answer without blaming even though students' answers are out of the teacher's expectation. In short, the teacher should be able to refrain from giving the correct answers directly to lead students to move to formal mathematics.

Meanwhile, the didactical phenomenology requires teachers to find relevant contextual situation suitable for children. By the contextual situation, they create contextual mathematical problem to start the learning. Then, teachers need to think about mathematical modelling and design a continues series of mathematics activities. To help students move from *model of* to *model for* [8], teachers determine suitable media for the series of activities. Gravemeijer [9] called this as the emergent models which may foster the movement from informal to formal mathematics.

The roles of teachers in implementing three principles of RME needs to train in the series of workshop. Since RME has been adopted in Indonesia in 2001 and now it has been two decades of its dissemination [10], many workshops for Indonesian teachers have been done. Many research has been conducted as well to examine how far Indonesian teachers' ability in the implementation. A study conducted by Yilmaz [11] examines the competencies of prospective elementary teachers in posing contextual problems with open-ended questions suitable to RME. Another attempt of study on preservice teachers shows that a model of Campus-School (CS) in which teacher students get trained of RME approach on campus and implement it at school enabled teacher students to enhance their pedagogical ability in mathematics teaching. Moreover, there was a study on in-service teachers' ability in using social norms within RME approach after series of workshops [12]. However, there is no study yet examining in-service teachers' perception of RME and portraying their understanding and struggles in implementing RME after series of workshops.

Therefore, in general, this paper aims to elementary teachers' perception of implementing the Realistic Mathematics Education (RME) approach in their best practice after training in a series of RME workshops. The perceptions captured in the study (1) include teacher's confidence in understanding RME and its implementation in their best practices; and (2) RME criteria which teachers found most challenging during the planning and the implementation. The workshop series provided RME materials, simulation during the workshop, teachers implementing in their best practice, and the workshop to discuss their experiences.

2. Methods

We conducted a series of workshops for Surabaya elementary teachers. The workshops were held in respective three weeks. One-week workshop provided examples of RME implementation. We let the participants designed and implemented the lessons with RME approach in the second week. Then, we met again in the third week to discuss their best practices and conducted a reflective survey. We randomly selected one teacher as the workshop participants to be the sample of this study. The subject of this study was 296 elementary school teachers attending the workshop series and following the implementation of RME in their best practices.

On the last day of the workshops, we distributed a questionnaire through a Google Form link to gather the survey data. Two sets of questions were respectively created to excavate teachers' confidents in understanding concepts of RME and its implementation in their best practices and to perform teachers' most challenging criteria of RME during the lesson planning and its implementation. The first set of questions are: (1) which statements below are you understand as the characteristics of RME? (2) How confident are you in implementing all RME characteristics during the best practices?, (3) Do you think all mathematical concepts can be taught using an RME approach?, (4) Is the RME approach suitable for thematic curriculum in elementary school?. The first question requires multiple answers, with all answers provided right. Meanwhile other questions in this first set require only one answer. The second set of questions are: (1) During your lesson planning, which parts of RME criteria you found challenging to accommodate? and (2) During the implementation, which RME criteria you face difficult to capture in your lesson?

The data was presented using graphs and diagrams. Then, we qualitatively analyzed the data by interpreting it descriptively to discuss the coherency of the findings with existing theories and other previous research. We described the data based on the following topics regarding the aims of the research:

- Teachers' confidence in understanding RME and its implementation in their best practices, and
- RME criteria which teachers found most challenging during the planning and the implementation.

3. Results and discussion

3.1. Teachers' confidence in understanding RME and its implementation in their best practices

As mentioned in the method section, in order to excavate teachers' confidents in understanding RME and its implementation in their best practices we posted multiple answers with all provided right answers. The finding shows only 120 of 296 participants responded to all right answers and others leave some unchosen. It means that less than a half of teacher participants have a better understanding on RME concepts.

Whilst asking how confident they are in implementing all characteristics of RME in their best practices, we used Likert scale from 1 to 4 to represent respectively the mostly unsure to mostly sure of the confident. The results were captured in the following bar chart.



Figure 1. Teachers' confidence to implement RME.

The bar chart from Figure 1 shows no teachers felt very unsure and only 3.7% of teachers felt unsure that they have implemented all RME characteristics during their best practices, whereas others are confident enough to say yes they do implement all the RME characteristics. In other words, most teachers felt confident during the implementation that they have done RME approach in their mathematics class and following all its criteria.

The data demonstrates that after the workshops less than a half of the participants have a better understanding on RME characteristics. However, more than a half of them believe that most mathematical topics can be taught by the RME approach and feel confident that they have implemented RME approach in their best practices. The RME characteristics that already given in this workshop are;

(1) real world context, (2) guided discovery, (3) a shift from informal mathematics to formal mathematics, (4) start from realistic problems, (5) use modelling, (6) created a fun learning. This theory is suggest by Clements (3) that main characteristics of RME include the development of model which lets the transformation happen from contextual to formal mathematics, the application of meaningful context, the interaction between teacher and students, the perception of mathematics as an integrated subject, and the reaction of mathematics concepts by the students. The most teachers understanding about RME characteristics is to create a fun learning.

The one of purpose RME is to change mathematics learning into meaningful and more fun for students by developing them into problems within context [8]. RME starts to take problems from around the society of the students. Then the teachers will help the students solve the contextual issues. This problem-solving activity is believed to give positive impact to students' cognitive achievement especially in their ability for understanding mathematics [13]. Dealing with contextual problems is the best way to teach mathematics.

Other findings portray how many teachers reckon all mathematical concepts can be taught using RME as an approach and the approach is suitable within a thematic curriculum in elementary school. The results were shown in these respectively two pie charts in Figure 2 and Figure 3.



Figure 2. Teachers respond about coherent between RME and mathematics concept.



Figure 3. Teachers respond about coherent between RME and thematic curriculum.

3.2. *RME criteria which teachers found most challenging during the planning and the implementation* The study tries to look for teachers' struggles during the RME lesson planning and its implementation. We reach the aims by asking these two questions. The first question is about the teachers' difficulties while design RME lesson planning. The results were shown in figure 4 below.

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Figure 4. The teachers' difficulties when designed RME lesson planning.

The pie chat illustrates that the most teachers' difficulties while designed RME lesson planning were to find suitable media for activities and mathematics learning (23,3%), changing informal mathematics to formal mathematics (18,6%), and both finding relevant contextual situation and designing a continue series for mathematics learning, each has the same percentage 12,8%. The theory suggests by Fry, Ketteridge, and Marshall [14] that media have function as mediator between learning context and students. Therefore, media is a tool for delivering messages and the materials in RME learning. The teachers should be innovative at choosing proper media in RME learning because it has the biggest affect for elementary students to understand the abstract concepts.

Furthermore, teachers found challenges in changing informal mathematics to formal mathematics. In the RME theory, this movement called vertical mathematization (3). Vertical mathematization is a shifting process involving symbolizing from model of to model for. In other words, Pinero Charlo [15] stated its focus on mathematical processing. It requires teachers to master the mathematical concepts, and teachers have to capable in making innovation in their teaching practices [16].



Figure 5. The teachers' difficulties when implementation RME learning.

Figure 5 presents the most teachers' difficulties when implementation RME learning was leading students to formal mathematics (23,3%). Brendefur et al. [17] argue that teachers' struggles happened because it demands on teacher's deeper knowledge in mathematics and students' thinking. Moreover, leading students to formal mathematics is a part of RME characteristics called guided reinvention, in which the teachers help students to move from their representations to abstract or symbolized mathematics. At least there two roles teachers must fulfil in such level, understanding mathematics behind students' representations and bringing such understandings into proper formal knowledge by guided questioning [18].

Posing guided questions apparently is another struggle as well even though it does not have major percentage in the chart. Nevertheless, we can interpret its relation to the second biggest percentage, namely teachers refrain from giving the correct answer directly. Demonstrating and providing direct correct answers are simpler for teachers than coming up with various questions in mind to respond to students' unexpected answers. The finding is in line with Franke et al. [19] conclusion from their research that teachers are struggle with following up students' ideas. In the study, although teachers can come up with a question such as "how did you get that?", they were not really assured whether following questions could help constructing students' further understanding.

4. Conclusion

In a nutshell, the findings and discussion capture teachers' perception in their understanding of RME and its implementation in their best practices after series of workshops. The workshop series provided RME materials, simulation during the workshop, teachers implementing in their best practice, and the workshop to discuss their experiences. The data demonstrate teachers' confidences is higher that their understandings of RME characteristics. It makes them believe that they have implemented the RME approach well during their best practices in the second week. However, they confessed that they did find difficulties during the implementation.

Teachers struggled to apply some principles of RME during the planning stage in designing mathematics activities and during the lesson. When planning the lesson, teachers found it most challenging in finding suitable media which can help students to do vertical mathematization. It affected their teaching practices, they also found problematic in doing guided reinvention because they barely told students the correct answer directly when they made mistakes.

These results suggest that the most impactful workshop is better, followed by best practices and participants' reflection afterward. However, further workshop should be conducted to train teachers in understanding students' ideas and posing proper guided questions.

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