

**PROCEEDINGS**  
**4<sup>th</sup> International Conference on Technical  
and Vocational Education and Training (TVET)**

**Theme:**  
**Technical and Vocational Education and Training  
for Sustainable Societies**

**Padang, November 9-11, 2017  
at Hospitality Center  
Universitas Negeri Padang**

**ISBN : 978-602-1178-21-8 (1)**



# **PROCEEDINGS**

## **4<sup>th</sup> International Conference on Technical and Vocational Education and Training (TVET)**

**Theme: Technical and Vocational Education and Training for Sustainable Societies**

### **General Chair:**

- Prof. Ganefri, Ph.D. (Rector Universitas Negeri Padang)

### **Program Committee Chair:**

- Dr. Fahmi Rizal, M.Pd., M.T. (Dean Fakultas Teknik Universitas Negeri Padang)

### **Steering Committee:**

- Prof. Dr. Nizwardi Jalinus, M.Ed. (Universitas Negeri Padang, Indonesia)
- Prof. Dr. Ali Ghuftron Mukti, M.Sc., Ph.D. (Direktorat Jenderal Sumber Daya Ilmu Pengetahuan Teknologi Pendidikan Tinggi Kementerian RISTEKDIKTI)
- Prof. Dr. David Stein, Ph.D. (OHIO State University, USA)
- Prof. Junji Kiyono (Tottori University, Japan)
- Prof. Maizam Alias, Ph.D. (UTHM, Malaysia)
- Prof. John Williamson, Ph.D. (University of Tasmania, Australia)
- Prof. Selamat Triono Ahmad, Ph.D. (Universitas Negeri Medan, Indonesia)
- Dr. Rijal Abdullah, M.T. (Universitas Negeri Padang, Indonesia)
- Drs. Hambali, M.Kes. (Universitas Negeri Padang, Indonesia)
- Drs. Hanesman, MM. (Universitas Negeri Padang, Indonesia)
- Dr. Ir. Arwizet K, ST., MT. (Universitas Negeri Padang, Indonesia)
- Drs. Martias, M.Pd. (Universitas Negeri Padang, Indonesia)
- Drs. Raimon Kopa, MT. (Universitas Negeri Padang, Indonesia)

### **Scientific Committee:**

- Prof. Sai Vanappali (University of Ottawa, Canada)
- Prof. Junji Kiyono (Tottori University, Japan)
- Prof. Maizam Alias, Ph.D. (UTHM, Malaysia)
- Prof. Jailani Mhd. Junos, Ph.D. (UTHM, Malaysia)
- Prof. Dr. Nizwardi Jalinus, M.Ed. (Universitas Negeri Padang, Indonesia)
- Ir. Syahril, ST., MSCE., Ph.D. (Universitas Negeri Padang, Indonesia)
- Prof. Dr. Kasman Rukun, M.Pd. (Universitas Negeri Padang, Indonesia)
- Prof. Dr. Ing. I Made Londen B (Institut Teknologi Sepuluh November Surabaya)

### **Reviewer:**

- Prof. Dr. Nizwardi Jalinus, M.Ed. (Universitas Negeri Padang, Indonesia)
- Dr. Hansi Effendi, ST. M.Kom. (Universitas Negeri Padang, Indonesia)

- Rusnardi Rahmat Putra, ST., MT., Ph.D. (Universitas Negeri Padang, Indonesia)
- Ir. Riki Mukhayar, ST. M.T. Ph.D. (Universitas Negeri Padang, Indonesia)
- Risfendra, S. Pd. MT., Ph.D. (Universitas Negeri Padang, Indonesia)
- Krismadinata, ST. MT. Ph.D. (Universitas Negeri Padang, Indonesia)
- Dr. Asrul Huda, S. Kom. M.Kom.(Universitas Negeri Padang, Indonesia)
- Dr. Remon Lapisa, MT. M.Sc. M.Eng. (Universitas Negeri Padang, Indonesia)
- Wawan Purwanto, S.Pd. M.T., Ph.D. (Universitas Negeri Padang, Indonesia)

**Editor:**

- Prof. Dr. Nizwardi Jalinus, M. Ed. (Universitas Negeri Padang, Indonesia)
- Prof. Dr.Kongkiti Phusavat (Kasetsart University, Thailand)
- Prof. Maizam Alias, Ph.D. (UTHM, Malaysia)
- Prof. Dr. Ramlee Bin Musthafa (Universiti Pendidikan Sultan Idris Malaysia)
- Prof. Dr. Michael Koh, Ph.D. (Republic Politecnic Singapore)
- Krismadinata, ST., MT., Ph.D. (Universitas Negeri Padang, Indonesia)

**Cover Design:**

- Dr. Asrul Huda, S.Kom., M.Kom (Universitas Negeri Padang, Indonesia)

**Layout:**

- Dr. Remon Lapisa, MT., M.Sc. M.Eng (Universitas Negeri Padang, Indonesia)
- Rahmat Azis Nabawi, S.Pd., M.Pd.T.(Universitas Negeri Padang, Indonesia)
- Syaiful Islami, S.Pd., M.Pd.T.(Universitas Negeri Padang, Indonesia)

**Cetakan :**

- Kesatu, Agustus 2018

**Publisher:**

**UNP PRESS**

Jln. Prof. Dr. Hamka Air Tawar Padang  
West Sumatra – Indonesia



ISBN 978-602-1178-21-8 (1)



## FOREWORD

Welcome for all respected scholars, researchers, post graduate students and especially Keynote Speakers to the 4 ICTVET. The theme of the conference focus on Technical and Vocational Education and Training for sustainable societies and consist of six subthemes. i.e Development of learning model on TVET, Workplace Learning and entrepreneurship, Innovation on applied engineering and information technology, Management and Leadership on TVET, Vocational and Technical Teachers education, and Assessment and Evaluation on TVET.

Sustainable society should be followed by the improvement of various factors that have impacts to the quality of vocational and technical education and training, particularly to overcome the competitiveness of the world business. As we have already known the rapid change of technology as well as the change of demography, having a great effects to the life of peoples in this world, The competitiveness need a collaborativeness to survive the life of millions peoples who lost their jobs. Young peoples as a productive generation have to be creative and innovative to face the competitiveness. So this proceeding contents consist of various findings of research in the field of vocational and technical education as well as applied technology and mainly based on the subthemes of the conference.

Finally, we would like to thank a million for all participants of this conference and all parties who support the success of this conference. Hopefully the seminars and scientific work of this seminar can be a reference material for basic education and elementary school teacher education in Indonesia.

Padang, July 2, 2018

Tim Editor

## CONTENT PROSIDING ICTVET 2017 REPOSITORY UNP

1. THE PROSPECT OF OFFSHORE IRON SAND IN TIRAM BEACH PADANG PARIAMAN REGENCY WEST SUMATERA Adree Octova, Ansosry, Yoszi Mingsi Anaperta and Indah Elok Mukhlisah.....	1-7
2. OPTIMIZE OF LEAST-SQUARE INVERSE CONSTRAIN METHOD OF GEOELECTRICAL RESISTIVITY WENNER-SCHLUMBERGER FOR INVESTIGATION ROCK STRUCTURES IN MALALAK DISTRICTS OF AGAM WEST SUMATRA Akman, Amir Harman, Putra Amali.....	8-13
3. CLUSTER ANALYSIS DISTANCE INTER DISTRICT USING SINGLE LINKAGE METHOD FOR DETERMINATION OF MPLIK CAR OPERATION ZONE IN MEDAN CITY Ali Ikhwan, Yasmin Mohd Yacob, Solly Aryza .....	14-16
4. EFFECT OF MIND MAPPING LEARNING METHODS ON LEARNING OUTCOMES Almasri .....	17-21
5. DESIGN OF SKILL ASSESMENT IN COMPUTER NUMERICAL CONTROL PROGRAMMING SUBJECT Ambiyar, Febri Prasetya, Yufrizal.....	22-26
6. MODIFICATION OF INPUT PUSHER ASSEMBLY OF LASER MARKING MACHINE Arif Rahman Hakim .....	27-34
7. COLLABORATIVE PROJECT-BASED LEARNING: AN INSTRUCTIONAL DESIGN MODEL IN THERMODYNAMICS ON TECHNICAL VOCATIONAL EDUCATION AND TRAINING (TVET) Arwizet K, Nizwardi Jalinus, Krismadinata.....	35-39
8. DEVELOPMENT OF EMPLOYEE INFORMATION SYSTEM-BASED WEB IN MAN 1 PADANG Asrul Huda, Rendy Harisca.....	40-46
9. DECISION SUPPORT SYSTEM (DSS) WITH WP AND MFEP METHODS IN SELECTION OF BEST BABY CLOTHES Asyahri Hadi Nasyuha, Rahmat Sulaiman Naibaho, Saniman.....	47-53
10. IMPROVING LEARNING MOTIVATION THROUGH IMPLEMENTATION PROBLEM SOLVING LEARNING STRATEGY Budi Syahri, Primawati, Syahrial .....	54-58
11. THE MODELING OF MASSIVE LIMESTONE USING INDICATOR KRIGING METHOD (CASE STUDIES OF MASSIVE LIMESTONE IN PT SINAR ASIA FORTUNA) Dedi Yulhendra, Yoszi Mingsi Anaperta .....	59-65
12. ELECTRONIC COMPONENT TESTER AS A LEARNING MEDIA FOR CLASS X STUDENTS AUDIO VIDEO ENGINEERING SMKN 1 SUMBAR Delsina Faiza, Thamrin, Ahmaddul Hadi, Yongki Saputra.....	66-74

13. EFFECTIVENESS OF INTERACTIVE INSTRUCTIONAL MEDIA ON ELECTRICAL CIRCUITS COURSE: THE EFFECTS ON STUDENTS COGNITIVE ABILITIES Doni Tri Putra Yanto, Sukardi, Deno Puyada .....	75-80
14. EVALUATION OF LEARNING PROCESS USING CIPP MODEL Dwi Sudarno Putra, Misra Dandi Utama, Dedi Setiawan, Remon Lapisa, Ambiyar .....	81-86
15. IMPLEMENTATION OF CONTEXTUAL TEACHING AND LEARNING ON ANALYZING ELECTRICAL CIRCUITS SUBJECT Dwiprima Elvanny Myori, Citra Dewi, Erita Astrid, Ilham Juliwardi .....	87-91
16. DOMESTIC EMPLOYMENT PROCESSING SYSTEM ON WORKING PROTECTION AND TRANSMIGRATION USING GEOGRAPHIC INFORMATION SYSTEM (GIS) Eddis Syahputra Pane, Kori Cahyono .....	92-98
17. CONDUCTING LABOR MARKET ASSESSMENT IN ENGINEERING CURRICULUM DEVELOPMENT Edi Septe, Suryadimal, Wenny Marthiana, Nizwardi Jalinus, Ramli.....	99-105
18. DIFFERENCES IN LEARNING OUTCOMES IN THE PRACTICE OF MICROCONTROLLER SYSTEM USING MCS51 MICROCONTROLLER TRAINER KIT Edidas, Dedy Irfan.....	106-108
19. MICROCONTROLLER SKILL TRAINING FOR SMKN 2 PAYAKUMBUH AND SMKN 1 SUNGAI RUMBAI Edidas, Legiman Slamet and Ilmiyati Rahmy Jasril.....	109-113
20. THE EFFECT OF ISLAMIC WORK ETHICS AND SPRITUAL LEADERSHIP ON EMPLOYEE'S COMMITMEN IN PADANG SHARIA HOTELS Eka Mariyanti, Rasidah Nasrah.....	114-120
21. THE DESIGNING OF THE PROTOTYPE OF THE AIR QUALITY MEASURING HELMET Eko Hariyanto, Solly Ariza Lubis, Zulham Sitorus, M. Iqbal.....	121-124
22. REVIEW DEVELOPING OF PROJECT BASED AS INNOVATION INSTRUCTIONAL Eko Indrawan .....	125-130
23. IMPROVING THE ESP STUDENTS' VOCABULARY BY USING PICTURES IN CIVIL ENGINEERING STUDY PROGRAM AT FIRST SEMESTER OF EKASAKTI UNIVERSITY PADANG Elda Martha Suri.....	131-133
24. INTEGRATED SERVICES SYSTEMS ELECTRONIC DEVELOPMENT FACULTY OF ENGINEERING PADANG STATE UNIVERSITY BASED ON JAVA DESKTOP Elfi Tasrif, Asrul Huda.....	134-137
25. THE EFFECT OF STRATEGY OF TRAINING MODELS IN LEARNING ELECTRICAL INSTALLATION Elfizon, Syamsuarnis, Oriza Candra.....	138-141

26. SOFTWARE DEVELOPMENT OF CONCENTRATION SELECTION WITH INTEREST TEST BASED ON INTELLIGENT SYSTEM Elin Haerani.....	142-149
27. NEEDS ANALYSIS ON INCREASING COMPETENCY TEST RESULTS STUDENTS IN S1 PROGRAM OF PUBLIC HEALTH SCIENCES STIKES HANG TUAH PEKANBARU Emy Leonita, Nopriadi, Ahmad Satria Efendi, and Niswardi Jalinus .....	150-155
28. THE READINESS OF STUDENT TO ENTREPRENEUR THROUGH INCORPORATION OF THE PILOT PROJECT PRACTICE Ernawati.....	156-161
29. EFFECT OF PROJECT BASED LEARNING MODEL IN IMPROVING STUDENT LEARNING RESULT Erwinsyah Simanungkalit.....	162-166
30. DESIGNING LEARNING TOOLS BY USING PROBLEM BASED INSTRUCTION (PBI) MODEL ON ENERGY RESOURCE MATERIAL INTEGRATED TO ENERGY SAVING CHARACTER Estuhono.....	167-170
31. THE DESIGN OF LECTURER PERFORMANCE EVALUATION MODEL BASED ON ANALYTIC NETWORK PROCESS (ANP) Fenny Purwani, Niswardi Jalinus, Ambiyar.....	171-175
32. DEVELOPMENT OF ONLINE EXAMINATION SYSTEM USING WONDERSHARE QUIZCREATOR BASED ON WEB Fitri Yanti, Rijal Abdullah, Krismadinata .....	176-180
33. THE VALIDITY OF TRAINING MATERIALS SCIENCE AND DEVICES SUBJECT AT DEPARTMENT OF ELECTRICAL ENGINEERING Fivia Eliza, Dwiprima Elvanny Myor, Hastuti.....	181-185
34. TRAINING MODEL-BASED KNOWLEDGE MANAGEMENT SYSTEM FOR VOCATIONAL HIGH SCHOOL TEACHERS SKILLS ENGINEERING COMPUTER NETWORK Gunawan Ali, Kasman Rukun, Syahril .....	186-193
35. FUZZY LOGIC BASED CONTROLLER FOR BUCK CONVERTER Habibullah, Irma Husnaini, Asnil.....	194-200
36. A NEW DESIGN OF HANDLESS STIRRED DEVICE Hanne Aulia, Riki Mukhaiyar .....	201-204
37. ACADEMIC INFORMATION SYSTEM OF STIKES PERINTIS PADANG Harleni, Marisa.....	205-209
38. DESIGN OF ELECTROMAGNETIC REGENERATIVE SHOCK ABSORBER AS A TOOL OF HARVESTING VIBRATION ENERGY ON VEHICLE Hasan Maksum, Aslimeri, Putra Jaya, Wanda Afnison.....	210-213

39. THE EFFECTIVENESS OF USING POSTER AND VIDEO MEDIA IN EDUCATION ABOUT DANGERS OF SMOKING ON KNOWLEDGE AND ATTITUDES OF SENIOR HIGH SCHOOL 12 PEKANBARU STUDENTS Hastuti Marlina, Reno Renaldi .....	214-217
40. A MODEL PREVENTIVE MAINTENANCE CONTROL IN THE MACHINE TURNING AT WORKSHOP THE FACULTY OF ENGINEERING OF THE STATE UNIVERSITY IN PADANG Hefri Hamid, Nizwardi Jalinus, Syahril, Ambiyar, Febri Prasetya .....	218-224
41. INVESTIGATION OF CHEMICAL FEASIBILITY AND DISTRIBUTION OF IRON SAND RESERVE REGIONAL AREA OF AGAM DISTRICT FOR CEMENT RAW MATERIAL IN PT. SEMEN PADANG Heri Prabowo, Sumarya.....	225-227
42. THE DEVELOPMENT OF INTERACTIVE MULTIMEDIA-BASED LEARNING MEDIA USING ADOBE FLASH CS3 AND CAMTASIA IN PROBLEM-SOLVING LEARNING IN ELEMENTARY MATHEMATICS OF IN STUDENT PGSD STKIP ADZKIA IN PADANG Ika Parma Dewi, Lativa Mursida, Rizkayeni Marta.....	228-235
43. ART EDUCATION THROUGH FREE EXPRESSION APPRECIATES, DISCIPLINE SCIENCE, AND MULTICULTURAL AS EFFORTS TO IMPROVE STUDENT CREATIVITY Indra Irawan .....	236-242
44. THE INFLUENCE OF USING ANIMATION MEDIA AND LEARNING MOTIVATION TOWARD LEARNING RESULT OF AUTOMOTIVE STUDENTS IN SMK N 2 PAYAKUMBUH Indra Wahyu, Fahmi Rizal, Rijal Abdullah.....	243-248
45. INFORMATION SYSTEM AND REPORT VALUE PROCESSING BASED MICROSOFT VISUAL BASIC 6.0 ON SENIOR HIGH SCHOOL (CASE STUDY AT SMAN 12 PADANG) Indra Wijaya, Isra Mouludi, Fandy Neta, Yaslinda Lizar, Satria Ami Marta .....	249-256
46. DESIGN OF SIMULATOR FOR REPLACEMENT OF TOOLS PRACTICE DIGITAL ENGINEERING IN THE VOCATIONAL SCHOOL Irwan Yusti, Ganefri, Ridwan .....	257-259
47. CELL ROTATION TO RESOLVE THE WEAKEST CELL DAMAGE IN THE BATTERY PACK IN DISCHARGING PROCESS Irwanto Zarma Putra, Citra Dewi .....	260-263
48. IMPROVEMENT OF CONCRETE QUALITY WITH ADDITION OF SUNUA PASIR PADANG PARIAMAN WEST SUMATRA Iskandar G. Rani, Widya Salmita.....	264-268
49. SIMPLE WATER PURIFIER USING MULTILEVEL SYSTEM Jasman, Nelvi Erizon, Syahrul, Junil Adri, Bulkia Rahim .....	269-272



50. DESIGN OF LIBRARY INFORMATION SYSTEM USING BARCODE ON SMAN 1 SOLOK CITY Jeprimansyah .....	273-280
51. THE DESIGN OF THE SIGNAL MEASUREMENT DEVICE OF BODY'S BIOELECTRICAL IMPEDANCE By USING THREE ELECTRODES Juli Sardi, Hastuti, Ali Basrah Pulungan .....	281-286
52. PATIENT INFORMATION SYSTEM DESIGN ON MATERNITY HOSPITAL RESTU IBU PADANG Jusmita Weriza .....	287-293
53. IDENTIFICATION THE IMPORTANCE OF LEARNING TOOLS DEVELOPMENT ON ENERGY-EFFICIENT BUILDING INNOVATIONS USING ROOT CAUSE ANALYSIS Kemala Jeumpa .....	294-297
54. DECISION SUPPORT SYSTEM FOR REKOMENDATION CERTIFICATION TEACHER ON VOCATIONAL HIGH SCHOOL Khairul, Rahmad Budi Utomo.....	298-302
55. IMPACT OF THE TWI LEARNING MODEL IN LEARNING STONE AND CONCRETE CONSTRUCTIONS ON VOCATIONAL EDUCATION Kinanti Wijaya, Daniel IrvansiusTampubolon.....	303-307
56. THE EFFECT OF SOFTWARE MASTERCAME TOWARD MECHANICAL ENGINEERING STUDENTS PERFORMANCE IN MAKING PRODUCT WITH CNC MILLING MACHINE IN VOCATIONAL HIGH SCHOOL 1 PADANG Kms. Muhammad. Avrieldi, Suparno, Nofri Helmi.....	308-310
57. LEARNING BROADCAST VIDEO SYSTEM WITH H264 VIDEO ENCODING RASPBERRY PI Leni Marlina, Aswandi.....	311-315
58. OPTIMIZATION OF EXTERNAL LIGHTNING PROTECTION SYSTEM DESIGN IN BUILDING CENTER FOR INFORMATION TECHNOLOGY AND DATA BASE (PTIPD) UIN SUSKA RIAU Liliana, Afriani, Anwardi .....	316-322
59. A NEW MODEL MOBILE LEARNING MANAGEMENT SYSTEM BASED ON MOODLE IN UNIVERSITY Lita Sari Muchlis, Kasman Rukun, Krismadinata, Yahfizham .....	323-327
60. DEVELOPMENT OF MECHANICAL TECHNOLOGY LEARNING MODULE PROGRAM EXPERTISE OF SMK ENGINEERING M. Giatman, Waskito, Maruli Sihombing .....	328-332
61. SECURITY OF MEDICAL RECORD WITH RIVEST SHAMIR ADLEMAN (RSA) METHOD M.Syaifuddin, Ahmad Fitri Boy, Ali Ikhwan.....	333-336
62. RAHMATAN LIL ALAMIN, THE CONCEPT OF MULTICULTURAL EDUCATION Muh. Barid Nizarudin Wajdi, Achmad Fathoni Rodli .....	337-340

63. LESSON STUDY FOR IMPROVING A LEARNING QUALITY Muh. Barid Nizarudin Wajdi, Andi Mursidi .....	341-345
64. THE ROLE OF INFORMATION TECHNOLOGY IN THE IMPROVEMENT OF TEACHER’S COMPETENCIES AND TEACHING LEARNING PROCESS EFFECTIVENESS IN ESA SEJAHTERA SCHOOL PEKANBARU Muhammad Luthfi Hamzah, Hamzah, Astri Ayu Purwati .....	346-350
65. IMPLEMENTATION OF PROJECT BASED LEARNING MODEL IN COURSE WEB DESIGN Muhammad Sabir Ramadhan, Neni Mulyani, Muhammad Amin.....	351-357
66. MEASUREMENT MODEL OF CONTRIBUTED FACTOR AND INDICATOR TOWARDS VOCATIONAL EDUCATION PRODUCTIVITY Mulianti, Ambiyar, Generousdi and Rodesri Mulyadi .....	358-364
67. ORNAMENTS ON THE TRADITIONAL ACEHNESE HOUSE IN CENTRAL ACEH, ACEH PROVINCE N Novita, M Mukhirah, R Dewi, Fitriana, F Noer, F Fadillah, E Erni.....	365-368
68. DESIGNING STRATEGY MAPS FOR PRIVATE ENGINEERING COLLEGE Nanang Alamsyah, Larisang, Muhammad Ansyar Bora .....	369-376
69. DESIGN OF INTERACTIVE MEDIA INTERACTIVE EYE LESSONS FOR CLASS III SD N 04 BARINGIN PADANG CULTURAL CULTURAL FLOOR BASED ON MULTIMEDIA Nelda Azhar, Putra Jaya, Asrul Huda, Etika Fahmidyah .....	377-383
70. DEVELOPMENT OF MALAY FRUIT ORNAMENT Netty Juliana.....	384-387
71. THE CONTRIBUTIONS OF DISCIPLINE AND ENVIRONMENTAL KNOWLEDGE ON CLEAN BEHAVIOR OF STUDENTS IN PUBLIC ELEMENTARY SCHOOL KAMPUNG BARU PARIAMAN, WEST SUMATERA Nurhasan Syah, Sanny Edinov .....	388-393
72. ANALYSIS OF VOLUME AND STRONG CONCRETE IMPROVEMENT ON NON- SAND CONCRETE MIXED WITH ADDITION BAKING POWDER Nurmaidah .....	394-398
73. BRACING CROSS SECTION EFFECT TO DISSIPATION ENERGY BY NUMERICAL ANALYSIS Prima Zola, Rahmat, Fitra Rifwan .....	399-405
74. DEVELOPMENT OF MODEL OF PROPELLER-CROSS FLOW WATER TURBINE FOR PICO HYDRO POWER GENERATOR TITLE Purwantono, Refdinal, Hendri, Syahrul.....	406-408
75. THE POTENTIAL OF RENEWABLE ENERGY (STUDY CASE IN TOMUAN HOLBUNG VILLAGE, ASAHAN REGENCY OF SUMATERA UTARA PROVINCE) Rahmaniar, Agus Junaidi.....	409-413

76. VIRTUAL LAB IMPLEMENTATION QOS METAROUTER ON COMPUTER NETWORK LEARNING Raimon Efendi.....	414-418
77. BLASTING DESIGN DEVELOPMENT AREA DECLINE CIBITUNG AND CIKONENG UNDERGROUND MINE PT CIBALIUNG SUMBERDAYA BANTEN Raimon Kopa, Afdhal Husnuzan, Bambang Heriya.....	419-423
78. ANALYSIS OF LEARNING COMPETENCY ENGINEERING STUDENTS VOCATION D 3 FT UNP Ramli, Febri Prasetya .....	424-429
79. FACTORS AFFECTING THE AUTOMOTIVE ENGINEERING STUDENTS' INTEREST ON TEACHING PROFESSION Rasinov Chandra, Anggi Aprianto, Mawardi, Reza Rahmadani.....	430-435
80. AN EXPERIMENTAL STUDY ON THE EFFECT OF CENTRIFUGAL CLUTCH COOLING GROOVE ON MOTORCYCLE PERFORMANCE Remon Lapisa, Hendika Syahputra, Irma Yulia Basri, Rifdarmon, Hendra Dani Saputra	436-440
81. EXPERT MODEL SYSTEM ON ENTREPRENEURSHIP PERSONALITY Resmi Darni, Z. Mawardi Effendi and Selamat Triono.....	441-446
82. THE ANALYZED OF TAR AS WASTE MATERIAL OF BITUMINOUS COAL GASIFICATION BY USING GASCHROMATOGRAPHY Rijal Abdullah and Hengki Ade Satria .....	447-450
83. EMPLOYEE PRODUCTIVITY IN TWO CROSS CULTURES BASED ENTREPRENEURSHIP Riki Adriadi, Ganefri and Fahmi Rizal .....	451-455
84. DEVELOPMENT OF INTERACTIVE MULTIMEDIA CD OF INSTRUCTIONAL MEDIA ON BUILDING CONSTRUCTION Rizky Indra Utama, Nurhasan Syah, Rijal Abdullah.....	456-458
85. MULTIMEDIA INTERACTIVE IN WEB PROGRAMMING SUBJECTS Rusli Saputra, Sophan Sophian, Delia Putri.....	459-464
86. PREDICTED VULNERABILITY ASSESSMENT OF NON ENGINEERED HOUSES BASED ON DAMAGE DATA OF THE 2009 PADANG EARTHQUAKE IN PADANG CITY, INDONESIA Rusnardi Rahmat Putra, Junji Kiyono and Aiko Furukawa .....	465-472
87. TWO SPECIES OF TERMITE DAMAGING TO BUILDING AND HOUSES AT BANDA ACEH (SUMATRA, INDONESIA) S Syauckani, M Bahi, M Muslim, M Shabri Abd Majid, D Sutekad, Y Yasmin, N Novita	473-476
88. PERSONAL MANAGEMENT IN INFORMATION SYSTEMS APPLICATIONS WITH TOGAF FRAMEWORK Safrian Aswati, Saleh Malawat, Suhendra, Iskandar, Yessica Siagian, Arridha Zikra Syah	477-482

89. ANALYZING OF TECHNICAL CUTTING OF EMPTY PALM BUNCHES Safril, Dedi Wardianto.....	483-492
90. DESIGNING AND MANUFACTURE OF RADIUS PAJI HAIRERS (PAHAT RADIUS POST) ON LATHE MACHINE FOR LABORATORY AND MODULES TEACH Saiful Anwar, Rindi Genesa Hatika, B.Herawan Hayadi.....	493-498
91. MATERIAL SELECTION ANALYSIS AND MAGNET SKEWING TO REDUCE COGGING TORQUE IN PERMANENT MAGNET GENERATOR Sepannur Bandri, M. Aldi Tio.....	499-506
92. COMPARISON OF DECISION TREE ALGORITHM METHOD (C4.5) AND NAIVE BAYES TO IDENTIFY STUDENT LEARNING RESULTS WITH COOPERATIVE LEARNING MODEL Sri Restu Ningsih.....	507-511
93. ONLINE ASSESSMENT TOOLS FOR 2013 CURRICULUM BASE ON INFORMATION TECHNOLOGY Suartin, Hambali, Oriza Chandra .....	512-517
94. GAME BASED LEARNING TO IMPROVMENT TEACHERS KNOWLEDGE FOR TEACHING STRATEGY IN THE CLASS Suherman.....	518-523
95. LEARNING RESPONSE OF JOURNEY LEARNING COOPERATIV LEARNING AND LEARNING MODULE IN EDUCATION MEDIA LEVEL Suparno, Bulkia Rahim, Zonny Amanda Putra, Junil Adri, Jasman .....	524-528
96. NEED ANALYSIS APPLICATION ON THE FEASIBILITY STUDY OF THE HYDROELECTRIC POWER SELECTION (CASE IN SOLOK, PESISIR SELATAN AND SIJUNJUNG REGENCY) Suryadimal, Edi Septe, Wenny Martiana, Fahmi Rizal, Nizwardi Jalinus.....	529-534
97. DEVELOPING SOFT SKILLS LEARNING MODELFOR MECHANICAL ENGINEERING STUDENTS OF VOCATIONAL HIGH SCHOOL Suryo Hartanto .....	535-538
98. IMPACT OF WORK-BASED LEARNING OF CONCRETE STONE WORK PRACTICE ON DIPLOMA-III CIVIL ENGINEERING STUDENTS Syafiatun Siregar .....	539-543
99. DEVELOMPENT OF WEB-BASED DECISION SUPPORT SYSTEM FOR SCHOLARSHIP RECIPIENTS SELECTION USING ANALYTICAL HIERARCHY PROCESS (AHP) METHOD Titi Sriwahyuni, Dedi Irfan, Ika Pharma Dewi and Hanny Maharani.....	544-552
100. EFFECT OF ENGINE TEMPERATURE CHANGES ON INJECTION TIME OF FUEL AND GAS EMISSION OF GASOLINE ENGINE Toto Sugiarto, Dwi Sudarno Putra, Wawan Purwanto .....	553-557

101. EARTHQUAKE AND TSUNAMI DISASTER MITIGATION TRAINING FOR ELEMENTARY SCHOOL STUDENTS IN THE COASTAL AREA OF PADANG PARIAMAN DISTRICT WITH KYOTO INTERNATIONAL DISASTER PREVENTATION SCHOOL METHOD Totoh Andoyono, Fitra Rifwan, Revian Bodi, Prima Zola, Annisa Prita.....	558-560
102. FUNCTIONAL MEMBERSHIP ANALYSIS OF FUZZY INFERENCE SYSTEM SUGENO IN ANEMIA CLASSIFICATION Tri Monarita Johan .....	561-563
103. DEVELOPMENTAL OF MEDIA LEARNING BASED ON TUTORIAL VIDEO AT CHARACTER MAKE UP SUBJECT IN SMKN 6 TyasAsih Surya Mentari, MurniAstuti, and Linda Rosalina .....	564-570
104. PSYCHOLOGICAL FACTORS INFLUENCING THE DECISION MAKING OF PURCHASING PRODUCTS VIA ONLINE Ulfa Annida Damanik, Sri Wening .....	571-577
105. IMPROVING TEACHERS' PROFESIONALISM APPROPRIATE TO NEW CURRIRULUM 2017 FOR VOCATIONAL SCHOOLS BY CAPACITY BUILDING AND WORKSHOP ABOUT PREPARING LOCAL GOVERNMENT FINANCIAL STATEMENT; AN EXPERIMENTAL STUDY ON ACCOUNTING TEACHERS' FROM VOCATIONAL SCHOOLS IN WEST SUMATERA PROVINCE Vita Fitria Sari, Mayar Afriyenti, Mia Angelina Setiawan .....	578-585
106. THE DEVELOPMENT OF VIT (VOCATIONAL INTEREST TEST) MODEL USING DECISION SUPPORT SYSTEM (DSS) TECHNIQUE Vitriani.....	586-590
107. ANALYSING INFORMATION SYSTEM OF ACADEMIC SERVICES IN THE UNIVERSITY Wahyu Prima, Ganefri, Krismadinata .....	591-595
108. RESOURCE SHARING–BLENDED PROJECT BASED LEARNING (RS-BPBL©) MODEL DEVELOPMENT IN VOCATIONAL HIGH SCHOOL Wahyudi .....	596-602
109. DEVELOPMENT ASSESSMENT MODEL TO HIGH ORDER THINKING SKILL ORIENTATE FOR EVALUATION STUDENT COMPETENCY Wakhinuddin S, Bahrul Amin, Waskito.....	603-605
110. USE OF GEARBOX VIAR ON FISHING SHIPS Wakhinuddin S, Donny Fernandez, Andrizal, M Nasir, Rifdarmon .....	606-609
111. THE APPLICATION OF SIMPLE STRAIN GAUGE DYNAMOMETER IN LEARNING STYLE CUTTING LATHE Wenny Marthiana, Suryadimal, Edi Septe, Duskiardi, Andika.....	610-613
112. DESIGN OF ANDROID BASED INTERACTIVE BOOK IN INTEGRATED ISLAMIC ELEMENTATY SCHOOL OF LAN TABUR PAGARALAM CITY Yadi, Efan, Sigit Candra Setya.....	614-617

113. SMART CLASSROOM DESIGNS IN THE SMART EDUCATIONAL ENVIRONMENT Yasdinul Huda, B Herawan Hayadi .....	618-626
114. BUILD AND DESIGN OF BUSINESS INTELLIGENCE UNIVERSITY SYSTEM AS DECISION SUPPORT ACADEMIC Yaslinda Lizar, Asriwan Guci .....	627-636
115. SOIL STABILITY USING CEMENT PCC IN LUBUK MINTURUN PADANG, INDONESIA Yocky Syaida Adha Putra, Tengku Ahmad Fauzan Syah .....	637-642
116. INFLUENCE THE LEARNING STRATEGY AND ENTRY BEHAVIOR TO YIELD LEARNING BUILDING CONSTRUCTION AND DRAWING 1 OF STUDENT Yuwalitas Gusmareta, Fahmi Rizal, Nurhasan Syah.....	643-646
117. IMPLEMENTATION OF DISASTER PREPARED SCHOOL (SSB) IN WEST PASAMAN DISTRICT WEST SUMATERA PROVINCE Yuwalitas Gusmareta, NurhasanSyah, Laras Andreas Oktavia, RizkyIndraUtama, MuviYandra.....	647-649
118. USING MOBILE TELECOMMUNICATIONS -2000 INTERNATIONAL FOR ANALYZING TECHNOLOGY NETWORK ERA 4G-LTE ZulhamSitorus, Ganefri, NizwardiJalinus .....	650-653
119. FACTORS AFFECTING STUDENTS IN CHOOSING COMPUTER ENGINEERING DEPARTMENT IN STT PAYAKUMBUH Zulkifli, Dilson, Rahmad Al Rian .....	654-659
120. FACTORS EFFECTING ELEMENTARY SCHOOL TEACHER READINESS ON IMPLEMENTING CURRICULUM IN WEST SUMATERA Zuryanty, Hamimah, Mulyani Zein.....	660-665

# COLLABORATIVE PROJECT-BASED LEARNING: AN INSTRUCTIONAL DESIGN MODEL IN THERMODYNAMICS ON TECHNICAL VOCATIONAL EDUCATION AND TRAINING (TVET)

Arwizet K<sup>1</sup>, Nizwardi Jalinus<sup>2</sup>, Krismadinata<sup>3</sup>

Fakultas Teknik, Universitas Negeri Padang, Padang, Indonesia

**ABSTRACT:** This paper explains a collaborative project-based learning in mechanical engineering diploma program on technical vocational education and training (TVET), in Padang. This test is validated through Focus Group Discussion (FGD) and measured by Aiken coefficient 0,840 and limited test to student learning outcomes. Collaborative project-based learning model in thermodynamics consisted of: curriculum analysis and student characteristics; classifying students and provide problems; solve problems together by students in experts group; group students to presentation about problem solving; evaluate learning process of by lecture; plan the project tasks and determine of the project task objectives; making of the project tasks schedule; monitor of the project tasks execution; assessment of the project results and conduct final evaluation of learning outcomes. The result of this research was obtained a collaborative project-based learning (CPJBL) model as a appropriate instructional design in thermodynamics on technical vocational education and training (TVET) with nine syntax and supporting product that validation, practical and effective.

*Keywords: Collaborative Project-Based Learning, Instructional Design Model, Thermodynamics, Technical Vocational Education, and Training*

## 1. INTRODUCTION

The 21st century is often referred to as the era of globalization. In this era of vocational education, graduates are required to always be able to adapt to changes in work environment and rapid technological developments in the industry to remain exist and excel. This condition makes the vocational education providers to always seek the formation of competence in vocational education oriented to 21st-century learning skills by developing creative and innovative learning process that emphasizes higher order thinking skills and application of literacy skill development as well as strengthening character education [1]. This is in accordance with the purpose of geared up workforce to accomplish job duty [2]. [3] Vocational education as "organized educational program" which is related to the preparation of individuals for paid or unpaid employment, or for additional preparation for a career requiring.

Thermodynamics is one of the subjects that must be given to students at the Mechanical Engineering Diploma Program, Faculty of Engineering, State University of Padang. But it was based on the observations conducted by the students that it took thermodynamics in Mechanical Engineering Diploma Program were founds that most of the students felt it was difficult to master thermodynamics teaching by well. Whereas the implementation of thermodynamics was often found in the industrial worlds as steam power plants, propulsion and gas power plants,

hydro power plants, geothermal power plants, pump installations and piping systems, combustion engines, fluid engines, geothermal power plants, heat exchanger and so on. To understand the concepts and principles of thermodynamics requires the ability of high-level thinking by the students because they are abstract. This is what makes the students difficult to mastering the subject of thermodynamics quickly, turning something abstract into real conditions in the field.

There should be an effort to develop a model of learning that can help students to be able to take thermodynamic material quickly that could to improve motivation, thinking power and creativity of students. The same is explained [4] that quality education can be achieved through improvements in the learning process. Further [4] states that the success of the learning process can not be separated from the role of a teacher. [5] A learning model-material books, films, tapes, and computer-mediated programs and curriculums. Learning model developed should be in accordance with the characteristics of the course, facilitate students in mastering the teaching materials and provide knowledge and skills about the implementation of teaching materials.

The learning model is a reference used by lecturers in delivering teaching materials. [6] a learning models is a plan or a tutorial setting and to shape instructional material-including books, films, tapes, and computer-mediated programs and curriculums (long-term courses of study).

Collaborative project-based learning (CPjBL) is a learning model that can provide reinforcement on cognitive, cognitive and affective aspects to learners. The CPjBL model is a combination of a collaborative learning model with a project-based learning model. Application of learning model by combining several precise methods can be the solution to the problems that occur. One of the effective learning methods to facilitate students in mastering the material was the collaborative learning model. Collaborative learning (CL) model was an umbrella term used for a variety of educational approaches involving a joint intellectual effort by student or teacher [7]. A situation in which two or more people learn or attempt to learn something together [8]. Learning collaboratively in groups refers to an instructional method where the work together toward a common goal [9]. Model of collaborative learning will strengthen student's cognitive competence theoretically.

To provide a complex competence about the applicability of the theories studied in the collaborative learning model was to use a project-based learning model. The model of project-based learning (PjBL) is a constructivist pedagogy that intends to bring about in-depth learning by the learner to use an inquiry. PjBL is well suited to helping students become active learners because it situates learning for their learning [10].

Looking at the advantages of CL model and PjBL model above, then the combination of these two learning models called collaborative-project based learning (CPjBL) is suitable for use in thermodynamics learning. The CL model to strengthen student cognition by studying in groups solve the problem given and the PjBL model will train students to think critically to find solutions.

## **2. VOCATIONAL EDUCATION AND LEARNING MODEL**

### **2.1. Definition of Vocational Education**

Vocational education is that part of education which makes an individual more employable in one group of occupations than in another [5]. Vocational education is also designed to develop skills, abilities, understanding, attitudes, works habits and appreciation. [7] also states that vocational education is any education that provides experiences, visual stimuli, affective awareness, cognitive information, or psychomotor skills, and that enhances the vocational development process of exploring, establishing, and maintaining one self in the world of work. Whereas according to [12] vocational and technical education is a program of specialized studies designed to prepare the learner for employment in a particular

occupation or family of occupation. It can be concluded that vocational education is education that leads learners to enter the world of work.

### **2.2. Learning Model and Collaborative Project-Based Learning (CPjBL) Model**

The learning model is a plan or a tutorial setting and to shape instructional material-including books, films, tapes, and computer-mediated programs and curriculums (long-term courses of study [13] collaborative project-based learning (CPjBL) is a learning model combined between a collaborative learning model and a project-based learning model.

[14] Collaborative learning (CL) affords students enormous advantages not available from more traditional instructions because a group - whether it be the whole class or a learning group within the class - can accomplish any meaningful learning and solve problems than any individual can alone.

While project-based learning (PjBL) is well suited to helping students become active learners because it situates learning in real-world problems and makes them responsible for their learning [15]. PjBL helps students to see that learning and life take place in contexts, context that effect the kind of solutions that are available and possible. The use of the CPjBL model involves students in an active, collaborative, student-centered learning process that develops the problem-solving and self-learning skills needed to meet the challenges of life and careers, in today's increasingly complex environment.

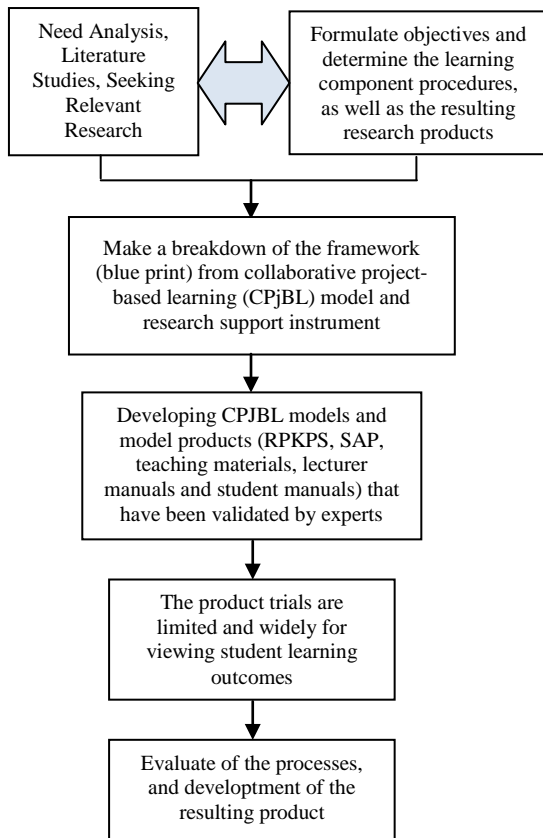
## **3. RESEARCH METHODS**

This research is research and development. [17] Educational Research and Development (R & D) is a process used to develop and validate the educational product. The steps of this process are usually referred to as the R & D cycle, which consists of studying research findings pertinent to the product to be developed, Developing the products based on these findings, field testing it in the setting where it will be used eventually, and revising it to correct the deficiencies found in the field testing stage. In more rigorous programs of R & D, this cycle is repeated until the field test data indicate that the product meets its behaviorally defined objectives.

The method of developing Collaborative Project-Based Learning (CPjBL) model in thermodynamics on technical vocational education and training (TVET) at this research was developed using learning descriptions of ADDIE. The ADDIE model is a development model



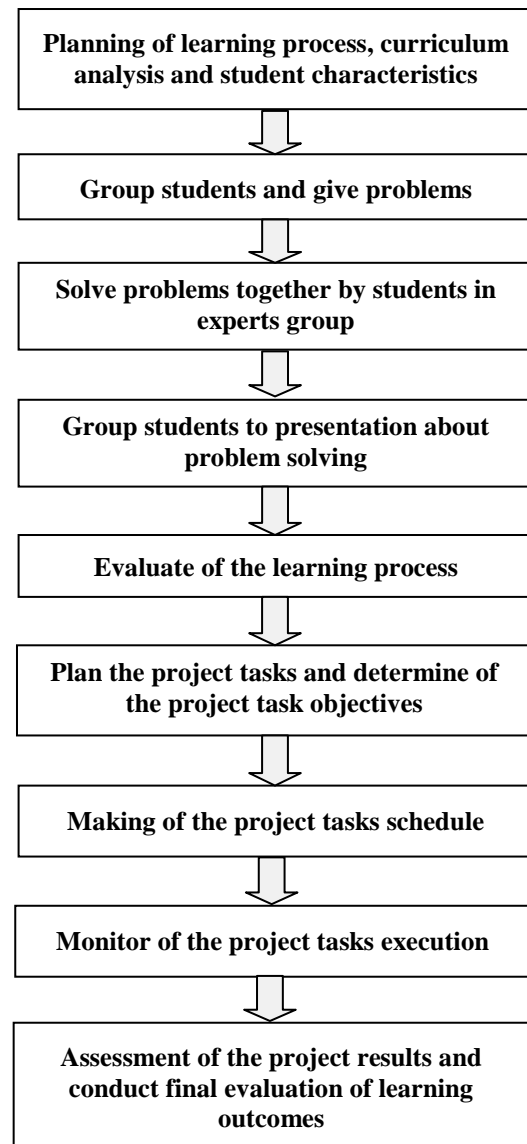
through the five stages: analysis, design, development or production, implementation or delivery and evaluation. In more detail step of developing model of ADDIE can be seen in figure 1.



**Fig 1. The procedures for developing the ADDIE model**

#### 4. RESULTS OF RESEARCH

The result of this research was obtained syntaxs of collaborative project-based learning model in thermodynamics learning process on technical vocational education and training (TVET). The syntax of collaborative project-based learning model (CPjBL) model consists of (1) identifying problems and determining learning objectives; (2) provide problems and create student groups (original and expert groups); (3) solve problems together by students in experts group; (4) group students to presentation about problem solving; (5) lecturers evaluate learning process; (6) plan the project tasks and determine of the project task objectives; (7) making of the project tasks schedule; (8) monitor of the project tasks execution; (9) assessment of the results project and final evaluation of learning outcomes. In the form of flow chart can be explained as in figure 2.



**Gambar 2. Nine syntax model CPjBL in thermodynamics on technical vocational education and training (TVET)**

#### 5. DISCUSSION

Based on the results of the research of syntax of the collaborative project-based learning (CPjBL) model in thermodynamics on technical vocational education and training (TVET). Implementation of the CPjBL model in thermodynamics was done systematically step as such as:

##### a. Planning of learning process, curriculum analysis, and student characteristics

The planning of the learning process and curriculum analysis are two of the most important steps. At this stage, the effort is to plan the learning process that will be given to the students. The CPjBL and adapted curriculum are in the Engineering Engineering Diploma Program, Faculty of Engineering, Universitas Negeri Padang. [18] stated that planning is the process of goal setting and that goal. The curriculum analysis aims to identify the teaching materials (problems) that will be distributed to the students [14]. Knowing the characteristics of the students that will be accomplished during the process.

#### **b. Group students and give problems**

At this stage, students are grouped into multiple heterogeneous study groups of 4-6 people using a pattern of origin groups and expert groups and each receives problems related to teaching materials [12]. Furthermore, each member of the original group is given a problem that will be solved on this group of experts [13].

#### **c. Solve problems together by students in experts group**

At this stage, students in the expert group discuss the same learning materials section, as well as devise a plan how to convey to a friend if they return to the original group [12]. Lecturers facilitate groups of origin and group of experts as long as they learn together to solve problems in the form of provision of teaching materials, study guides and guidance [13]. Each group of experts discussed the problem and sought answers to the teaching materials given after the study guide. Once the problem is solved then they return to the original group to share the results of problem-solving with other members of the original group. Present the problem-solving results in front of the class [14]. Lecturers ask the representatives of each group of origin to present the results of problem-solving that has been obtained according to the given problem.

#### **d. Evaluate the learning process**

Lecturers give an evaluation in the form of small test for individual students about teaching materials that have been studied. The process of giving a small test is done at each meeting for 11 weeks. Stages of the learning process from the beginning to the stage of this small test is called a collaborative learning model whose goal is to strengthen students' cognitive competence [15].

#### **e. Plan the project tasks and determine the project task objectives**

At this stage, the lecturer assigns project assignments to each group [19]. The lecturer explains the project task framework and determines the objectives to be achieved in the project task. This step is an important step, the task of the project can work well if the purpose of the project task is clear and understood by the students. Making of the project tasks schedule [20].

At this stage lecturers and students jointly develop a project assignments schedule. Preparation of project assignments implementation stages by considering the complexity of the steps.

#### **g. The monitor of the project tasks execution**

This stage lecturers always monitor the project tasks assigned to the students. Lecturers help find solutions, if students experience obstacles in doing project tasks [21]. At this stage, the lecturer should also know how far the project work has been done by the students in terms of finding industry relevant to the project task, the achievement of the project tasks, the process of collecting data, analyzing the data and making the final report on the project task.

#### **h. Assessment of the project results and conduct final evaluation of learning outcomes**

At this stage, the lecturer facilitates the student in making the project task report, presenting the result of the project task in front of the lecturer and other students. All groups present their project, discuss, and draw the final conclusions of the given project task.

Lecturers and students reflect on the activities and results of project assignments undertaken by students. The reflection process is done both individually and in groups. Lecturers also provide an assessment of the project tasks undertaken by students either individually assessments or group assessments.

Finally, the lecturers give a final evaluation to all students, to measure the mastery of course material by the students during the learning process in the form of final test or also called post-test.

## **6. CONCLUSION**

Collaborative project-based learning (CPjBL) model is an alternative to the instructional design model which is appropriate to TVET. By using this instructional design model, it is expected that the learning process in TVET is more motivating, creativity, innovative and more

fun for students in learning (the learning will be more meaningful).

Further model CPjBl model which has been applied in TVET so as to help students in improving their competence and facilitate them enter the world of work (enter the world of work). Besides this CPjBL model be able to develop of students critical thinking, and having good morale

## 7. REFERENCES

- [1] Hamid Muhammad.2017. Panduan Revitalisasi SMK. Jakarta: Direktorat PSMK, Kemdikbud Press.
- [2] M Y A Hadi et al. 2015. *Application of Thinking Skills in Career: A Survey on Technical and Vocational Education Training (TVET) Qualification Semi-Professional Job Duties*. 2<sup>nd</sup> Global Conference on Business and Social Science-2015, GCBSS-2015, 17-18 September 2015, Bali, Indonesia.
- [3] Calhoun, C. C., & Finch, A. V. 1980. *Vocational and Career Education: Concepts and Operation*. Belmont California: Wads Wort Publishing Company
- [4] Dimiyati dan Mulyono. 2006. *Belajar dan Pemelajaran*. Jakarta. PT. Rineka Cipta
- [5] Joyce, B., Weil, M., & Calhoun, E. 2009. *Models of Teaching*. New Jersey:Pearson Education Inc
- [6] Evan, R.N & Edwin L.H. 1978. *Foundation of Vocational Education*. Penerbit: Charles E. Merrill Publishing Company. Columbus. OHIO.
- [7] Thompson.1073. *Foundation of Vocational Education: Social and Philosophical Concept*. Michigan: Prentice-Hall
- [8] Ralph C. Werich. 1988. *Administration and Vocational Education*. USA: John Wiley & Son.
- [9] Joyce. B, Weil. M, dan Calhoun. E. 2009. *Model-Model Pengajaran*. Terjemhan Edisi Kedelapan. Yogyakarta: Pustaka Pelajar.
- [10] B. Abbie and D. G. Timothy. 2011. *The Essential of Instruction Design Connecting Fundamental Principles with Process and Praticce*. Second Edition, Pearson Education, Boston, Amerika Serikat.
- [11] Slamento. 2010. *Belajar dan Faktor-faktor yang Mempengaruhinya*. Jakarta: PT. Rineka Cipta.
- [12] Slavin, Rober E. 2009. *Cooperative Learning*. Bandung: Nusa Media.
- [13] Ezekoka, G. K. 2015. *Maximizing the Effect of Collaborative Learning Through ICT*. *Procedia- Social and Behavioral Sciences* 176 (2015) 1005-1011.
- [14] Dillebourg, P. 1999. What do you mean by “collaborative learning”? In P. Dillenbourg (Ed), *Collaborative-learning: Cognitive and Coputational Approaches* (pp1-15). Oxford: Elsevier.
- [15] M. Laal. et al. 2013. *Individual Accountability in Collaborative Learning*.
- [16] Balve, P. and Albert, M. (2015). Project based Learning in Production Engineering at the Heilbronn Learning Factory. *Procedia CIRP*. 32: 104-108.
- [17]Borg, W.R. & Gall, M.D. Gall. 1983. *Educational Research: An Introduction*, Fifth Edition. New York: Longman.
- [18]Maisah dkk. 2009. *Manajemen Pembelajaran Kelas: Strategi Meningkatkan Mutu Pembelajaran*. Jakarta: Gaung Persada Press.
- [19] Chen, P., Hernandes, A., and Dong, J. 2015. Impact of Collaborative Project-Based Learning on Self- Efficacy of urban Minority Students in Engineering. 11:26-39.
- [20] Lanmer, J. Mergendoller, J and Boss, J. 2015. *Setting the Standar for Project Based Learning: A Proven Approach to Rigorous Classroom Instruction*, Beauregard St. Alexandria: Genny Ostertag.
- [21] Rais. 2010. *Project Based Learning: Inovasi Pembelajaran yang Berorientasi Soft Skills*. (Makalah). Surabaya: Unesa.

## 8. AUTHOR'S BIOGRAPHY

Dr. Ir. Arwizet K, MT is a lecturer in Department of Mechanical Engineering, Faculty of Engineering, State University of Padang. Currently a lecturer at Postgraduate Program PTK FT UNP. He obtained his MT from Institut Technolgy of Bandung (ITB) and Dr of Postgraduate Program PTK FT UNP 2017. His research interests include energy conversion, thermodynamics and development of learning model in thermodyanmics. His contact e-mail is arwizet1969@gmail.com

## 9. AUTHOR'S CONTRIBUTIONS

This section should state the contributions made by each author in the preparation, development and publication of this manuscript.

### 1. Prof. Dr. Nizawardi Jalinus, M.Edi:

conception, model design, and interpretation of model to enhance student's learning outcomes and drafting the article.

### 2. Krismadinamata, Ph.D:

critical reviewing and final approval of the version to be submitted.

## 10. ETHICS

This article is original and contains



unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.