STEM-CP Modul BasedSciencetoImproveStudentIndependenceandLearningOutcomesinJuniorHighSchoolScience Learning

ABSTRACT

Science, Technology, Engineering, and Mathematics Contextual Problem (STEM-CP) canbe used as a basis forthe development of models and media forscience learning whose theoreticaldiscussion and application of science in enabling technology can be created and developed by students. STEM-CP basedscience modules meet validity and practicality. Independent learning as a personal characteristic of students who havecharacteristics that are responsible and active in the learning process. Both interact with each other and are also influencedbythesocialenvironmentintheformofthe rolesandpoliciesoftheorganizinginstitutions.Thisresearchis development research designed to produce a valid, practical, and effective module model product to increase independenceand learning outcomes. The research design used is 4-D or: Define, Design, Develop, and Disseminate. The time forresearch to disseminate STEM-CP Based Science Modules to Improve Student Independence and Learning Outcomes inJunior High School Science Learning is planned for 10 months effective starting when research must be carried out. Theresearch location is set around the Besuki Residency. The research subjects were 4 high school students in 3 classes eacharoundtheformerBesukiResidency. Modul STEM-CP telahmemenuhikepraktisanmeliputi: responsiswa yang positifsebesar 72,91% dan keterlaksanaanmodulpembelajaran 97,56%. SelainituModul STEM-CP telahmemenuhikepraktisanmeliputi: kemandirianbelajarsebesar 95,7% dan teshasilbelajardenganNgainsebesar 0,69 dengankategorisedang

Keywords:Independence, Junior HighSchool, LearningOutcomes,Science, STEM-CP

1. INTRODUCTION

In some developed countries as America named approach That with STEM (Science, Technology, Engineering, and Mathematics). The STEM-CP (Contextual Problem) approach can understood as something approach for develop learning science, with science and math or the calculations for base development technology and techniques on common problems encountered, known, or can developed by students That [1]. becausethat, STEM-CP can used as base for development of learning models and media science which is discussed in a manner theoretical and applicable science in enabling technology can created and developed by students.

Module is one of the designed learning media for support learning independent. related with learning science based on STEM-CP, then need developed module for learning parts appropriate science with approach the. With This module science based on STEM-CP developed in order to be able to support learning independent, mastery science and its applications, as well have one Skills think level high [2]. Besides think creative, independent learning is also important aspect for students in the 21st century. this supported by results study show that learning physics with module introduction STEM-CP based magnetic fields can increase Skills think creative student.

Science module STEM-CP based for learning science in a manner independently in junior high school has done study development. Science modulebased STEM-CP compliant validity and practicality show that validation experts and users to module science STEM-CP based achieve *the* average value ≥ 90% is in the valid category which includes: validation content,construct, and advance so that module worthy for disseminated in the learning process.Practical Results module science based on STEM-CP shows: (1) implementation the average value of < 3.7 is in the very good category; (2) activity relevant students with module with the average value <87% is in the very active category; and (3) obstacles that arise during the learning process module science based on STEM-CP has solution right alternative so that can increase independence Study student.

independence learn basically explained in two perspective that is Study independent as a learning process that makes learner responsible answer full in plan,implement, own freedom full for control material important learning as well as evaluate it [3]. Perspective others, Independence Study as characteristics personal students who have responsible feature answer and be active in the learning process. Both of them each other interact and be influenced as well by environment social form roles and policies institution organizer [4].

1.1 Statement of problem

Science knowledge important in development technology which means anyway as knowledge important in influence progress life human. because that, in junior high school, science be one eye lesson main, because related with technology.becausethatis, development module middle school science that can support implementation learning science until student can own independence study, results learning, and high creativity for the era of the 21st century is necessary done. STEM- CP is one possible approach can invite student for creative in look for solution For solve existing problem in life real in the environment student. Research target This is module science STEM-CP based for means Study science junior high school students self that can increase independence learning, and results Study student. Contribution study to knowledge knowledge is add science and technology information, in particular in form of learning media science in a manner independently in middle school. the medium in the form of a learning media model science based on STEM-CP that can used for learning science in a manner independent, valid, practical, and effective junior high school students .

1.2 Objectives of the study

Objective from study This is describe practicality and effectiveness STEM-CP Based moduleSciencetoimproveStudentIndependenceandLearningOutcomesinjuniorshighschoolScience Learning.

2. LITERATURE REVIEW

Science (Physics, Chemistry, and Biology) is knowledge learned knowledge about incident as well as changes that exist in nature-built universe from concept,law, theory along

application [5]. Learning science related with effort understand various phenomenon natural in a manner systematically, so learning science No only mastery gathering form knowledge facts,concepts, principles only, but also is a discovery process [6].

STEM basically is something implementation approacheducation or implementation basis learning for science and its applications in technology and development. The STEM approach has impact good at results Study students, though implementation learning science with the STEM approach begins with providing relevant problems with concept, but the problem in question No contextual or happening in the environment around students [6]. supported with condition of Indonesia as an archipelagic country with facilities and basic conditions experience Study student many haven't same, then resulted implementation education for the same level, especially for learning often No same. [7]

With This come up idea for develop implementation learning modified STEM based be implementation learning STEM-based with contextual problems, to be exact for learning science is learning science based on STEM Contextual Problem or STEM-CP. Implementation learning science STEM-CP based is implementation learning emphasized science mastery continuing science with gift insight and training in apply science on technology and or existing engineering or known by students. STEM-CP as a learning base science can made base For development of learning models science as well as learning media science [8]. because it on occasion This approach or STEM-CP base is used for base development a shaped medium module. the module called " module". science based on STEM-CP". Module is part package Study for Study independent among them load experience planned and designed learning in a manner systematic for reach objective learning. because that is, module can made as facility source Study the material discussed. Characteristics good modules,namely: 1) self instructional, 2) self contained, 3) stand alone , 4) adaptive , 5) user friendly , and 6) consistency [9].

Students who have independence Study tall capable utilise opportunities and abilities For Study in a manner maximum. Student can said own independence Study if you have initiative for learn, solve problem, as well responsible answer on action taken [10] .So, independence Study is activity learning done student with his consciousness Alone for apply the knowledge he has without dependency with help of others in reach objective learn it. Study This use four indicator independence Study students used in research This includes: 1) believe self, 2) responsibility responsibility, 3) initiative, and 4) discipline [11]. Researcher use four indicator the Because can practice student for responsible answer on the learning process so that can reach objective learning optimally.

Study results is an internal process obtain mark success Study student after go through the learning process in One period certain. Study results is change in yourself related students with aspect knowledge,attitudes, and skills as results from activity study [12]. Morefurther, results Study is change Act in demand individual Because exists interaction with environment surrounding through the learning process. Evaluation results Study in accordance with demands The 2013 curriculum is expected can done in a manner comprehensive with involve realm knowledge,attitudes, and skills. Evaluation results study is also expected always experience change emphasis on each enhancement level education. Indicator results Study by Benjamin S. Bloom with taxonomy of education objectives share objective education become realm cognitive,affective , and psychomotor [13].

3. METHODOLOGY

3.1 Type Study

Study This is study designed development for produce valid, practical, and effective module model products for increase independence and results learn. Design research used 4-D isDefine, Design, Develop, and Disseminate[14].

3.2 Time, Place, and Subject Study

time for study Science Module Dissemination STEM-Cp based for Increase Independence and Learning Outcomes Students on Learning Middle school science is planned 10 months effective started when study must carryout. As for the place study set around Ex-Residency Besuki. subject study is 4 junior high school students each 3 classes around Ex-Residency Besuki.

3.3 Stages Study

Stages study development module science based on STEM-CP with 4-D Design which steps can outlined as following.

3.3.1 Stage Define

stage used for set need necessary development in learning. Analysis early-late is analysis results observations of science teachers and students at neighboring junior high schools need in carry out learning suitable science for support lesson in a manner independent and capable increase results learn and apply science in technology. Analysis student is analysis results observation of studentsneighbour need for Study science in a manner independent. Analysis task is analysis component Core Competency and Basic Competency lessons science in middle school Curriculum 2013. Analysis draft is analysis material science at a suitable high school for development tests module science based on STEM-CP. Formulation objective learning is formulation objective learning science with learning use module science STEM-CP based, for test level.

3.3.2 Stage Design

Determination content format design and design appearance module science based STEM-CP based theory.

3.3.3 Stage Develop

Validation draft module science STEM-CP based by expert, limited test draft module science based on STEM-CP which has validated by experts.

3.3.4 Stage Disseminate

Extensive test or test usage module science based on STEM-CP which has validated by experts and tested in a manner limited.

3.4 Data Collection Techniques

3.4.1 Practicality

Data collection techniques for know practicality module science STEM-CP based is documentation questionnaire response students and observations implementation learning student. Students who use module the willrequestedfor fill in questionnaire response, and then data filling questionnaire response processed [19]. Besides that, the observer also assesses implementation learning student during use module.

3.4.2 effectiveness

Data collection techniques for know effectiveness module science STEM-CP based is test results learning and creativity student used for measure results learning and

creativity student. Questionnaire form question open for obtain independent data learn. Analysis results these three data used for determine effectiveness module for learning with use *normalized gain* (Ng).

3.5 Data Analysis Techniques

Study development module science STEM-CP based will test:

3.5.1 Analysis practicality module can is known from results questionnaire response students and results observation implementation learning use module STEM-CP-based junior high school science. In questionnaire response student, statement positive worth 1 and statement negative has a value of 0. Next, the score questionnaire response student will process[15].

$$\text{Student respondent} = \frac{A}{B} \times 100\%$$

Description:
A = Amount mark questionnaire response student
B = amount mark maximum

response data student entered in category practicality module like following.

Table 1. Categories Practicality Textbook

Percentage answer respondent	Category
0 – 20	No practical
21-40	Less practical
41-60	Enough practical
61-80	Practical
81-100	Very practical

Observation implementation learning performed by the observer using instrument sheet observation.*Observers* provide sign *check* (√) in the column appraisal. Observation score implementation learning made with range scale 1-100, and processed use formula following [15].

$$\text{Learning Performed} = \frac{A}{B} \times 100\%$$

Description:
A = Amount mark observation implementation learning
B = amount mark maximum
implementation data learning entered in category implementation learning following.

Table 2. Categories of Observation Results Execution Learning

Score	**Category**
0 – 39	No Good
40–59	Not good
60–79	Enough Good
80 – 100	Good

3.5.2 Analysis effectiveness module
Effectiveness module can be seen from score skills independence and results Study student. Independence and results study counted based on each indicator and analyzed in a manner descriptive. For effectiveness test module science STEM-CP based can counted with using Ng, with formula as following [15].

$$N_{gain} = \frac{\text{Score Posttes} - \text{Score Pretest}}{\text{Score maximum} - \text{Score pretest}}$$

Description:
Ngain: Upgrade independence and results Study student
Post-test score: score results evaluation independence and results Study student after learning with module
Pre-test score: score results evaluation independence and results Study student before learning with module
Maximum score: score maximum from pre-test and post-test data groups evaluation independence and results Study student after learning with module

Furthermore results analysis converted in criteria enhancement as following:

Table 3. Categories of N-gain values

intervals	Category
Ng >0.7	High = very valid
0.3≤ Ng ≤0.7	Moderate = valid
Ng < 0.3	Low = invalid

4. RESULTS AND DISCUSSION

4.1 Analysis practicality

4. 1.1 Response Student

LearningWhichpleasantcausegrowthresponsepositivefromparticipanteducate Whichin a mannerdirectimpactonenhancementto interest learn,activity follow activity learning, which is onFinallyimpactonenhancementresultsstudy [16] .AttitudepositivetolearningSTEM-CP isprerequisitesuccessparticipanteducateStudyIPA and rising interest participant educate to IPA materials.In other words if mastery science concepts and principles onvery low at first accompanied with attitude negative to science lesson,difficultexpectedparticipanteducatewillsucceedwithGoodinlearningSTEM-CPnext, results response student shown in the table following.

Table 4. Response Results Student

Criteria	Indicator	intervals (%)	Response
Response	Format	76,16	Positive
	Relevance	73,84	Positive
Reaction	Attention	73,66	Positive
	Satisfaction	72,39	Positive
	Believe Self	68,53	Less Positive
Average		72,91	Positive

4.1.2 Learning Module Implementation

Resultsobservationimplementationmoduleinlearningdoneforseeso farwherelevelimplementationmoduleinlearningin matter This modulethis. Besides thatforview observational data for criteria practicality done observation inlearning,

observation in question is observation implementation modulecarried out by two observers, results implementation module learning shown in the table following.

Table 5. Results of Learning Module Implementation

AspectWhichinMeasuring	Percentage (%)
ActivityBeginning	98.5
activityCore	96.8
ActivityEnd	97.4
Average Observation Results	97.56

Practicalityobtainedbased onimplementationusemoduleduringprocessStudyteachgoing on.kindlygeneralresultstesttriesinfieldforcriteriapracticalityhasfulfilcriteria.Componentpracticali tymoduledeterminedbytwomatterthat isbased onevaluationexpert(expertjudgment)Andbased on resultsobservationimplementationmodule [17].

4.2 Analysis Module Effectiveness

4.2.1 Independence Study

independence is capabilitiessomebody for do something and got take responsibility for it. independence can apply in Lots thing, for one thing is independence learn. independence Study is one important attitudeowned by students. independence Study is an active and constructive process Where participant educate setobjective for learning them and then try monitor,regulate, and control cognition, motivation, and behavior them, guided and limited by goals and features contextual them in the environment. independence Study is activity someone 's learning with his freedom in define and manage Alone teaching materials,time,place, and utilization necessary learning resources [18]. So that can it is said, someone who has independence high learning capable manage activity learn Alone started from stage preparation,execution, and evaluation. Independence results study shown in the table following.

Table 6. Independence Results Study

Indicator	Percentage (%)
Self-confident	97.5
Responsibility	91.8
initiative	92.4
Discipline	95.7

4.2.2 Test Results

Utilization variousstrategyineffortforconfirmideas student. Learning outcomes is be something students can do Nowthat they No Can do previously change people as results fromexperience learn. Study results offerattentional meanscan focused on achievement actual student and this is more size realistic and original from mark education from size inputteach, results study and approach based results own implicationfor design curriculum, teaching, learning and assessment, as well guarantee quality,givebaseforcurriculumin a mannereffectivealignedAndintegrated [19].ContributionWhichmostfamousfordevelopmentcurriculumbasedresultsispublishingAtaxo nomyofCognitiveObjectivesbyBenjaminBloomonyear1956.taxonomyBloomgiveframework for classify Study in matter cognitive states varioustypethinkstudent(ieknowledge,understanding,application,analysis,synthesisAndevalu ation. Test resultsresults Study shown in the table following.

Table 7. Test Learning Outcomes

Mark	Pre-test	Pre-test
MarkAt a minimum	41.70	76.00
MarkMaximum	68.80	88.00
MarkAverage	52.02	80.25

The normalized gain (N-gain) test was performed forknow enhancement results Study cognitive student after given treatment [20]. Enhancement This taken from pre-test and post-test scores obtained by students. Normalized gain or abbreviated with N-gain represents comparison actual gain score with maximum gain score [21]. Actual gain score that is gain score obtained student whereas maximum gain score that is highest possible gain score obtained student. The N-gain results are shown in the table following.

Table 8. N-Gain results

Value	MarkPre - test	MarkPost t-test	gains	N- g ain	Information
Average	52.02	80.25	29.26	0.69	Moderate
Maximum	68.80	88.00	401	1	
Minimal	41.70	68.80	10	0.58	

4. CONCLUSION

Based on research that has done related Science- based STEM-CP modules in SMP can concluded that enhancement independence and results learn. The STEM-CP module has fulfilledpracticalityinclude: response positive students of 72.91% and implementation module learning 97.56%. Besides That,The STEM-CP module has fulfilledpracticalityinclude: independence Study of 95.7% and test results Study with Why of 0.69 with category medium.Science module based on STEM-CP developed in order to be able to support learning independent, mastery science and its applications, as well have one Skills think level high. Besides think creative, independent learning is also important aspect for students in the 21st century.

Consent

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist

REFERENCES

1. Rusydiyah, EF, et al. STEM Learning Environment: Perceptions and Implementation Skills in Prospective Science Teachers. Journal of Indonesian Science Education . 2021 ; 10(1): 138-148. Indonesian.
2. Arini, Yayuk Sri Wahyu Endah, Wawan Gunawan, and Marianus Subandowo. Development of Problem Based Learning Applied Science Modules to Support Independent Learning in Vocational High Schools.Educate: Journal of Educational Technology . 2021 ; 6(2) : 72-82. Indonesian.
3. Kosasih, Aceng, et al. Higher-Order Thinking Skills in Primary School: Teachers' Perceptions of Islamic Education. Journal of Ethnic and Cultural Studies . 2022 ; 9(1): 56-76.
4. Faoziyah, Nina. Students' Mathematical Problem Solving Ability Through PBL-Based STEM Approach.Pasundan Journal of Mathematics Education Journal of Mathematics Education . 2021 ; 11(1) :50-64. Indonesian.
5. Dewi, Kusuma, Sumarmi Sumarmi, and Alfyananda Kurnia Putra. Development of STEM-Based Digital Teaching Materials with an Eco-Spatial Behavior Approach to Population Materials. J-PIPS (Journal of Social Science Education) . 2021: 7(2): 92-102. Indonesian.
6. Budiarso, AS, and N. Hasanah. Application of STMCpE-Based chemistry books with chemo-entrepreneurship orientation in the learning of acid-base solutions to improve students' creative thinking skills. Journal of Physics: Conference Series. 1 832 (1) . IOP Publishing, 2021.
7. Patimah, Epi, and Sumartini Sumartini. Student Learning Independence in Online Learning: Literature Review.Edukatif: Journal of Educational Sciences . 2022 ; 4(1): 993-1005. Indonesian.
8. Rijal, Syamsu, and Suhaedir Bachtiar. The relationship between attitudes, learning independence, and learning styles with students' cognitive learning outcomes. Journal of Bioedukatika . 2015 ; 3(2): 15-20. Indonesian.
9. Jumaisyaroh, Tanti, E. Elvis Napitupulu, and Hasratuddin Hasratuddin. Improving mathematical critical thinking skills and learning independence of junior high school students through problem-based learning. Kreano, Journal of Creative-Innovative Mathematics . 2015 ; 5(2) :157-169. Indonesian.
10. Oktaviana, Dwi, and Iwit Concerned. Analysis of Student Learning Outcomes in Comparative Material Based on the Cognitive Domain Revised Bloom's Taxonomy. Buana Mathematics: Scientific Journal of Mathematics and Mathematics Education . 2018 ; 8 (2) : 81-88. Indonesian.
11. Kristin, Firosalia. Analysis of discovery learning learning model in improving the learning outcomes of elementary students. Journal of Basic Education Perkhasa: Journal of Basic Education Research . 2016 ; 2(1) :90-98. Indonesian.
12. Setyosari, Punaji. Research and development methods. Jakarta: golden ; 2010.
13. Nieven, Nienke. Prototyping to Reach Product Quality, in Plomp, Tjeerd, Branch, Robert Maribe., Kent,. Nieven, Nieken. Design Approaches and Tools in Education Training ; 1999.
14. Arikunto, S. Research Procedures A Practice Approach. Jakarta: PT Rineka Cipta ; 2010 .
15. Sugiyono.Research methods; Educational Development. Bandung: Alphabet a; 2015.
16. Haryadi, Rudi, and Heni Pujiastuti. Enhancing Pre-service Physics Teachers' Higher-Order Thinking Skills Through the STEM-PjBL Model. International Journal of STEM Education for Sustainability . 2022 ; 2(2) :156-171.

17. Alqurashi, Emtinan. Self-efficacy in online learning environments: A literature review. Contemporary Issues in Education Research (CIER) . 2016 ; 9(1) :45-52.
18. Rijal, Syamsu, and Suhaedir Bachtiar. The relationship between attitudes, learning independence, and learning styles with students' cognitive learning outcomes. Journal of Bioedukatika . 2015 ; 3(2) :15-20. Indonesian.
19. Handayani, Novia Amarta, and Jumadi Jumadi. Analysis of Online Science Learning During the Covid-19 Pandemic. Journal of Indonesian Science Education . 2021 ; 9(2): 217-233. Indonesian.
20. Jannah, Dewi Rahmawati Noer, and Idam Ragil Widianto Atmojo. Digital Media in Empowering 21st Century Critical Thinking Skills in Learning Science in Elementary Schools. Basicedu journal . 2022 ; 6(1) :1064-1074. Indonesian.
21. Putri, Rima Melani, Asrizal Asrizal, and Usmeldi Usmeldi. Meta-analysis of the Effects of the STEM Approach on Scientific Literacy and Understanding of Learners' Concepts in Each Education Unit. Journal of Science & Science Learning 2022 ; 6(1): 86-98. Indonesian.