International Journal of Learning, Teaching and Educational Research
Vol. 19, No. 1, pp. 206-230, January 2020
https://doi.org/10.26803/ijlter.19.1.12

Educative Curriculum Material and Its Impact on the Teachers' Instructional Performance and Learners' Achievement

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Abstract. This research aim is to reveal the components of Educative Curriculum Material (ECM) and its impacts on the chemistry teachers' instructional performance and learners' achievement. This study applied the experimental method with matching only pretest-posttest control group design. A total of 36 junior chemistry teachers as the experiment group, and 36 senior chemistry teachers as the control group, and were selected by purposive-sampling. The sample of learners is chosen randomly. They consisted of 64 people as an experimental group and 64 people as a control group from different High School. The research instruments were a questionnaire, form of the analysis lesson plan and observation instructional performance, the items of teacher knowledge and learners' achievement. Data were analyzed qualitatively and quantitatively through t-tests and Normalization-Gain. The research findings indicate that (1) ECM components that effectively enhance knowledge of chemistry teachers are curriculum, chemistry content, instructional strategies, professional development, and academic skills. (2) Understanding pedagogical and professional knowledge of junior chemistry teachers as ECM users and trained better than senior chemistry teachers who do not use ECM. (3) The instructional performance of junior chemistry teachers who use ECM is better than senior chemistry teachers both in their planning and implementation. (4) The learner's achievement that learns from teacher used ECM increased higher significantly than those who did not. Based on these findings, it can be concluded that the ECM effectively improves on chemistry teachers' instructional performance and learners' achievement. Therefore it is recommended that Chemistry Teacher Group Discussion use the ECM.

Keywords: education; educative; curriculum material; chemistry teacher; learner

INTRODUCTION

Background

The main factors that influence the quality of the success of the education system are teachers, learners, curriculum, management of instruction, facilities, and infrastructure. Among these factors, the teacher is the most crucial element because the teacher can act as the planner, executor, controller, manager, and developer of the educational system. Many experts stated that there would be no change or development in the educational system without any change and improvement in the quality of teachers. Therefore the teacher is a determinant and dominant factor that plays a role in the learning process, where the learning process is at the core of the overall education process (Dharma, 2008; Yusof, Yaakob, Othman, 2019).

The Indonesian National Education System section, 1 and subsection 1 of Law No. 14 of 2005 stated that teachers are professional educators with the main task of educating, teaching, guiding, directing, training, and evaluating students on all levels and types of education (Depdiknas, 2005b). The teacher profession requires certain skills. This job cannot be done by a person who does not have these skills. Based on Academic Qualification Standards and Teacher Competence, professional teachers are teachers who can integrate critical competencies, namely: (1) pedagogical, (2) subject matter, (3) personality, and (4) social, and (5) professionals manifested by their performance (Depdiknas, 2005a). To conduct qualified education, teachers must demonstrate convincing competence in terms of knowledge, skills, mastery of the curriculum, subject matter, teaching methods, evaluation techniques, and commitment to tasks and high discipline. According to the Regulation of the Minister of National Education of the Republic of Indonesia Number 16 of 2007, teacher competencies need to be continuously maintained programmatically and continually through a system of guidance that can improve the quality of professionalism (Depdiknas, 2007).

Teacher professionality in Indonesia is currently considered low. The data states that the national average test scores of teacher candidates for elementary, junior high school, high school, and vocational schools for mathematics studies only (27.67), physics (27.35), biology (44.96), chemistry (43.55), and English (37.57), while mastery of minimum expertise in the field of study of a teacher could teach well is 75 (Sudarman, 2007). Another finding from the Educational Sciences Consortium 2000 states that 40 scores junior high school teachers and 33 of high school teachers teach fields of study outside their areas of expertise (Mustofa, 2007). In terms of performance, it was found that in preparing the instructional program, most teachers did not compile themselves but only used the work product of the Chemistry Teacher Group Discussion (CTGD) The competence of teachers to comprehend the subject matter and classroom management is still low. Teacher reading interest has not been facilitated by resource books as teacher guides, journals, and bulletins. The culture of conducting Classroom Action Research (CAR) is also still low (Ma'ruf, 2009). The teacher professionalization determined through portfolio assessment and

Teacher Professional Education and Training (TPET). The percentage of graduates from the portfolio and TPET graduation only reached 49.60 and 42.89 in 2006 out of 200,000 participants. Thus in 2007, only reached graduation of 40.95 and 50.02 of the total participants of 180,450 people. In 2008 only reached 38.22 and 33.20 of the 200,000 participants. The low competency of the teacher lies in the pedagogical, subject matter, and the process of self-development especially writing scientific papers (Dasuki, 2009).

Moreover, it was found that novice teachers who taught at various levels of education and fields of study faced difficulties in finding curriculum material resources that helped them to prepare and carry out their instructional assignments (Kauffman *et al*. in Grossman & Thompson, 2004). Likewise, the sourcebooks for chemistry teacher guides in Indonesia are still scarce, only in the 1994 curriculum era. Chemistry teacher sourcebooks are available through Open Universities such as the module "Development of Curriculum and Chemistry Learning" (Arifin *et al*., 2007), the "Renewal in Chemistry Learning" module (Karyadi *et al*., 2007), and the module "Chemistry Learning Strategies" (Wiryawan *et al*., 2007). Even though the existence of the sourcebook and teacher's guide is very essential as one of the supporters of improving the quality of teacher professionality.

Literature Review

Based on its function, educative curriculum material can facilitate the willingness and learning abilities of teachers in improving their instructional practices, especially more effectively by presenting studies of pedagogical content knowledge (PCK) aspects that combine instructional content and pedagogy (Scheneider, Krajcik & Marx, 2000). Educative curriculum material designed by applying a heuristic approach is more effective in improving teacher learning. Teachers are ready to follow curriculum changes when they have competence in the curriculum, instructional, content subject matter, curriculum management and teaching, curriculum and instructional evaluation, as well as student understanding. Educative curriculum material is also very supportive for improving the ability of teachers to practice learning, facilitating teachers always to continue learning, so that they have the readiness to carry out their roles as agents for converting and constructing curricula and instruction (Davis & Krajcik, 2005, Krajcik & Delen, 2017).

The knowledge that must be possessed by teachers in educative curriculum materials are knowledge of (1) the subject matter, (2) general pedagogy such as classroom management, (3) pedagogical subject matter, (4) curriculum, (5) learners and their characteristics, (6) the context of the school and society, and (7) the goals and value of education. These seven kinds of knowledge are combined integratively to form the Subject Material Pedagogical (SMP) knowledge. By adapting Shulman's view, the integration of all teacher's knowledge components can be called as "Amalgamation Teacher Knowledge" (ATK). Each component that forms the SMP is curriculum knowledge, subject matter, and others must first be found"essential concepts" through the process of analyzing or making concept maps. The integration between essence concepts and knowledge curriculum with other knowledge is carried out through a link named "key formula." For example "syllabus component = curriculum component + curriculum design model." (Shulman in Julie, 2008; Rosbiono, 2020a, 2010b).

The educative curriculum material design can also be compiled based on a heuristic approach consisting of Design-1 until Design-9. Design-1 (assisting teachers to educate learners with phenomena). Design-2 (assisting teachers in using representations of scientific instructional). Design-3 (assisting teachers to anticipate, understanding, and responding to learners' about science). Design-4 (assisting teachers to educate learners through questions). Design-5 (assisting teachers to activate learners by collecting and analyzing data). Design-6 (assisting teachers to activate learners by designing investigations). Design-7 (supporting teachers to activate learners by making explanations based on evidence). Design-8 (helping teachers to activate learners by improving scientific communication), and Design-9 (supporting teachers to activate learners by developing subject matter) (Davis & Krajcik, 2005).

The educative curriculum material should be compiled by applying the principle of deepening the understanding of concepts (science), instructional strategies, and conformity to the needs of various educational participants. Some types of knowledge that teachers urgently need improvement include techniques to improve instructional such as training or modeling, specific instructional strategies such as prediction-explanations, class management, content presentation technology, and inquiry support, and non-traditional assessments (Krajcik, Marx & Soloway in Schneider & Krajcik, 2000). Other views suggest that educative curriculum material should teach teachers to think about: (1) enrichment content from concepts accepted by educators, (2) pedagogical foundation, (3) content development and community dynamics into the future, (4) needs of educators, and (5) broader community needs (Ball and Cohen in Schneider & Krajcik, 2000).

Educative curriculum material in the form of resources and teacher guidance should cover the study component of instructions for use, practical curriculum variety, the content of the field of study for teachers and educators (enrichment), general pedagogic, and specialized pedagogical fields of study known as pedagogical-content-chemistry (PCC). The process of preparing resources and guiding teachers should be based on the principles of usability and adaptability that encourage teachers to be willing and able to learn. It is important to provide teachers about the development of the society in the future and the role of education as the center for character building through the fields of study "education through subject matter," which is a new paradigm as a modifier of the old model of "subject matter through education." Thus the interests of society are far more preferred than the benefits of the field of study; in other words, the socio-scientific approach is more prominent than the scientific method. The sources and guidelines of the teacher need to be structured in such a way that they have a role in arousing curiosity and want to train themselves. Therefore, on the content side of the field of study, it is necessary to develop content mapping based on the structure of science, problem-solving, and socio-scientific, which is also called the model of making decisions (Holbrook, 2005).

Some previous studies suggested that (1) the preparation of educative curriculum materials paid more attention to pedagogical content chemistry (PCC) because this knowledge was more effectively used by teachers than separate aspects of content and pedagogy, also could facilitate teacher willingness and learning ability in improving learning practices (Scheneider & Karjcik, & Marx, 2000). (2) The design of educative curriculum material should apply a heuristic approach because it is more effective in improving teacher learning (Davis, & Krajcik, 2005). (3) Educative curriculum material should prioritize an assessment-driven process approach and a pedagogical project-based science approach (Reiser et al., 2003). (4) Preparation of educative curriculum material should be carried out concerning learning objectives, principles of adaptability and usability so that it can act as a vehicle for reform, effectively used in large classes, and used by teachers in different situations (Schneider & Rivet, 2000). (5) Curriculum material should reveal operational matters accompanied by detailed descriptions because such presentation is felt by many teachers; increasing the quality of the instruction process is very dependent on increasing the knowledge and skills of teachers, school leaders, and educators obtained through the use of sourcebooks (Scheneider & Krajcik & Blummenfeld, 2005). (6) Educative curriculum material should provide training in making teaching plans for beginner teachers, provide opportunities for teachers to develop their ideas and strategies, make new teachers more confident in teaching, laying out basic ideas that can build the ability of teachers to adapt in creating new ways because comprehensive designs (involving content, instructional approaches, valuations, etc.) provide learning opportunities that are strong enough for novice teachers (Groosman & Thompson, 2004). (7) The chemistry education curriculum has tended to focus on the subject by raising internal concepts of the subject's interests so that chemistry learning is unpopular and irrelevant in the views of educators, therefore educative curriculum material should train teacher learning oriented towards the needs of educators (Holbrook, 2005). (8) Educative curriculum materials should be prepared about concerning reform standards, scientific content, teaching strategies, and having content that can develop teacher skills, reviewed by professional staff, and tested in the field (Flores *et al*., 2004).

In addition to the andragogy model, educative curriculum material is also carried out by applying the ADDIE model (Analysis, Design, Develop, Implement, Evaluation). This model is part of Instructional System Design (ISD), which emphasizes when implementation is carried out through ADIR (Absorbing, Doing, Interacting, and Reflecting) mechanisms. After being given the conditions by providing Educative Curriculum Materials (ECM), the first step for the teachers to do the *Absorbing* process is to absorb the information or knowledge contained in the ECM by reading, analyzing, summarizing, or making concept maps for each topic so that they find the concept of essence of reading. The second stage of the teachers performs the *Doing* process, which is to work on completing the work being trained in ECM in the form of answering questions, compiling syllabus, preparing lesson plans, or conducting optimization experiments on chemistry experiment procedures. The third stage is the *Interacting* process, which is to do interpersonal relationships with fellow teachers or with educators. Interaction with peer teachers is done through discussion or brainstorming so that the work completed produces a better product. The interaction with participants is carried out through the appearance of learning based on the lesson plan improvement. The fourth stage is doing the Reflecting process, which is analyzing the advantages and disadvantages of the product and work processes that have been produced or displayed. To determine the level of success of the process that has been carried out, then at the reflection stage an internal evaluation or self-evaluation or external evaluation is carried out. The weaknesses that have been identified, become a reference for the improvement process in the future (Clark, 2000).

Educative Curriculum Material (ECM) model "Amalgamation Teacher Knowledge" (ATK) as an alternative to improve understanding of pedagogical competencies and teacher professional competence because this model emphasizes the integration of various intact knowledge that must be possessed by the teacher. Even this ATK model encourages an increase in teacher academic performance through the mechanism of "Absorbing, Doing, Interacting, and Reflecting" (ADIR), as an educational process that opens opportunities for the growth of learning independence, so that the increase in professionality of chemistry teachers can run continuously. Because of that, a program to improve the professional competence of teachers is vital to be conducted (Hamdu, Sopandi, & Nahadi, 2018). Teachers' and learners' empowerment also can be improved through connecting the Use of Educative Curriculum Materials to Students' Engagement in Science Argumentation (Arias, Smith, Davis, Marino, Palincsar, 2017) or use of multimedia (Loper, Katherine, McNeill, González-Howard, 2017).

Research Problems

Based on the background of the problem that has been raised, the general problem of this research is "What components and impact of educative curriculum material (ECM) on improving high school chemistry teachers' performance and learner's achievement?". In particular, the formulation of the problem of this research are:

1. What the components pedagogical and professional knowledge to build an ECM that can empower the potential of chemistry teachers?
2. What the impact of using ECM on teachers' understanding of pedagogical and professional competencies?
3. What the impact of using ECM on the ability of chemistry teachers on planning and implementing chemistry instructional?
4. What the impact of chemistry instructional by teachers who use ECM on learners' achievement?

Research Purposes

The main objective of this study is to produce an "Educational Curriculum Material (ECM)" that effectively improves the understanding and performance

of chemistry teachers on pedagogical and professional knowledge and their impact on learners' achievement. Specifically this research aims:
1. Determine the component's pedagogical and professional knowledge to build an ECM that can empower the potential of chemistry teachers.
2. Determine the impact of using ECM on teachers' understanding of pedagogical and professional competencies.
3. Determine the impact of using ECM on the ability of chemistry teachers on planning and implementing chemistry instructional.
4. Determine the impact of chemistry instructional by teachers who use ECM on learners' achievement.

METHOD

Research Design

This study was a type of Research & Development (R & D) Model by Sukmadinata (2007) which consisted of preliminary studies, development studies, and testing studies. The preliminary and development studies have been carried out by Rosbiono (2010a) with the product obtained as an Educational Curriculum Material (ECM). ECM is a chemistry teacher resource book that contains aspects of pedagogy and fields of study (Chemistry) and provides educational aspects to motivate teachers to learn and practice continuously. In this study, analyzed again about the characteristics of the ECM, then continued to the testing phase that uses ECM in the chemistry instruction with acid-base material.

Acid-base chemistry material proposed in this study is based on reasons, namely: (1) this topic is commonly found in natural phenomena so it must be recognized by humans at various levels of education; (2) the material as a prerequisite to other essential concepts in chemistry; (3) the material that is directly related to syllabus of school chemistry; and (4) the material is instructional content which has a wide enough opportunity to build thinking skills and practice skills.

The testing phase is carried out through experimental studies *"The Matching Only Pretest-Posttest Control Group Design"* with the following pattern:

M (EG)	O_1	X	O_2
M (CG)	O_1		O_2

M(EG) = Matching of Experimental Group
M(CG) = Matching of Control Group
O_1 = Pretest
O_2 = Posttest
X = Chemistry Teaching with ECM

Research Subjects

The subject of this study consisted of chemistry teachers and high school learners in XI grade. A total of 36 junior chemistry teachers (have teaching experience 1-5 years) were selected by purposive sampling from the Chemistry

Teacher Group Discussion (CTGD) in Karawang City, Indonesia. Senior chemistry teachers (have teaching experience 6-20 years) as many as 36 people were selected by purposive sampling from the CTGD of Bandung City, Indonesia. Junior chemistry teachers are used as an experimental group that receives training using ECM by researchers for one semester, while senior chemistry teachers are used as a control group, where teaching uses non-ECM learning resources. The sample of students was 2 classes (64 people) from Karawang High School, as a group of experiments. Whereas 2 classes (64 people) came from Cimahi High School, Indonesia as a control group. The sample of students is chosen randomly.

Instruments
The relationship between the problem and the instruments used and validation techniques in this study are presented in Table 1 below:

Table 1: Research Instrument and Validity Technique

Problems	Instruments	Number of questions	Validation
ECM components	Questionnaire and interview	210	Content validity by Chemistry Education Expert, Chemistry Expert and Chemistry Curriculum Expert
Pedagogical knowledge and subject matter chemistry teacher	Item test multiple choice reason	100	Reliability Coefficient KR-20 = 0.8383 (Very high)
Teaching Plan	Form analysis lesson plan	21	Content validity by Chemistry Education Expert, Chemistry Expert and Chemistry Curriculum Expert
Teaching Implementation	Form teaching observation	17	Content validity by Chemistry Education Expert, Chemistry Expert and Chemistry Curriculum Expert
Student achievement	Item test multiple choice	50	Reliability Coefficient KR-20 = 0.6935 (High)

KR-20 = Kuder Richardson-20

Data Analysis
Data analysis of the pretest and posttest values was performed with Normalization Gain (N-Gain). N-Gain is used to determine the quality of student learning outcomes improvement before and after learning. N-Gain can be calculated using the formula:

$$N\text{-}Gain = \frac{S_{posttest} - S_{pretest}}{S_{max} - S_{pretest}}$$

The criteria for classifying N-gain results can be seen in the following table 2 (Meltzer, 2002).

Table 2: N-Gain Value Classification Criteria

Achievement of N-Gain	Criteria
Height	$(N\text{-}gain) \geq 0{,}7$
Medium	$0{,}7 > (N\text{-}gain) \geq 0{,}3$
Low	$(N\text{-}gain) < 0{,}3$

The significance of the means difference between the pretest and posttest scores was done by t-test. If the value of the t-count is greater than the t-table, the null hypothesis (H_0) is rejected. This means that there is a significant difference between the understanding of teachers who use ECM or students who learn from ECM users teachers than those who do not. If the t-count is smaller than the t-table, the H_0 is accepted. This means that there is no significant between the understanding of teachers who use ECM or students who learn from ECM users teachers than those who do not. T-dependent tests were performed to determine the difference between the pretest and posttest scores in each of the experimental and control groups, t-pre(E)-post(E) and t-pre(C)-post(C). While the t-independent test was conducted to determine the difference between the experimental-control group pretest scores, and the experimental-control group post-test scores (t-pre(E)-pre(C) and t-post(E)-post(C). Thus t-independent determines differences in achievement between the experimental group and the control group.

Research Findings and Discussion

Components of Educative Curriculum Material (ECM) for Chemistry Teacher

The components educative curriculum material for Chemistry Teacher shown in Table 3 below.

Table 3: Components of educative curriculum material

Components ECM	Sub Components ECM	Response Respondents (n = 72) Agree (%)	Strongly Agree (%)	Total (%)
Curriculum Knowledge	Level and Curriculum Components	34	66	100
	Curriculum Design			
	Curriculum Development			
	National Education Standards			
	Scope of Chemistry Content			
	Syllabus and Chemistry Lesson Plan			

Components ECM	Sub Components ECM	Response Respondents (n = 72)		Total (%)
		Agree (%)	Strongly Agree (%)	
Chemistry Subjects Knowledge	Chemistry Knowledge Dimension Concept Map of Chemistry Content Description of Main Concept of Chemistry Content Description of Prerequisite, Enrichment, and Applied Chemistry Concepts Description of Misconceptions Reading Resources for Learners	24.8	74	98.8
Chemistry Instructional Knowledge	Model, Approach, and Chemistry Instruction Methods Instructional Assessments Determining of Minimum Mastery Criterion Test Question Validation Preparation of Learners and Teachers Worksheet Instructional Media Development Classroom and Laboratory Management	31.7	67.4	99.1
Professional Development Knowledge	Development of Teacher Education Rights and Obligations of Chemistry Teacher's Social Interaction of Chemistry Teacher's Self Development of Chemistry Teacher Classroom Action Research	20.8	68.4	89.2
Academic Skills Development	Training about Compiling and Analyzing Syllabus Training about Compiling and Analyzing Lesson Plans Training about Drafting and Analyzing Learners and Teachers Worksheets Training about Making and Analyzing Instructional Media Training about Developing and Analyzing of Learners Book Training about Compiling and Analyzing Items Test Training about Composing Minimum Mastering Criterion	34.2	59.7	93.9

Components ECM	Sub Components ECM	Response Respondents (n = 72)		Total (%)
		Agree (%)	Strongly Agree (%)	
	Training about Validation of Test Question			
	Training about Instructional Simulation dan Reflection			
	Training about Developing A Laboratory Experiment			
	Training about Implementing Classroom Action Research			

Based on Table 3 above to build professional chemistry teachers, it is essential to understand the curriculum, school chemistry contents, chemistry instructional strategies, professional development, and academic skills to carry out chemistry learning well. As a practitioner and curriculum developer, chemistry teachers should know curriculum levels, so that the job descriptions as curriculum developers at the national, institutional (school) to class level are apparent. Based on the laws of the Indonesian national education system, in essence, the curriculum is interpreted as planning and managing for the provision of educational and instruction components. The simplest that the curriculum encompasses the components of the objectives, content, methods, and evaluation. Its component focus is carried out at the class level, while the teacher and education component, facilities and infrastructure, management, and budget are components of the curriculum that are run at the school level. Knowledge of curriculum design and development also really needs to be mastered by chemistry teachers. Since the proclamation of the Republic of Indonesia in 1945, the Ministry of Education and Culture has launched several curriculum reforms, ranging from the subject-based curriculum design, turned into a goal-based curriculum, student active learning-based curriculum, and recently in 2013 changed to the competency-based and integration-based curriculum (Arifin et al., 2007).

In 2003 the National Education System Law was launched. The regulation contains eight educational standards namely, Graduates Competency Standards, Content Standards, Process Standards, and Assessment Standards, Educators and Education Personnel Standards, Facilities and Infrastructure Standards, Management Standards, and Budget Standards. The first four standards are related to the learning process in the classroom, while the other four rules are related to the management of school-level education. Of course, to increase the insight of chemistry teachers, the essential concepts of all education standards must be contained in an educative curriculum material document. The scope of the material and theories of chemistry essence that must be taught in schools are included in the content standard document, while the syllabus guidelines and unit lesson plans are included in the conventional processes. With the detailed information contained in national education standards, it is conducive for the developers of learner's books, instructional media, and instructional assessments (Depdiknas, 2007)

The knowledge taxonomy that has been carried out in Indonesia lately is applying Anderson's view, which is to develop thought processes ranging from remembering to creating, in addition to that, the taxonomy reveals the dimensions of factual, conceptual, procedural, and metacognitive knowledge. By mapping chemistry content into the knowledge dimension, it becomes more apparent the knowledge that chemistry teachers must provide to their learners. Following the characteristics of chemistry, in addition to mapping the aspects of learning according to Anderson, chemistry teachers must also think of the macroscopic, sub-microscopic, and symbolic aspects of the chemistry content they taught. Chemistry teachers also need knowledge in making concept maps of hierarchical forms. This knowledge is essential because it can be trained and used as an assessment tool to explore learners' comprehensive understanding of the chemistry concepts they learn (Arifin et al., 2007; Karyadi et.al, 2007).

Description of the main concepts, prerequisites, enrichment, applied, and misconceptions of school chemistry content is very necessary for chemistry teachers because it provides a comprehensive understanding, so it is conducive to making regular instructional plans, remediation or enrichment. Explanation of enrichment chemistry content is not widely revealed in most high school chemistry books, even though it is very much needed by teachers to provide answers to critical student questions. Chemistry lessons that do not reveal applied concepts in real life will reduce the attractiveness and motivation of learners. Through Vygotsky's social constructivist approach, contextual (real-life) instruction of chemistry is essential and is an obligation of the chemistry teacher (Arifin et al., 2007).

To increase learners learning motivation and strengthen positive perceptions of chemistry lessons, the chemistry content presented not only reveals the essential concepts but also has to touch the needs of daily life. In this regard, the school chemistry curriculum provided in the Netherlands is implemented in the form of themes such as themes related to fire prevention, marine chemistry, food quality and water quality (De Vos et al., 2003; Gilbert et al., 2003). Likewise, in Western Australia, the school's chemistry content provided is focused on the study of household chemicals, environmental and industrial chemical processes, chemical production, forensic chemistry, and environmental chemistry.

Thus the chemistry curriculum provides opportunities for learners to complete their vocational competencies by working in a laboratory. This new proposal is consistent with the educational tendency towards more relevant content, contextual learning, understanding of scientific methodologies, and the development of chemistry literacy for learners. Another thing that is not less important that chemistry teachers still need about Reading Resources for Learners (RRL). Learners can use many chemistry instructional materials but professional teachers should to identify and even create RRL that better suits the needs of learners. Thus the important thing that can be taken based on the data above is that the curriculum material that must be developed can describe "holistically" chemistry materials that will be presented to learners.

An understanding of the Model, Approach, and Chemistry Instructional Method and practice skills is one of the characteristics of a professional chemistry teacher. The learning process that applies multi-methods will maximize the learning experience gained by learners. The preparation of the Instructional Assessment Tool that is in line with the learning objectives will provide objective information about the learning outcomes achieved by learners. Thus the teacher can determine the Minimum Criteria for Mastery Learning from the material being taught, so the teacher can identify which learners need to be enriched or remediated. Conducting Test Question Validation activities both in determining the validity of the content, the analysis of the severity, the level of difficulty, and the distinguishing power of test questions are essential parts that the teacher should master so that from time to time the teacher can develop and obtain a reliable assessment tool (Karyadi et al., 2007).

To correct student worksheets, the teacher must have data generated from laboratory optimization tests. Instructional Media Development activities, either searching through electronic media or developed by the teacher is a crucial part of clarifying learner's understanding of microscopic concepts. Likewise, a good knowledge of Classroom and Laboratory Management activities can facilitate learners in getting used to being involved in problem-solving as one of the primary missions of instructional chemistry.

The data above shows that the chemistry teacher who is a research respondent needs information related to professional development, as indicated by the high percentage of responses that agree and strongly agree with the questionnaire statement submitted. Very extreme is the need for Classroom Action Research and Self Development of Chemistry Teacher. Information related to the Development of Teacher Education in Indonesia wants to know as a basis to get a more practical orientation of their self-development. Information associated with Social Interaction of Chemistry Teachers, both with fellow teachers, learners, school leaders, parents, professional institutions, and the government is also needed. It seems that respondents want information about the substance that must be raised in conducting excellent professional communication, so that social interaction takes place more effectively not only lived naturally, as it is.

The National Board of Professional Teacher Standards have developed assessment standards and procedures based on five basic principles (Depdiknas, 2005; Dharma, 2008), namely: teachers are committed to learners and their learning; the teacher knows the teaching material they teach and how to interpret the content to learners; the teacher is responsible for managing and monitoring learners learning; teachers think systematically about what they do and learn from experience; the teacher is a member of the learning community. The last two items are not optimal parts that occur in the field, as indicated by respondents in this study. The culture of recording or documenting work done or called reflection is an effort that must be encouraged. With the internalization of Classroom Action Research knowledge, it is expected that instruction will continue to improve. The teaching profession is a position that requires specialized training for a long time. Itis having a code of ethics to explain things that are doubtful or doubtful relating to the services provided. Specific training will also be effective, if supported by information sources, in this case, curriculum material that accommodates teacher needs.

Every teacher, including the respondents in this study, is a person who is developing and has a high enough potential to be creative to improve his performance. If this development is given more directed guidance, it will show optimal performance. The development of the teaching profession must also be balanced with other efforts such as establishing a unique library for teachers so that teachers, are not too difficult to find materials and references for teaching in class. Other developments can be done by providing opportunities for teachers to compose their learning materials as additional books for learners, both individually or in groups. This effort can motivate teachers to innovate and develop creativity, which means providing opportunities for teachers to improve their performance. The thing that needs to be addressed and reaped its benefits based on this research data is that essential information relating to the professional development aspects of the chemistry teacher above must become a substance or an integral part of the curriculum material to be developed. This indicates that the curriculum material developed must build "Amalgamation Teacher Knowledge" as required in professional teacher competency standards. Another thing that curriculum material must have the character of "flexibility" is that it can accommodate pre-service education needs and in positions. It is no less important that curriculum materials should guide chemistry teachers towards "self-reliance" in reflecting on their performance.

There are eleven academic skills in chemistry teachers proposed by respondents to be accommodated in curriculum materials. Researchers observed that the intensity of the prospective chemistry teacher's academic skills training held in the Professional Skills Course and the Professional Course when pre-service education was still not enough to build professional chemistry teachers. Therefore, these skills need to be trained intensively and continuously in a variety of teacher coaching activities such as in Teacher Professional Education for pre-service education, and Chemistry Teacher Group Discussion activities for in-service education. It should be noted that a teacher's academic skills cannot be transferred from a trainer to a participant teacher, so training is a non-negotiable requirement, without training yourself, the achievement of becoming a professional teacher is not possible. For training to be more targeted, effective, and efficient, each academic instruction skill that will be trained, teachers must first know and even find a "key formula" that acts as a guide that they can adapt to new conditions. For example, in compiling syllabus components, the teacher obtains a critical formula that "syllabus component = curriculum component + curriculum design model adopted." The curriculum component consists of (1) objectives, (2) content, (3) learning experiences, (4) methods, (5) time allocation, (6) tools, materials, and instruction resources, (7) instructional process, and (8) assessment.

If the curriculum design model adopted or implemented is Competency-Based Curriculum (CBC), then the characteristics of the curriculum design model are the targets in the form of Competency Standards (CS), EssentialCompetencies (EC), and Indicators of Competency Achievement (ICA). By substituting the CBC curriculum design model characteristics namely CS, EC, and ICA into number (1) the objectives of the curriculum component, the syllabus component in the CBC must be composed of CS, EC, and ICA components, followed by number (2) to number (8) of the curriculum component. Another thing that might be considered new for chemistry teachers is the need to develop Teacher Worksheets (TW). LW contents are similar to the Learners Worksheet (LW). In TW, data must be filled (answer key) as a reference that must be found by learners in their LW (Arifin et al., 2007).

In this way, teachers can provide a relatively regular assessment of the performance of learners. If the TW requires laboratory experiment data, the teacher first performs an optimization test of the experimental procedure that will be carried out by the learners. In other words, the teacher is ready to check the data that the learners will lookfor. Based on the needs of the respondents in this study, the educative curriculum material developed must provide a "key formula" as a guide for teachers. Thus educational curriculum material must be "adaptable" to curriculum changes.

The Impact of using ECM on Understanding Pedagogical and Professional Knowledge of Chemistry Teachers

Understanding Pedagogical and Professional Knowledge of Chemistry Teachers were shown in Table 4.

Table 4: Competencies Chemistry Teacher

Subject	Group (n)	Pretest value				Posttest value				NG value
		a	b	c	d	a	b	c	d	
Junior Chemistry Teacher (1-5 years)	Experiment (36)	39	40	33	31	72	66	70	78	0.56
		35.61				71.60				
Senior Chemistry Teacher (6-20 years)	Control (36)	49	47	39	37	55	50	51	57	0.19
		42.78				53.46				

(a) understanding of the chemistry teacher professionalism
(b) understanding the high school chemistry curriculum
(c) understanding of acid-base chemistry in High School
(d) understanding of chemistry instructional acid-base in High School

The data in Table 4 shows that in the initial state (pretest), senior chemistry teachers' understanding of teacher professionalism (score 49 out of 100), curriculum (score 47), acid-base chemical content (score 39), and teaching strategies (score 37) higher than junior chemistry teachers. Thus the teaching experience factor contributes to the teacher's pedagogical and professional competencies (Vaudroz, Berger, Girardet, 2015). The senior chemistry teacher shows the perspective that teaching chemistry is a task to empower students' self abilities in addition to equipping their chemistry. Junior chemistry teacher still views teaching as a technical work for transferring chemistry (Edge, 2015). But when we look at the post-test scores, it turns out that junior chemistry teachers' understanding in all aspects of teacher professionalism is higher than senior chemistry teachers. It is suspected that Junior teachers have used ECM and received incentive training by the research team for one semester in the 2018/2019 academic year. By paying attention to the NG value of 0.56 (medium category), it can be said that the use of ECM and its training is effective in increasing the ability of chemistry teachers because ECM is designed to educate teachers to want to learning (Anthopoulou, Valkanos, Fragkoulis, 201; Ibrahim, Yusof, Yaakob, Othman, 2019).

In other words, that the increase in learner's achievement from the experimental group (receiving instruction from teachers using ECM) on acid-base chemistry is higher than control group learners (receiving education from teachers who do not use ECM) because these learners get psychological effects from ECM teachers in the form of achievement motives. Because ECM teachers have relatively superior pedagogical and chemical knowledge through intensive training. The excellence that exists in the teacher's persona is an example that is used as an example for learners so that learners are inspired to excel. This phenomenon is in accordance with studies developed by Bobrakov (2014); Magwilang (2016); Krajcik & Delen (2017).

The results of statistical testing hypotheses about Teachers' understanding of pedagogical knowledge and professional knowledge are shown in Table 5 below.

Table 5: Statistical hypothesis test results of chemistry teachers understanding of pedagogical dan chemistry subject knowledge

Statistical Parameters	T test dependent				T test Independent			
	Pre (E)	Post (E)	Pre (C)	Post (C)	Pre (E)	Pre (C)	Post (E)	Post (C)
n	36	36	36	36	36	36	36	36
df	70				70			
t-cal	+50.68		+22.45		+0.595		+6.63	
t-table	+1.994		+1.994		+1.994		+1.994	
H_0	rejected		rejected		accepted		rejected	

E= Experiment group; C = Control group

The data in Table 5 shows that increase teacher understanding in both groups was significant (Ho rejected). Both teachers who use ECM or not. However, if we analyze based on an independent t-test shows that the Ho pretest in both groups was accepted, it implies that the initial ability of teachers from both groups about similar. In contrast to the posttest value, that the Ho was rejected, meaning that the final ability of the Junior chemistry teacher significantly different than the Senior chemistry teacher. (Arias, Smith, Davis, Marino & Palincsar (2017); Barron, Rupley, Paige, Nichols, Nichols, JrLumbreras (2018); Jusuf *et al.*, 2019)

Chemistry Teacher Performance in Planning and Implementing Acid-Based Chemistry Instruction

The performance of chemistry teachers in planning acid-base instruction is shown in Table 6 below.

Table 6: Chemistry teacher performance in planning for instruction acid-base materials

Lesson Plan	Experiment Group		NG	Cat.	Lesson Plan	Control Group		NG	Cat.
	Initial	Final				Initial	Final		
LP-1	34	57	0.8	high	LP-1	28	38	0.3	med.
LP-2	34	56	0.8	high	LP-2	30	38	0.2	low
LP-3	35	57	0.8	high	LP-3	25	35	0.3	med.
LP-4	33	56	0.8	high	LP-4	27	37	0.3	med.
LP-5	41	60	0.9	high	LP-5	25	36	0.3	med.
LP-6	38	59	0.8	high	LP-6	26	36	0.3	med.

NG = Normalization Gain; Cat. = Category; med. = medium

The data in Table 6 above shows an increase in the performance of the experimental group chemistry teachers in making lesson plans (LP) after they use ECM. The performance improvement is categorized high, as stated by the Gain-normalization value. The performance improvement is mainly in overcoming the weaknesses done previously in terms of (1) formulating competency achievement indicators, (2) formulating learning objectives, (3) formulating teaching materials, (4) writing laboratory equipment and chemicals, (5) include learning resources, (6) write and choose learning media, (7) formulate learning assessments, (8) the existence of instructional media, (9) optimization of experimental procedures, and (10) preparation of learners' reading.

It should be noted, that the form of the unit lesson plan used by chemistry teachers is based on the Process Standards document. In the document, the components of the unit lesson plan consist of identity, core competencies, essential competencies, competency achievement indicators, instructional objectives, instructional chemistry content, instructional strategies, instructional media-equipments-resources, instructional steps, and instructional assessment. The identity of the unit lesson plan contains information about the school name, name of the subject, semester, subject matter, sub-subject matter, and time allocation. Core and essential competencies are sourced from school chemistry syllabus documents that are determined nationally by the education and culture department. Chemistry teachers are obliged to develop indicators of competency achievement that refer to the formulation of essential competencies. To reflect on the instructional strategies to be carried out, the teacher is obliged to develop operational instructional objectives that involve the ABCCD component (Audience, Behavior, Content, Condition, and Degree). Learning content expresses the label and description of essential concepts. Content knowledge is broken down into factual, conceptual, procedural, and metacognitive knowledge, according to Anderson's taxonomy. As the completeness, a map concept, macrostructure and instructional material of the learners is attached.

Instructional strategies are expressed from the level of models, approaches, methods, techniques to tactics. The policy required by the curriculum is learning that is inspiring, innovative, and empowers learners' potential. This type of instruction is Problem-based Learning, Discovery Learning, Project-Based Learning, Guided Inquiry, Science Process Skills, instructional 5E (Engagement, Exploration, Explanation, Elaboration, Evaluation), and others that are collected in scientific learning. Instruction media that are highly recommended in instructional chemistry are experiment-based or demonstration-packed in the form of learner worksheets. Chemistry teachers are required to optimize laboratory work, so teachers have data that is useful for correcting the work of learners.

Learning resources included in the unit lesson plan document are teaching materials developed by the teacher or from other relevant authors. Instructional resources must be written based on standard procedures. The instructional steps are written in three phases, namely the opening stage, the core, and closing activities. All aspects are colored by the model, approach, and learning method chosen. The final component in the unit lesson plan is assessment. The assessment revealed the types of instruments used to measure knowledge competencies, skills, and attitudes. Likewise, the overall learning planning document consists of the main document and attachments, which are concept maps, macrostructure, teaching materials, learner worksheets, instructional media, assessment grids, items and answer keys, observation skills, and attitude sheets.

Chemistry teacher performance in implementing acid-base instruction is shown in Table 7 below. The data in Table-7 shows an increase in the performance of chemistry teachers in presenting acid-base instruction when they have used ECM as a source to improve their instruction plans. Thus an excellent instruction performance depends very much on proper planning. Reflecting on what is shown, also observing and giving an assessment of the appearance of peers turned out to have a positive impact on improving performance.

Table 7: Chemistry teacher performance in implement instruction acid-base material

Teacher	Experiment Group		NG	Cat.	Teacher	Control Group		NG	Cat.
	Initial	Final				Initial	Final		
T-1	19	48	0.9	high	T-1	22	34	0.4	med.
T-2	29	51	1.0	High	T-2	31	45	0.7	high
T-3	28	50	1.0	High	T-3	28	44	0.7	high
T-4	17	47	0.9	High	T-4	20	34	0.5	med.
T-5	19	43	0.8	High	T-5	18	29	0.3	med.
T-6	29	50	1.0	High	T-6	29	46	0.6	med.

NG = Normalization Gain; Cat. = Category; med. = medium

The findings show that chemistry teacher skills in displaying instruction models require sufficient time allocation so that the frequency of peer teaching needs to be increased. The experience of viewing an instructional model well apparently has a significant impact on the ease of viewing other types of instructional models. Critical feedback from peers and examples of ways of presenting instruction by the mentor, an enormous influence on teacher teaching changes. Therefore, empowering activities in the focus group discussion of chemistry teachers becomes essential. Thus an effort to increase the chemistry teacher's acceleration skills in presenting innovative learning is to restructure the focus of Focus Group Discussion activities towards a more productive direction by producing better curriculum material. Chemistry teachers need to identify their strengths as the basis for developing their expertise so that some focus on fostering expertise in the field of learning innovation, teaching material development, instructional IT media, and evaluation of learning chemistry.

Impact of Instruction with ECM on Learner Achievement on Acid-Base Material

Learner achievement on acid-base material is shown in the following Table 8. The superiority of learners in answering chemistry questions lies in convergent questions that demand one answer and algorithmic questions. Understanding the factual, and conceptual knowledge of chemistry lessons is relatively better than procedural and metacognitive knowledge. For example learners answers to topic questions (h), (j), and (m) relatively better. Instead of the answers of learners who are still low lie in questions that require explanations, alternative thinking, critical and creative thinking, analyzing or higher-order thinking skills, procedural and metacognitive knowledge such as the topic of questions (a), (b), (c), (d), (e), (f), (g), (i), (k) and (l). Therefore in the future learners must be trained to intensively build metacognitive strategy. This phenomenon is in line with studies conducted by Espinosa (2014), and Talin (2016).

Table 8: High School Learners Competencies to Content of Acids-Bases Chemistry

Subject	Group (n)	Pretest value	Posttest value	NG value
HS Student Karawang	Experiment (64)	32.03	69.13	0.55
HS Student Cimahi Bandung	Control (64)	30.72	42.78	0.17

Based on the NG values it can be stated that the increase in learners' achievement in the experimental group is in the medium category, while the control group learners are in a low category. In other words, that the increase in learner's achievement from the experimental group (receiving instruction from teachers using ECM) on acid-base chemistry is higher than control group learners (receiving education from teachers who do not use ECM) because these learners get psychological effects from ECM teachers in the form of achievement motives. Because ECM teachers have relatively superior pedagogical and chemical knowledge through intensive training. The excellence that exists in the teacher's persona is an example that is used as an example for learners so that learners are inspired to excel. This phenomenon is in accordance with studies developed by Bobrakov (2014); Edge 2015); Magwilang (2016); Krajcik & Delen (2017); Bernard (2017).

The results of statistical testing hypotheses about learner achievement in acid-base chemistry are shown in Table 9 below.

Table 9: Statistical hypothesis test results of learner understanding about the concept of acid-base

Statistical Parameters	T test dependent				T test Independent			
	Pre (E)	Post (E)	Pre (C)	Post (C)	Pre (E)	Pre (C)	Post (E)	Post (C)
n	64	64	64	64	64	64	64	64
df	126				126			
t-cal	+38.11		+11.64		+0.446		+13.25	
t-table	+1.979		+1.979		+1.979		+1.979	
H_0	rejected		rejected		accepted		rejected	

E= Experiment group; C = Control group

To confirm the level of significance between the different means between pretest and posttest, a t-test was performed. The t-dependent test was conducted to determine the significance of the difference means between pretest and post for each experimental group t-(pretest-E & posttest-E), and the control group t-(pretest-C & posttest-C). The data in Table 9 shows that increase learners' achievement in both groups was significant (Ho rejected). Both learners learn from teachers who use ECM learning-resources and other learning resources.

However, if we analyze based on an independent t-test, namely the t-(pretest-E & pretest-C) the data in table 4 shows that the Ho pretest in both groups was accepted, it implies that the initial ability of learners from both groups about similar. In contrast to the t-(posttest-E & posttest-C), the data in table 4 shows that the Ho posttest in both groups was rejected, meaning that the final ability of the experimental learners significantly different than the control group learners. Reinforced by the data NG (0:55) that learners achievement experimental group is higher than NG (0.16) control group, so it can be stated that the learning achievement of learners learns from teachers who use ECM higher than the learners learn from teachers who do not use ECM. Thus the achievement reached by learners is related to the ability of the teacher's performance (Arias, Smith, Davis, Marino & Palincsar (2017); Barron, Rupley, Paige, Nichols, Nichols, JrLumbreras (2018); Jusuf *et al*., 2019)

CONCLUSION

This study shows: (1) Educative curriculum materials that are effective in improving the performance of chemistry teachers must contain about the chemistry curriculum, chemistry instructional strategies, school chemistry content, professional development, and academic skills; (2) Junior chemistry teachers' understanding of pedagogical and professional knowledge using ECM and trained better than senior chemistry teachers who do not use ECM; (3) Based on NG value, the teachers' performance of experimental group shows in drawing up a lesson plan is much higher than that of the control group. The performance of the teachers who became the experimental group showed the ability to demonstrate the instructional of acid-base chemistry was far higher than that of the control group teachers; (4) The achievement of learners who receive acid-base instruction from teachers who use educative curriculum material is far higher than that of learners who receive acid-base instruction from teachers who do not use educative curriculum material and differ significantly. Given these above, it can be concluded that the development and implementation of the Educative Material Curriculum Material (ECM) are optimally successful in increasing pedagogical and subject matter knowledge as well as the academic skills of chemistry teachers as well as learners' achievement.

RECOMMENDATION

Since the Educative Curriculum Material (ECM) is effective in increasing understanding of pedagogical and subject matter competencies as well as the academic skills of chemistry teachers, a Teacher Education Program, both pre-service and in-service Teacher Training Program, should use the ECM. This ECM can be used as one of the substances of Professional Expertise Courses (PEC) or in entering the Teaching Practice Program (TPP). Because the ECM requires the integration of several disciplines, the coach of the PEC course is expected to have technical and practical experience in schools. Likewise, in-service teacher institution's primarily Chemistry Teacher Group Discussion (CTGD), can adopt and adapt ECM as a filler for their activities so that CTGD activities run continuously and produce products as a professional teacher of chemistry.

Since the ECM raises generic aspects of the curriculum, instruction, and professional development of teachers, then there are opportunities for different researchers to try the ECM model on other subjects with adjustments to the content of their issues. For researchers in the field of chemistry education, such models can be developed in other teaching materials besides acid-base that was tried in this study. With the research of high school chemistry teaching materials, it is hoped that one day, the ECM model will be intact. Likewise, in terms of practical training on the academic skills of chemistry teachers, there are still wide open opportunities to hold exercises outside the preparation of lesson plans and instructional performance. One of the needs that are considered urgent by chemistry teachers is the practice of preparing Classroom Action Research (CAR) proposals and implementation as well as scientific publications. Eleven skills that must be trained and possessed by chemistry teachers, three of which are skills in making assessment tools, making learning media, and optimizing laboratory experimental procedures.

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