

Developing Teaching Materials of Natural Product Chemistry to Increase Student's Life Skills

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Developing Teaching Materials of Natural Product Chemistry to Increase Student's Life Skills

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ABSTRACT

The research aimed to develop teaching materials of natural product chemistry (NPC) by conducting group investigation of cooperative learning model to increase students' life skills and to describe their feasibility. In this research, students' life skills include academic and social skills. Then, the intended feasibility includes three aspects—validity, practicality, and effectiveness aspect. The teaching materials (i.e., syllabus, lesson plan, students' books, and students' worksheets) accompanied by students' life skills observation sheets were developed using Research & Development methods as proposed by Borg and Gall. The teaching materials developed were used for the students of Chemistry Department, Universitas Negeri Surabaya, Indonesia. The developed materials were further assessed and validated by an expert (for validity aspect), and the implementation of the materials in the class were observed by a number of observers (for practicality and effectiveness aspects) and then analyzed quantitatively and described qualitatively. The findings of the research showed that the developed teaching materials of NPC were feasible because of their validity, practicality, and effectiveness. This means that the materials were valid according to the expert's judgments, were practical and effective when implemented in the NPC learning process, and were able to increase students' life skills.

Keywords: Feasibility, Natural Product Chemistry, Students' Life skills, Teaching Materials.

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INTRODUCTION

Materials include textbooks, workbooks, cassettes, CD-ROMs, videos, photocopied handouts, newspapers, etc., and are used to impart knowledge (Tomlinson, 1998). Further, Tomlinson (2001 in Harsono, 2007) stated that "materials mean anything which are used to facilitate the learning process of students" and can be called as teaching materials. Teaching materials can be presented in the form of prints, live performances, on cassettes, CD-ROMs, DVDs, or via the internet. However, in this research, we focus on teaching materials that are presented in print form, including syllabus, lesson plan, students' books, students' worksheets, and students' life skills observation sheets.



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Natural product chemistry (NPC) is the name of a course taken by students in the third year. In Indonesia, the course had been available mostly in higher education, including, in Chemistry Department, Universitas Negeri Surabaya, Indonesia. Almost all of Chemistry Department of higher education in Indonesia held the course above. However, for this time, the course was taught without involving chemicals and other environmental sources as real objects in the classroom. Teaching materials of NPC arranged on the basis of field studies and using chemo-entrepreneurship (CEP) are not available in Indonesia. Therefore, we tried to prepare the materials (syllabus, lesson plan, students' books, students' worksheets, and students' life skills observation sheets) in this research.

Life skills have been defined by the World Health Organization as "abilities for adaptive and positive behavior that enable individuals to deal effectively with the demands and challenges of everyday life." They represent the psycho-social skills that determine valued behavior and include reflective skills, personal skills, and interpersonal skills. Life skills are thus distinctly different from physical or perceptual motor skills, as well as from livelihood skills, such as crafts, money management, and entrepreneurial skills (https://en.wikipedia.org/wiki/Life_skills-based_education).

Entrepreneurial skill is the ability of an individual to exploit an idea and create an enterprise (small or big) not only for personal gain but also for social and development gains (Olagunju, 2004 in Adeyemo, 2009). Entrepreneurship itself can be positively linked to economic growth by introducing new ideas, processes, products, services, and business opportunities (Mayhew *et al.*, 2012). Thus, we introduce a CEP approach, which is used in the learning process to use and maximize chemicals and other environmental sources as real objects. Chemical here means associated with chemical components contained in a plant and the functionality and usability of the plant itself to the interests and welfare of the community. In this case, students may learn to improve and give added value of the sources. Students can take advantage of a plant, e.g., mangosteen rind, that is known to contain a chemical mangostin as an antioxidant ingredient and/or for other bioactivity functions.

By using the CEP approach, students will get a hands-on experience in handling chemicals and environmental sources. Hence, the students are able to not only know, learn, and create how the sources can be treated to be new ideas, processes, and products that are useful and that have economic value but also grow their entrepreneurial skills. In this paper, we want to analyze students' entrepreneurial skills especially related to students' co-operation and communication skills that are part of social skills, besides academic skills.

Currently, in Indonesia, 70% out of 4,135,975 students opt for nonvocational subjects and only 30% opt for vocational subjects, and the university enrollment rate was only 29%. More than 71% or 2,055,580 students to general high school graduates back to the community without life skills (www.pdsp.kemdiknas.go.id). This means that they do not have the life skills to be truly ready for on-field activities. Therefore, a learning process that integrates the CEP approach to grow students' life skills should begin immediately, especially, in Indonesia.

Utomo *et al.* (2015) reported that the training of CEP approach integrated life skills is considered to be very appropriate to be administered to chemistry teachers. Related to this report, Paristiowati *et al.* (2014) have done a research that was conducted at SMAN 39 Jakarta, Indonesia. They informed that a student's cooperation and communication skills that are part of entrepreneurial skills can be improved through the implementation of the CEP approach. To improve a student's social skills, it can be facilitated by starting to use real objects or phenomena orientations available in our environments (Hardy, 2003). It meant that objects or phenomena orientations can be used as a source and media to train students' social skills such as cooperation and communication skills. In this view, environments as material sources can be used as media of CEP or can be brought in the class to be studied by students. Material sources include herbs, processed products of herbal plant, preparation

process and packaging process. Therefore, an NPC lesson should be arranged and developed by partly involving environments. In this, material sources as media can be involved to arrange the teaching materials of NPC. The lesson can be provided in the class through an appropriate learning strategy. This can be achieved through a field study and using the CEP approach so that students can gain the required entrepreneurial skills.

Field studies should be done by teachers prior to preparing the teaching materials. By undergoing field studies, teachers will obtain many experiences so that they can overcome and look for a solution for handling the student's problems when students did a wrong activities deal with the results of field study. When conducting field studies, it was possible for students to do activities that are less precise, such as preparing the observation sheet for identification of the type and name of the herbs, mentioning its function as a traditional medicine, preparation for phytochemical test herbs, and others. To promote an achievement of students' life skills, a learning model that can be used to model and accelerate its syntax based on field study and CEP approach. That is, the syntax of the model should contain phases and activities of teachers and students who are oriented toward field study and CEP approach. The proposed learning model is the **group investigation cooperative learning model (GI-CLM)**.

GI is one form of CLM. In GI, students form interest groups within which they plan and implement investigations and demonstrate the findings to the class in the form of group presentations (Ivy Geok-Chin Tan *et al.*, 2006). The teacher's general role is to make the students aware of resources that may be helpful while conducting the investigation (Zingaro, 2008). For this reason, we choose GI-CLM as stated by Slavin. Slavin (2005) stated that the syntax of the model included the following: 1) identify topics and segregate students into groups, 2) plan tasks that are learned, 3) perform the investigation, 4) prepare final reports, 5) present the reports, and 6) evaluate the final reports.

According to Joyce and Weil (Aunurrahman, 2010), GI-CLM possessed advantages that are able to facilitate academic research skills, social integration, and social learning process. The model made a condition in which students not only perform academic research but also perform social integration and a social learning process. As we have mentioned above that academic and social skills are a part of entrepreneurial skills, the skills should be trained in the learning model. For this reasons, this study focuses on developing teaching materials of NPC by conducting field studies and using the CEP approach. In general, the study can be illustrated by a framework as shown in Figure 1.

Developing teaching materials of NPC using GI-CLM to increase students' life skills has not been done yet. In addition, the materials developed by focusing more on field studies and by using the CEP approach had not also been done yet. The materials were developed by directly relating to real objects or phenomenon in our environments. By conducting field studies and using the CEP approach, students may obtain learning experiences regarding how a treatment process of natural sources may become useful products and added value. As a result, the learning process will be more interesting, joyful, and meaningful (Supartono, 2006 cited from Saptorini and Mursiti, 2007). One of the advantages of the learning that is developed on the basis of field studies and by using the CEP approach is that it enhances students' life skills. Students are able to use and maximize the natural sources (i.e., potential plants) become herbal medicines (Saptorini and Mursiti, 2007). In order to facilitate the learning mentioned above, it is required to develop teaching materials as mentioned above. In this paper, we only focus on students' life skills, in particular, **academic skills**, such as formulating a problem, preparing a hypothesis, designing a procedure, performing analyses, interpreting data, discussing, obtaining a conclusion, and presenting reports, and **social skills**, such as responsibility, collaboration, and accepting differences.

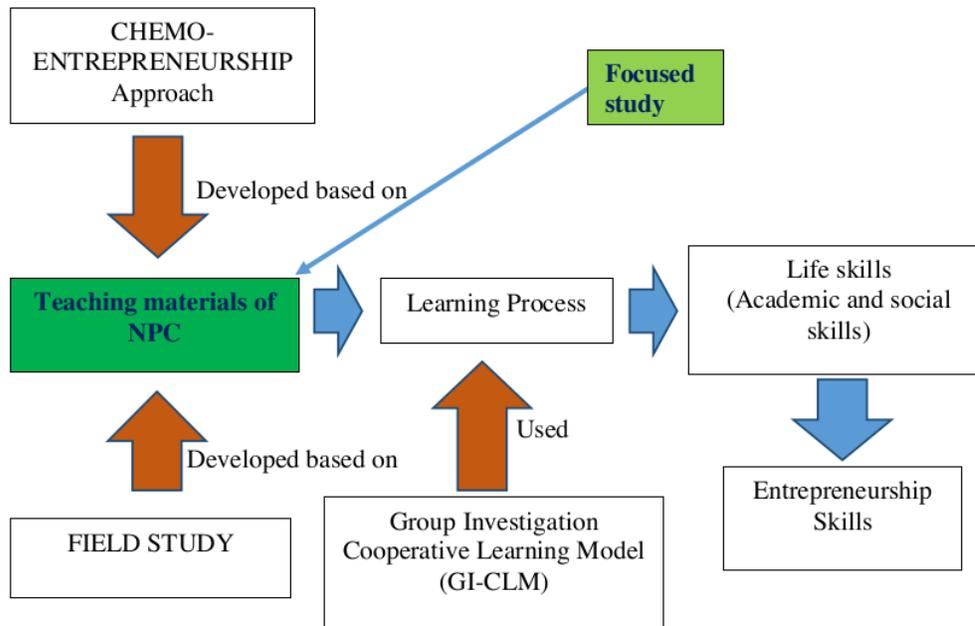


Figure 1. Theoretical framework to develop teaching materials of NPC using GI-CLM, to implement the materials, and to know their effects toward the students' life skills

The aim of the research is to know the feasibility of teaching materials developed on the basis of field studies and by using the CEP approach to increase students' life skills. According to Nie¹⁶n (1999), the feasibility of a teaching material should be tested from three aspects, i.e., validity, practicality, and effectiveness of the developed teaching materials. In this research, the validity of the materials will be theoretically determined on the basis of an expert's judgments, while the practicality of them will be answered by collecting data related to the implementation of the lesson plan and students' activities during the instructional process in the classroom. Then, the effectiveness of the materials will be examined by collecting data using the results of students' academic and social skill observation sheets during the learning process. The results and materials help the teachers in constructing students' academic skills of NPC and supporting students' social skills. We hope that the findings of the study could guide and help the lesson designers (teachers) in designing better teaching materials for teaching NPC.

METHODS

a. Teaching Materials' Development Procedures

The research was performed to know the feasibility of the teaching materials of NPC that were developed on the basis of field studies and by using the CEP approach through GI-CLM and to describe the results of implementation of the materials in the classroom. The research was done in three stages, i.e. 1) developing the materials, 2) doing validation and revision the materials, and 3) trying out the materials in the classroom.

³⁰ At the first stage, the teaching materials were developed by referring to Research & Development (R&D) method (Borg and Gall, 1989). The R&D method consists of ten stages,

5 that are: (1) Study and Information Collecting, (2) Product Planning, (3) Preliminary Product Form developing, (4) Preliminary Field Testing, (5) Main Product Revision, (6) Main Field testing, (7) Operational Product Revision, (8) Operational Field Testing, (9) Final Product Revision, and (10) materials implementation. All of the first stages had been done and required corrections were revised to produce teaching materials of NPC. The teaching materials developed consist of syllabus, lesson plans (LP-01; -02; and -03), students' books (SB-01, -02, and -03), and students' worksheet (SW-01,-02, and -03). Ten stages to develop the materials can be explained as follows.

(1) *Study and Information Collecting*

At this stage, it has been carried out the literature study and field study. Literature study that had been conducted is to analyze the concepts and theories related to teaching materials of NPC especially the material support of Basic Competences and the selected indicators. The activity of field study supported by CEP approach is to identify, acquire, and collect information related to the early knowledge and descriptions of bioactive plants presented in the field. The next information are the results of phytochemical test of the plants, the recognition and understanding of the various separating techniques, and the knowledge and processing of traditional medicinal plants into herbal medicine. Stages of this research have largely been done in the first year (2014) of two years (2014-2015).

(2) *Product Planning (teaching materials of NPC)*

In this research, products proposed are NPC teaching materials. The entire information obtained from the first stage was used as materials to prepare and develop teaching materials of NPC. The plan of the development of teaching materials of NPC is initiated by preparing syllabus, lesson plan, students' book, and students' worksheet and is then followed by preparation of students' life skill observation sheets. The following are the components of students' books: 1) book title, 2) foreword, 3) a brief description of the course (includes competency standards, basic competences, indicators, and learning objectives) are taken from the syllabus and also laid in each chapter, 4) keywords, 5) chapter (matter), 6) exercises, 7) references, and appendix such as 8) student worksheet.

(3) *Preliminary Product Form Development*

Development of teaching materials of NPC, of course, preceded the development of the syllabus and lesson plan. Lesson plan is a guide that may be created by lecturers (researchers). The steps of the learning process should be well organized in a scenario of activities such that it easily facilitates and transfers matter to students. Moreover, a lesson plan is prepared for each meeting and comprises three meetings ($3 \times 3 \times 50$ min). Each meeting contains a different matter. Scenario learning activities developed by using GI-CLM as proposed by Sharan (in Supandi, 2005), includes the following: (1) lecturer divided the class into a heterogeneous group, (2) the lecturer explained the purpose of learning and task that should be performed, (3) lecturer summoned the head of each group to perform the material duties co-operatively, (4) each group discussed the matter co-operatively, (5) once completed, each group is represented its chairman or any member who presents the results of the discussion, (6) other groups can provide feedback on the results of the discussion, (7) lecturer gave a brief explanation (clarification and/or strengthening) in the event of an error or doubt and provided conclusions, and (8) procurement evaluation was conducted (test).

Moreover, some research instruments developed in this study include (1) validation sheets for teaching materials of NPC, (2) observation sheets of implementation of lesson plan, (3) observation sheet of students' activities, and (4) observation sheet of students' life skills.

The aspects observed to know students' life skills are (1) ability to read the material, to understand the essence of the material, and motivation to solve the problem; (2) ability to work in a group; (3) ability to communicate (included in the presentation) and respect the

opinion of people other; (4) capability of thinking and reasoning in performing stage process (compiling the final report of activity); and (5) skill and innovative thinking in making herbal medicinal products from medicinal plants as well as creativeness in designing the price of herbal medicinal products. All this work has produced a preliminary draft of NPC teaching materials (draft I).

(4) *Preliminary Field Testing*

Early trials of the product (NPC teaching materials) (draft I) are conducted to validate the product. That is, teaching materials of NPC that are developed on the basis of field studies and by using the CEP approach is further validated theoretically (theoretical validation: construction and contents) (aspect of **validity**), namely, by asking for feedback/comments and assessment of experts who strongly understand the field or course material of NPC with minimal academic qualifications as doctor and/or masters who are studying education doctoral program.

(5) *Main Product Revision*

Based on the feedback/comments of experts in the fourth stage, researchers revise teaching materials of NPC (draft I). The revised draft I is the teaching materials of NPC (draft II).

(6) *Main Field Testing*

NPC teaching materials (draft II) were validated in terms of construction and contents and then were tested to assess the feasibility of NPC teaching materials from the aspect of **practicality** (empirical validation). The test may be carried out and determined by some research instruments, i.e., (1) observation sheets of implementation of lesson plan, (2) observation sheet of students' activities, and (3) observation sheet of students' life skills.

(7) *Operational Product Revision*

After teaching materials of NPC are tested, the next step is to revise the teaching materials of NPC (draft II). The stage produces teaching materials of NPC (Draft III).

(8) *Field Operational Testing*

NPC teaching materials (draft III) are further tested to assess the feasibility of teaching materials (empirical validation) from the aspect of **effectiveness**. The test can be executed after teaching materials of NPC have been compiled and prepared.

(9) *Final Product Revision*

The teaching materials of NPC are further refined on the basis of the results above to always learn, analyze, and interpret feedback/comments and suggestions. These activities will lead to the acquisition of NPC teaching materials that are more complete, perfect, and readily disseminated in the field (the class) that is greater.

(10) *Teaching Material Implementing*

Implementation of teaching materials of NPC had been conducted in the classroom within a specified period (3 meetings). When implementing the materials in the class, it is necessary to prepare some research instruments as mentioned above.

At the second stage, all of teaching materials of NPC are validated by an expert's judgments by using a validation sheet. After the materials are stated to be valid by the expert, they will be implemented in the classroom to confirm their practicality and effectiveness.

At the last stage, the materials that are valid were further tested in the classroom. This was followed by data collection by using three data collection tools: (1) observation sheet about lesson plan implementation, (2) observation sheet about students' activities, and (3) observation sheet about students' life skills. All of these tools had been validated by experts before being used to collect data needed. All of collected data was then analyzed quantitatively and described qualitatively.

The learning activities in the classroom were observed by three observers. The observers monitored the students' activities and students' life skills (**academic and social skills**) and also gave scores using observation sheets based on their rubrics.

b. Participants

Third year students registered in the Chemistry Department³⁹ Universitas Negeri Surabaya, Indonesia, were required to enroll for a NPC lesson. There are **two parallel classes, class A and class B**, comprising 25 students each (totally 50 students). All students are treated to be participants.

c. Data Collection Tools

This study used four data collection tools as mentioned above that will be needed to know the feasibility¹⁷ of the teaching materials of NPC: (1) observation sheet about lesson plan implementation, (2) observation sheet about students' activities, (3) observation sheet about students' life skills, and (4) validation sheet for an experts' judgement.

d. Validity and Reliability of Instruments

Before being used as data collection tools, the validity and reliability of the instruments should be determined as explained below.

1) Validity of Instruments

There are four types of validity to assess an instrument: 1) content validity, 2) face validity, 3) concurrent validity, and 4) construct validity. Validity refers to what is tested and how well this corresponds with the behavior. Validity, however, is not a simple concept, and various forms of it are identified according to the basis of the judgement of validity. Evidence relating to the **content validity** of an instrument would result from comparing the content assessed with the content of a curriculum that it was intended to assess. **Face validity** is based on expert judgement of what an assessment appears to assess, while **predictive validity** is the extent to which an assessment reflects an intended future performance. **Concurrent validity** is derived from the correlation of the outcomes of one assessment procedure with another that is assumed to assess the same knowledge or skill. **Construct validity** is a judgement of how well the assessment calls upon the knowledge and skills or other constructs that are supposedly assessed. The validity requires a clear definition of the domain being assessed and evidence that, in the assessment process, the intended skills and knowledge are used by the learners (Harlen, 2000). In the research, we only use two types of validity that are **content and construct validities** to assess the instruments including teaching materials of NPC, with category as shown in Table 1.

Table 1. Validation assessment category for the instruments (also teaching material of NPC)

| Average Scores | Category |
|----------------|--------------|
| >3.6 | Strong valid |
| 2.8–3.6 | Valid |
| 1.9–2.7 | Enough |
| 1.0–1.8 | Invalid |

Source: Adapted from Ratumanan (2006)

⁶ Based on the category as mentioned in Table 1 above, the materials developed on the basis of field studies and the CEP approach by using GI-CLM are called to be valid if all of components of the instruments including teaching material of NPC were assessed by validators with an average score of ≥ 2.51 .

2) Reliability of Instruments

As mentioned above, there are four data collection tools (instruments) that will be used in the study. However, there are only two instruments whose reliability will be

determined, namely (1) observation sheet about lesson plan implementation and (2) observation sheet about students' activities. Their reliability can be known by using the equation below that is called "percentage of agreement."

$$\text{Percentage of agreement} = \left[1 - \frac{A-B}{A+B} \right] \times 100\%$$

where A is the frequency aspect of the activity observed by observers who give high frequency and B is the frequency aspect of the activity observed by an observer who provides low frequency

The tools that had been prepared can be called to be reliable if they gave percentage of agreement $\geq 75\%$ (Borich, 1994).

e. Data Analysis Techniques

In this study, data analysis techniques used include (1) analysis of the results of validation of NPC teaching materials and instruments, (2) analysis of the implementation of NPC lesson plan, (3) analysis of students' activities in the learning process, and (4) analysis of students' life skills. These will be explained as follows.

(1) Analysis of the Result of Validation of NPC Teaching Materials and Instruments

NPC teaching materials (syllabus, lesson plan, student' books, and students' worksheet, and keys) and research instruments ("data collection tools") had been prepared. The validation of NPC teaching materials and research instruments can be conducted by validators (two persons) by means of providing a score from 1 to 4. Validators are also asked to give advice and comments (if any) toward the materials and instruments. The scores given are then analyzed to determine average scores. From the average scores, their category can be established, as presented in Table 1. The teaching materials of NPC and instruments that have been validated will be revised in accordance with the advices and comments from a validator to obtain the materials and instruments that qualify and are eligible for use in the next trial.

(2) Analysis of the Implementation of NPC Lesson Plan

When the NPC lesson plan was implemented in the classroom, it was observed by three observers by means of providing a score from 1 to 4. Observers are also asked to give advice and comments (if any) toward the implementation of the lesson plan. The scores given are then analyzed to determine the average scores. From the average scores, their category can be established, as presented in Table 2. Two observers at the trial stage for three meetings use the same instrument to observe the same variables. Assessment category for implementation of Lesson Plan can be shown as in Table 2.

Table 2. Assessment category of implementation of NPC lesson plan

| Average Scores | Category |
|----------------|-----------|
| >3.6 | Very good |
| 2.8-3.6 | Good |
| 1.9-2.7 | Enough |
| 1.0-1.8 | Not good |

Source: Adapted from Ratumanan (2006)

Agreement between the two observers who had given judgment on the implementation of the lesson plan will be calculated by the percentage of the agreement technique. Both analysts were asked to rate according to observation results that were tested.

(3) Analysis of Students' Activities in the Learning Process

Agreement between the two observers who had given judgment on students' activity instruments during the learning process will be calculated by the percentage of agreement technique. Agreement between the two observers who had given judgments on students' activity for three meetings will be calculated by the percentage of agreement technique. Both analysts were asked to rate according to observation results that were tested.

(4) Analysis of Students' Life Skills

Students' life skills (academic and social skills) are analyzed on the basis of assessment results by observers by using a given assessment rubric. Assessment category for students' life skills in the learning process can be shown as in Table 3.

Table 3. Assessment Category of Students' Life Skills in Learning Process

| Average Scores | Category |
|----------------|-----------|
| 3.56–4.00 | Very good |
| 3.00–3.55 | Good |
| 2.56–2.99 | Enough |
| 1.00–2.55 | Not good |

Source: Adapted from Ratumanan (2006)

Students are said to possess the mastery of life skills competences if the profile of their life skill lied on a minimal category of **good (3.00–3.55)**.

RESULTS AND DISCUSSION

RESULTS

The feasibility of a teaching material is determined by three aspects: 1) validity, 2) practicality, and 3) effectiveness (Nieveen, 1999). Three aspects of developed teaching materials of NPC that are obtained can be reported as follows.

a. The Validity of Developed Teaching Materials of NPC and Instruments

The validity of developed teaching materials of NPC was assessed by experts' judgments (two persons). According to the experts, all the teaching materials developed are valid. The average score that was given by the experts for syllabus is 3.80; for lesson plan LP-01, LP-02, and LP-03 are 3.86, 3.88, and 3.88; for students' book SB-01, SB-02, and SB-03 are 3.80, 3.83, and 3.85; for students' worksheet SW-01, SW-02, and SW-03 are 3.83, 3.85, and 3.83. Then, the average score that was given by the experts for observation sheets of academic skills for two meetings are 3.92 and 3.92. While the average score given for observation sheets of social skills for three meetings are 3.95, 3.95, and 4.00. As the average score of the materials and instruments given by experts is more than 3.60 (≥ 3.60), so the materials can be categorized to be strong valid.

b. Practicality of Developed Teaching Materials of NPC

Practicality of developed teaching materials of NPC can be seen from the observation results after the implementation of the lesson plan and students' activity during the learning process. The observation results of both can be explained as follows.

1) The Implementation of Lesson Plans of NPC

The implementation of lesson plans of NPC (LP-01, LP-02, and LP-03) during three meetings had been observed by three observers. The average score that was given by the observers for implementations of LP-01, LP-02, and LP-03 are 3.50 (good category); 3.50 (good category); and 3.87 (very good category), respectively. The percentage of

agreements that was given for LP-01, LP-02, and LP-03 are 82.59%; 88.57%; and 96.03%, respectively. It seems that the average score and percentage of agreement of lesson plan increased when implemented during three meetings.

2) Students' Activities during Learning Process

During learning process for the three meetings (meeting 1, 2, and 3), students' activities was observed by the same observers (three persons). The average of percentage (%) for students' activities was represented in Table 4. As shown in Table 4, it seems that predominant students' activities in learning process are 1) browsing the internet, 2) working in groups, and 3) presenting their works and have average scores of 23.19%, 21.62%, and 11.76%, respectively. Therefore, the lesson plans developed by NPC had maximized the students' activities especially for three activities as mentioned above.

Table 4. The results of analyzed data of students activities during three meetings

| No | Students Activities | Percentage of Students' Activity (%) | | | Average of Percentage (%) |
|--------------|----------------------------------------------|--------------------------------------|------------|------------|---------------------------|
| | | Meeting 1 | Meeting 2 | Meeting 3 | |
| 1 | Paying attention to the lecturer explanation | 8.96 | 7.01 | 8.93 | 8.30 |
| 2 | Reading student books | 8.96 | 7.90 | 8.04 | 8.30 |
| 3 | Preparing student worksheets | 16.99 | 9.65 | 9.38 | 12.01 |
| 4 | Browsing the internet | 15.57 | 26.32 | 27.68 | 23.19 |
| 5 | Working in a group | 18.87 | 24.12 | 21.87 | 21.62 |
| 6 | Presenting their work | 12.27 | 10.96 | 12.05 | 11.76 |
| 7 | Asking or giving comments | 8.96 | 4.83 | 4.92 | 6.24 |
| 8 | Arguing | 7.54 | 7.01 | 6.70 | 7.08 |
| 9 | Others | 1.88 | 2.20 | 0.44 | 1.51 |
| Total | | 100 | 100 | 100 | 100 |

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c. Effectiveness of Teaching Materials of NPC

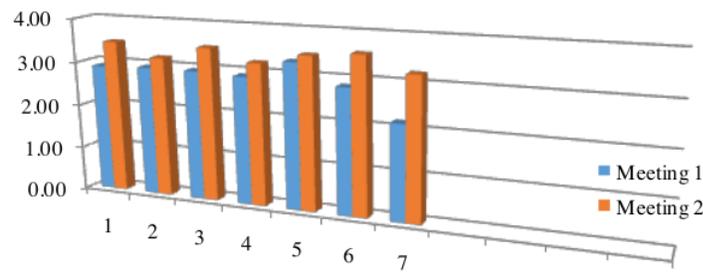
The effectiveness of the developed teaching materials of NPC was also confirmed by the data that were collected after trying out materials in the classroom. There were at least two data that were able to confirm the effectiveness of the developed teaching material, i.e., 1) the data related to academic skills and 2) the data related to social skills. These data entirely confirmed that the developed teaching materials were effective to be implemented in the classroom.

1) Students' Life Skills (Academic Skills)

In this case, students' life skills (academic skills) that were observed included 1) formulating a problem, 2) constructing a hypothesis, 3) designing a procedure, 4) conducting analyses and data interpretation, 5) discussing, 6) obtaining conclusions, and 7) presenting reports. The analyzed data during two meetings were resulted as seen in Figure 2 below.

As presented in Figure 2, academic skills (such as formulating a problem, constructing a hypothesis, designing a procedure, conducting analyses and data interpretation, discussing, obtaining conclusions, and presenting reports.) had been represented by students at the meetings 1 and 2 with average scores of 3.05 and 3.50, respectively.

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Note:

1) formulating a problem, 2) constructing a hypothesis, 3) designing a procedure, 4) conducting analyses and data interpretation, 5) discussing, 6) obtaining conclusions, and 7) presenting reports.

Figure 2. Diagram of Analyzed Data of Academic Life Skills at Meeting 1 and 2

It seems that the average score for students' academic skills are categorized to be good (3.00–3.55). Therefore, the teaching materials of NPC were developed on the basis of field studies and by using the CEP approach and their implementation in the classroom, we were able to increase students' academic skills because there is an increase of average score of them from 3.05 to 3.50 for two meetings.

2) Students' Life Skills (Social Skills)

Students' social skills were observed by three observers. Social skills observed included responsibility, collaboration, and accepting differences by using an observation sheet of social skills and obtained average score of them as shown in Figure 3 below.

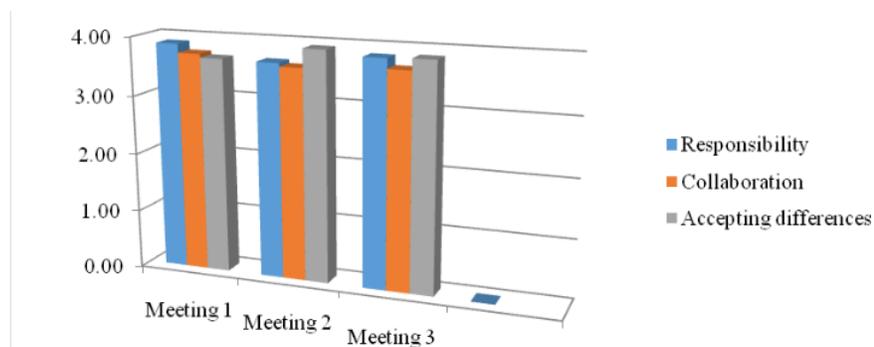


Figure 3. Diagram of Analyzed Data of Social Skills at Meeting 1, 2, and 3

As shown in Figure 3, it was reported that average scores of responsibility are 3.88; 3.66; and 3.84, collaborations are 3.74; 3.60; and 3.84, and accepting differences are 3.67; 3.92; and 3.86 with their modus 3.80; 3.82; and 3.84, respectively, for meetings 1, 2, and 3. It seems that the average score for students' social skills are categorized to be very good (≥ 3.60). Therefore, the teaching materials of NPC developed on the basis of field studies and by using the CEP approach and their implementation in the classroom were able to

increase students' social skills because there is an increase of average modulus of them from 3.80; 3.82 to 3.84 for three meetings.

DISCUSSION

As mentioned above that the aims of the research were to develop teaching materials of NPC by conducting group investigation of cooperative learning model (GI-CLM) and to describe their feasibility. In this case, teaching materials of NPC had been developed. The teaching materials were developed using research & development methods proposed by Borg and Gall. After the materials were developed, the next step was to describe their feasibility. According to Nieve³⁴ (1999), the feasibility of the teaching materials developed should refer to three aspects, i.e. validity, practicality, and effectiveness.

Firstly, the validity of the materials and research instruments developed had been stated to be strong theoretically by expert's appraisal. This is supported by the average score for the materials and instruments given by experts to be more than 3.60. Therefore, the materials and instruments were ready to be implemented in the classroom.

Secondly, the practicality of the materials can be shown by two data, namely (1) data related to lesson plan implementation and (2) data related to students' activities during learning process. The average score⁴⁰ and percentage of agreement that was given by the observers for implementations of LP-01, LP-02, and LP-03 were categorized to be good (3.00–3.55) and very good (≥ 3.56). Therefore, it can be established that the materials can be practice to be implemented in the classroom.

The third, the effectiveness of the materials can be confirmed by two data that are (1) data related to students' academic skills obtained after learning process and (2) data related to students' social skills gained during learning process. As reported above that the students' academic skills had been represented by students at the meetings 1 and 2 with average scores of 3.05 and 3.50, respectively. As their academic skills lay in the good category (3.00–3.55), students can be said to possess the mastery of life skills competencies. Furthermore, the average scores of students' social skills at three meetings for responsibility are 3.88, 3.66, and 3.84; collaborations are 3.74, 3.60, and 3.84; and accepting differences are 3.67, 3.92, and 3.86 with their modulus 3.80, 3.82, and 3.84, respectively. It seems that the average score for students' social skills are categorized to be very good (≥ 3.60). Therefore, the teaching materials of NPC developed on the basis of field studies and by using the CEP approach and their implementation in the classroom were able to increase students' social skills because there is an increase of average modulus of them to 3.80, 3.82, and 3.84 for three meetings.

In Indonesia, some researches related to development of teaching materials with various topics/matters and oriented on certain learning models/methods/approaches had mostly been conducted to be used in elementary schools until higher education. In addition, a research related to development of teaching materials of certain topics/matters using the CEP approach have also been partly done. However, research related to development of teaching materials of NPC using GI-CLM focused on field study and CEP approach had not been studied yet.

The following are some researches that are relevant with this purposed research such as researches conducted by: 1) Sumarti (2008) reported that Practice of General Chemistry Lesson at Study Program of Chemistry Education, Universitas Negeri Semarang, Middle Java, Indonesia, was able to increase entrepreneurship motivation for students' chemistry education, 2) Mursitiet al. (2006), and 3) Saptorini and Mursiti (2007), concluded that the implementation of model and teaching materials using CEP and home industry approaches as CET media through field observation can increase entrepreneurial skills and students' learning outcomes on Terpenoid and Alkaloid Topics, 4) Supartono (2006) with title "Increasing Students' Creativities in Chemistry Learning Using CEP Approach," declaring that

implementation of Chemistry learning model using CEP approach can improve students' creativities, 5) Sumartiet *al.* (2014), stated that learning tools for chemoentrepreneurship-based hydrocarbon and petroleum was valid and effective in increasing the soft skills and interest in entrepreneurship of X-2 Graders of SMA PGRI, Jepara, Middle Java, Indonesia, 6) Kadarwati *et al.* (2010), concluded that the learning method using the CEP approach on Chemistry-Physics 5 Lesson possess an important role in being easy to understand the lesson, 7) Kusuma and Siadi (2010) study—"Developing Materials (Students' Books) of Chemistry oriented on CEP to increase Students' learning outcome and life skills"—declared that the materials of Chemistry based on CEP approach developed were valid and effective in increasing students' learning outcome and life skills, and 8) Adlimet *al.* (2014), reported that the research integrating entrepreneurial practice in biotechnology lesson is reasonable since some of traditional home-made biotechnology products have been commercially available in local market. Those products include yeast, soybean fermentation with Indonesian name as "tempe," "tahu or tofu," "tauco," rice, or cassava fermentation ("tape"). From this, students could learn to improve the value addition of the commodities by making a better packaging, new tastes, a new appearance, or through a new marketing system. Thus, teaching materials developed referring to field study and CEP approach that has been declared to be valid when implemented in the classroom will provide a change to an increase in life skills.

In other words, the teaching materials of NPC lesson are stated to be valid according to expert's appraisal had been proven to be effective to be implemented in the NPC learning process and be able to increase the students' life skills.

CONCLUSION

The teaching materials of NPC developed on the basis of field studies and by using a chemo-entrepreneurship (CEP) approach with GI-CLM were valid according to experts' opinion. In relation with the implementation of the materials, it can be reported that (1) the developed lesson plan could be implemented well in the classroom and (2) the students were highly engaged in GI model of environmental instruction so they were practice. Then, the effectiveness of the materials can be considered by two aspects, i.e. students' academic and social skills. The results reported that the students' life skills showed significantly improvement during learning process (at meeting 1 and 2 for academic skills and at meeting 1, 2 and 3 for social skills). Referring to the aims of the research supported by the results and discussion, it can be concluded that the teaching materials of NPC arranged based on field study and CEP approach using GI-CLM are feasible.

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