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The Development of Innovative Chemistry Learning Material for Bilingual Senior High School Students in Indonesia

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Abstract

The development of innovative chemistry learning material for bilingual Senior High School (SHS) students in Indonesia is explained. The study is aimed to obtain an innovative chemistry learning material based on national curriculum in Indonesia to be used as a learning media in the teaching and learning activities. The learning material is developed by enhancing the chemistry topics to meet the requirement of a national curriculum followed by integration of laboratory experiments, learning media, and contextual application of the relevant chemistry topics. The material is then designed in printed and electronic bases. The performance of developed chemistry material is standardized to meet good quality learning material for class purposes. The results showed that the performance of developed chemistry materials is categorized as very good. The developed learning material is found effective to be used in teaching and learning process, and be able to motivate the students to learn chemistry. The facilities provided in the material are adequate to guide the student to study chemistry independently that make learning activities moving from teacher centre learning become students centre learning. Students achievements in experimental class (M = 83.0) is found higher than that with control class (M = 73.5), where both are significantly different. There is a positive correlation between the student's motivations with the student's achievement in chemistry subject, where the correlation in experimental class (R^2 = 0.711) is better than in control class (R^2 = 0.467).

Keywords: innovation, learning material, bilingual teaching, laboratory experiment

1. Introduction

The trend for bilingual teaching and learning of science with English as second language has increasingly implemented in many countries (Benson, 2004; Carstens, 2015; Catter, 2011; Purkarthofer & Mossakowski, 2011; Traore et al., 2008), including in Indonesia. Implementing bilingual teaching in Indonesia is designed to improve the quality of education delivery to provide competence human resources towards a competition in global era (Simatupang & Situmorang, 2013). The bilingual teachings are conducted both in Indonesian and English for special class which is known as "kelas unggulan" in selected schools. However, most of the schools are still using chemistry textbook that are published in Indonesian language, while the learning instructions are given in English. Therefore, it is needed to design a teaching and learning material for bilingual teaching to make the teaching activities effective and efficient. The learning material is needed to be written in English to meet the requirements stated in the national curriculum in Indonesia.

Innovation in teaching and learning activities is very interesting to discuss, as it is believed that implementation of the right teaching strategy would increase student's achievement in learning chemistry (M. Situmorang & A. Situmorang, 2014). Improving the quality of education could be performed through innovation in the teaching and learning materials. Standard chemistry learning materials for bilingual teaching is very important to be used in the teaching and learning activities in Indonesia. It could help the students to understand chemistry concept clearly, and make the learner free from students misconception on specific chemistry terms. Many SHS students consider chemistry as a difficult subject that make them not interested to study (Situmorang & Saragih, 2013; Situmorang et al., 2006). Therefore, innovation in teaching and learning chemistry has to be made to make the

students are motivated to study chemistry. One of a strategy is conducted through the development of innovative chemistry learning material to obtain good teaching materials that suit to students' development in science bilingual class.

The aim of this study is to develop an innovative chemistry learning material for bilingual SHS students to meet the requirement of national curriculum in Indonesia. The development is carried out by enhancing the chemistry topics with local contents, followed by integration of laboratory experiments, learning media, the contextual applications, and the hyperlink of trusted website on relevant chemistry topics. The innovation is conducted to provide standard learning material for bilingual students to make it easy to learn, to facilitate the students to learn chemistry intensively, and to improve students competence. The chemistry learning material is designed in separate chapters, and provided as printed and electronic formats. The learning material is then used as a learning media in the classroom, and probably used outside classroom depend on the subjects being taught, all are set to improve student's achievement in chemistry. The communication on the teaching and learning process to meet the students achievement in chemistry is also been studied. Student motivation to study chemistry in teaching and learning activities is also investigated.

2. Literature Review

2.1 Innovative Learning Material

The development of innovative learning material is needed to help SHS student to learn science subject such as chemistry. Innovation in teaching and learning has been conducted through many ways such as lesson study (Sudejamnong et al., 2014), inquiry-based learning (Maaß & Artigue, 2013), project-based learning (Situmorang et al., 2010; Toolin, 2004), by using interactive multimedia (Noor & Ilias, 2013), and implementation of learning media (H. Situmorang & M. Situmorang, 2009). It has been reported that innovative teaching is able to improve students ability (Qian & Xuefeng, 2013), and be able to facilitate the development of students' cognitive, enhance reasoning and social abilities, and provide more enjoyable lessons (Lu, et al., 2010). The development of interactive teaching and learning strategies for science has been explained (Baron & Chen, 2012; Holmes, 2006; Situmorang et al., 2011). Innovation in science teaching and learning has been reported effective in learning practices to improve science education (Tytler, 2007). The innovative teaching approach have a positive influence on students' learning attitude and knowledge acquisition that may foster a stronger motivation to learn new skills, acquire knowledge, and to increase student learning satisfaction (Lee, et al., 2015). Laboratory experiments are compulsory in chemistry teaching and it needs to design suited to the curriculum. The example of chemistry laboratory experiments can be seen in the references (Gooding, et al., 2001; Situmorang et al., 1998). Integration of relevant laboratory experiments in to a chemistry textbook has proven to be able to help the students to learn chemistry efficiently (Situmorang, 2013).

2.2 Text Book as Teaching Media

Textbook as a learning resource plays an important role in teaching and learning in the classroom (Abed & Al-Absi, 2015; Carter & Mayer, 1988; Sinatra & Broughton, 2011; Yore et al., 2003). A good textbook provides correct and positive information that help the students to understand the concept theory, to lead the students to think, behave and develop (Chambliss, 2001). Textbook is commonly used in teaching and learning activities because it consited of complete learning materials that can navigate the learner to learn based on their needs (Good, et al., 2010). For high schools students, the textbook is very important in the teaching and learning activities because it can strengthen and support the information material presented by the teacher in the class. The textbook could help the students to learn complex material that has not been obtained in the class. The scientific information in the textbook can be learned repeatedly to achieve the desired competencies. Textbook is a central role in empowering students' competencies because the learning materials provided in the books become important source of informations to the readers based on the student's interest. It is expected that a standard textbook be able to guide the student to learn from simple to difficulty level, provide relevant practice questions, and solving scientific problems to enhance the student knowledge and competencies. High school science textbook is commonly design to satisfy demands stated in national curriculum that make it different to another book (Holliday, 2002). Therefore, science textbook may different from one to the other, depends on the students need and developments, such as for bilingual SHS students.

The development of bilingual learning material is very important for science bilingual teaching as it can be used to develop both native language and second languages through reading and writing activities (Semingson et al., 2015). Bilingual learning material in the format of textbook or module provide learning instruction that can help the student to study science (Mantzicopoulosm & Patrick, 2011; Terrazas-Arellanes et al., 2013; Wood & Lewthwaite, 2008), or mathematics (Lim & Presmeg, 2011; Zahner, 2015). Good science textbook contains the

vision, mission, context, content, and the process, and the scientific information that are presented in the textbook will motivated the students to learn (Simatupang & Situmorang, 2013). A good quality high school science textbook serves as an effective learning media in teaching and learning activities that leads to achieve the objectives and students competence. The presentation in a textbook is expected contains learning activities that can be done by students and becomes communication tool to bring accurate information from learning resources to the learners (Tompkins et al., 2006).

3. Research Methodology

3.1 Research Overview

The studies are conducted by the combination of development and experimental research. The development is carried out to produce an innovative of chemistry learning material for Year X bilingual SHS students, in Semester 1, that are provided in both printed and electronic bases. The development is made to enhance the chemistry topics with local contenst, and to improve the performance in its contents, format, language, and design layout to meet standard high school learning material. The contents of chemistry subjects are then integrated with relevant laboratory experiments, case study, learning media, and provide a hyperlink to a trust website for future reading. Sets of learning materials are then standardized to obtain standard innovative chemistry materials. Finally, the developed material is then designed in printed and electronic book. The developed chemistry learning material is then been applied as a teaching and learning media for teaching and learning activities in the classroom. The overview of the research is summarized in Figure 1.

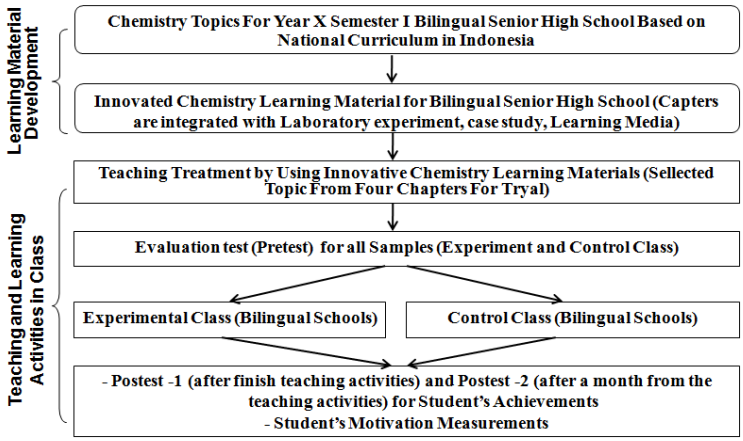

Figure 1. The overview of development on innovative chemistry learning material, and implementation of the material to increase student's achievement on the teaching and learning chemistry to bilingual senior high schools students

3.2. Population and Sample

The study was conducted in the Province of North Sumatera, Indonesia, at academic year 2014/2015. The objects to study are including: (1) Chemistry learning materials for science bilingual class, (2) Chemistry lecturer with has experience in General Chemistry teaching, (3) Chemistry teachers with has experience in teaching of science high school bilingual students, and (4) Bilingual students from selected SHS targets. The populations are SHS students with major in science. The samples are purposively selected from three school, they are SHS in Tebing Tinggi, SHS in Brastagi, and SHS in Kisaran. The distributions of samples and the short description of the target schools are presented in Table 1. Sample in the school targets are then divided into two groups, one group is named as an experimental class and another group is a control class. The students to be included in the study were selected based on their performance on chemistry in preliminary test (pretest). Afford has to be made to make the sample homogen by removing outlier samples (H. Situmorang & M. Situmorang, 2009). All students are equally treated in the teaching and learning activities, however, the data to be analyzed are limited to 30 students in a class (Situmorang et al., 2009; Situmorang et al., 2010).

Table 1. The description of population and samples in selected SHS targets for trial of innovative chemistry material on the teaching and learning chemistry

No	Name of SHS Target	Number of Student	Selected Class	Selected sample		Total sample	Short description of the schools
				Exp.	Ctrl.		
1	SHS in Tebing Tinggi	320	2	30	30	60	- Situated in the capital city of *Kota* (City) with multy ethics background
2	SHS in Brastagi	280	2	30	30	60	- Situated in the city of *Kabupaten* (Regency) with homogenous ethics background
3	SHS in Kisaran	294	2	30	30	60	- Situated in capital city of *Kabupaten* (Regency) with multy ethics background
Total		894	6	90	90	180	

*Exp. is science SHS student in experimental class that was treated with innovated chemistry learning material, and Ctrl. is science SHS student in control class that was treated with existing chemistry textbook in the school.

3.3 Arranging Research Instruments

The instruments used in this study are: (1) Packages of developed chemistry learning material, (2) Sets of standard questionnaire, and (3) Evaluation tests for pretest and posttest (posttest-1 and posttest-2). Chemistry learning materials are consisted of four chapters, they are successively: Chapter 1 is Chemistry, the science of matter, Chapter 2 is Atoms, Molecule and Ions, Chapter 3 is Chemical reaction, and Chapter 4 is Stoichiometry. Standard questionnaire to measure the performance of learning materials is obtained from Situmorang et al. (2013). The questions in the questionnaire are arranged to ask the performance of learning material, they are consisted of the components, content, extension, depth, design, and the language. The questionnaire to measure students motivations on teaching and learning chemistry are adopted from previous study (Silitonga & Situmorang, 2008). The components in the motivation questionnaires are consisted of intrinsic motivation, extrinsic motivation, and the condition of students during learning activities. All questions are raised in multiple choice options, starting from strong opinion with positive response of very good (score 4), down to a very low opinion with negative view of very poor/bad (score 1). The evaluations is provided in multiple choise tests, they are arranged based on the chemistry topics, and the items in the tests have been standardized followed the procedures explained previously (Situmorang & Sitorus, 2012). A set of evaluation test contains 20 problems that are distributed with variation from simple to difficult questions. They questions is designed to cover all chemistry topics in the chapter and be able to measure students achievement in chemistry. The quality of the questions for pretest, postest-1 and potest-2 are all made to be equals.

3.4 Research Procedures

The development of innovated chemistry learning materials is conducted starting from the analysis of high school chemistry textbooks for year X in semester 1, and the results is used to obtain relevant SHS chemistry subjects to be included in learning materials for bilingual students. The selected chemistry topics to be included in the learning materials have to meet the criteria in national curriculum in Indonesia. The developed chemistry material is then evaluated by expert judgments, followed by tryal in real teaching, and the contribution and suggestion is used to revise the chemistry learning material. The developed material is then standarised followed by the criteria given by Indonesia Education National Standard Bureau or *Badan Standar Nasional Pendidikan* (BSNP). The chemistry material is then be used as learning media in the teaching and learning activities in the classroom and outside classroom. The details of the development and implementation of learning materials are explained in the following discussion.

3.4.1 Development of Chemistry Learning Material

Innovation to a chemistry learning material is developed to make it suited for bilingual SHS in Indonesia. The development is made followed by the success of development of chemistry textbook and module made in previous studies (Situmorang, 2013; Situmorang & Simatupang, 2013; M. Situmorang & A. Situmorang, 2014;

Situmorang et al., 2011). A draft of chemistry material is prepared with rich in scientific content accompany with local contents for contextual example, followed by integration of laboratory experiments, integration of learning media and learning strategies, and to provided hyperlink material to trusted websites for future reading. The draft chapters of the chemistry materials are developed to make chemistry topics are suited to students need and meet the requirement of national curriculum in Indonesia. The materials are then edited to make standard format in its contents, language, illustrations, problem examples, drills, key answers of the problems, and the design visibility. Standardization of the chemistry material is conducted by asking the respondents opinions on the performance of developed chemistry learning materials with given criteria. All relevant suggestions are accepted to revise the chemistry innovative learning materials. Chemistry material is consisted of four chapters, and they are then designed in printed and electronic format. Standard chemistry learning material is ready to be implemented as learning media in the chemistry teaching and learning activities.

3.4.2 Teaching Treatments and Data Collection

Implementation of developed chemistry learning material in the teaching and learning activities has been carried out to increase student achievement in chemistry. Chemistry teachers from target schools have been invited to Department of Chemistry State University of Medan (Universitas Negeri Medan) to explain their involvement in the study, followed by training the teacher to use innovated chemistry learning material (printed and electronic books) in the classroom. The teachers are then asked to be responsible for the following: to select target sample based on given criteria, to introduce innovated learning material to students and how to use it in the classroom and outside classroom, to motivate the students to use developed chemistry learning materials for self learning, to perform evaluations (pretest and posttest), and to distribute questionnaire to measure the motivation of students in target samples.

Student achievements on chemistry were measured before and after teaching activities by performing evaluation tests to both experiment class and control class. Preliminary evaluation was performed before the teaching treatment, where the score that has been obtained in the pretest is useful to measure student knowledge on the target topic before teaching treatment activities. The pretest is also used to homogenize the sample and to reject outlier data. Teaching treatments are carried out to experimental classes by using innovated chemistry learning material as learning media in teaching and learning activities, and the students in control class are taughed by using existing chemistry textbook. Both classes are given the same subject matter, the alocation of time teaching are considered to be similar, and the chemistry teacher to teache both class is maintain the same. Teaching activities in experimental class was started by giving the instruction to use innovated chemistry learning material, followed by teaching the chemistry subject as it has been arranged in learning instruction. The students are then asked to use learning facilities that are available in the innovated learning material, and are suggested to use"help" in electroneic material (e-book) if they found any problems in solving chemistry problem when study a specific topic. Teaching activities in control class are performed similar to those in experimental class by using existing chemistry textbook available in the schools instead of innovated chemistry learning material. The students in both classes are then given drills, followed by the explanation how to solve given problems related to chemistry topics. Evaluation test (postest-1) is conducted to all samples at the end of the teaching and learning session. Another evaluation test (postest-2) was carried out one month after the teaching and learning activities. Student achievements are obtained from the student ability to solve 20 multiple choise questions in every separate chapter of innovated chemistry materials, and the data analysis is counted from the right answer without giving penalty to the wrong answer. The results are then calculated to investigate the influence of the innovated teaching method onto the student achievements in chemistry. The decision has been made based on the measurement and hypothesis testing. The motivations of students are then investigated from their views on using developed chemistry learning materials. A set of standard questionnaire is distributed to participants at the end of the sesion after completing all the teaching and learning activities.

4. Results

4.1 Development and Standardized of Chemistry Learning Material

Chemistry learning material is very useful tools in teaching and learning process for bilingual SHS students. There are four chapters of chemistry materials have been developed for Year X bilingual SHS students in the first semester. Each of the chapter consisted of adequate sub chapters with complete chemistry materials based on national curriculum in Indonesia. The material has been developed to enrich the content of chemistry topic with local contents that is suited for bilingual teaching. The development has also been made through integration of the following: relevant laboratory experiment, contextual application, the illustration to support chemistry materials, problem examples and solving problem, teaching and learning media to help the learner to do

independent study, chemistry problems and the key answer to solve the problems, and the address of relevant website for further study. The chemistry materials have been provided in printed material and electronic book. The learning material was adjusted suited to student development to make the contents easy to understand by the learners. The summary of innovation components in the learning material are listed in Table 2. Chemistry learning material has also provided with specific elements such as: (1) Teacher guide as an instructions for teachers to use the materials in teaching and learning process, the list of students activities in the classroom or outside classroom, the allocation time provided to complete a chapter, learning media to be used in teaching and learning activities, the instruction on learning strategy to deliver the chemistry subjects, and the evaluation test, (2) Student activity sheets and work sheets containing the relevant subject matter for students, (3) Drills and the problem solving answers are provided at the end of every book chapter, and (4) The evaluation test to measure students achievement on chemistry is also provided along with key answer for self evaluation and correction assessment tool.

Table 2. Chemistry topics for bilingual SHS student year X Semester 1 based on national curriculum in Indonesia, and the short descriptions of innovations that have been integrated in the learning material

Chapter	Chemistry Subject/Topics	The description of innovation that are integrated in Chemistry Learning materials
1	Chemistry, The science of Matter	- Enriching chemistry topic with local contents, integration of laboratory experiment, video, learning media (flash animation), case study, evaluation test, and the hyperlink to relevant website for future reading. The material is designed in both printed and electronic book in flipbook maker format
2	Atoms, Molecule and Ions	- Enriching chemistry topic with local contents, integration of learning media (flash animation), example problems, quiz, problems and answer, and the hyperlink to relevant website for future reading. The material is designed in both printed and electronic book in flipbook maker format
3	Chemical reaction	- Enriching chemistry topic with local contents, integration of laboratory experiment, video, learning media (flash animation), case study, example problems-solving problem, outside class activities, contextual application, evaluation test and key answer, and the hyperlink to relevant website for future reading. The material is designed in both printed and electronic book in flipbook maker format
4	Stoichiometry	- Enriching chemistry topic with local contents, integration of virtual laboratory experiment, video, learning media (flash animation), contextual application, example problems and answer, evaluation test and key answer, and the hyperlink to relevant website for future reading. The material is designed in both printed and electronic book in flipbook maker format

4.2 Standardization of Chemistry Learning Material

Innovated chemistry learning material has been standardized to make it suitable for bilingual SHS students. Standardization is carried out by presenting a draft chapter of chemistry material to expert judges, they are chemistry lectures and experience chemistry bilingual schools teachers. The opinions of the students are also asked to investigate their response on the performance of developed learning material based on their need to study chemistry. The respondents opinions on the performance of innovated chemistry learning material are summarized in Table 3.

Table 3. The performances of innovated chemistry learning material based on the respondents opinions. The number is the average value based on the opinion of expert judgments of Chemistry Lecturer (P) and Chemistry Teacher (Q), and the response from bilingual SHS students (R). The total average is the average value from 288 respondents

The Components	Short Description of Innovative Learning Material	Respondents Opinion			
		P	Q	R	Total Average
Content	- The completeness of chemistry contents	3.57	3.71	3.41	3.56
	- The accurate of content	3.68	3.80	3.52	3.67
Extension	- Presented the extension of material by integration of local contents, laboratory experiment, contextual application, learning media and strategy	3.45	3.56	3.47	3.49
	- The chemistry material is clearly derived	3.41	3.55	3.36	3.44
Depth	- The material is presented in good order: introduction, main concepts, problem example, drills, quiz, and hyperlink to website	3.53	3.57	3.40	3.50
	- Application concepts with real life	3.40	3.48	3.38	3.42
Design	- Suitable between the design layout with the target material	3.74	3.68	3.63	3.68
	- Presentation of illustration, figures, the table and images	3.63	3.73	3.56	3.64
	- Involving learners for interactive study	3.51	3.57	3.34	3.47
Language	- In accordance with the development of learner	3.60	3.72	3.49	3.60
	- The chemistry material is easy to read, the language is simple, and provide communicative massage	3.47	3.56	3.53	3.52
	- Straightforward, accuracy on chemistry term, and symbol	3.67	3.67	3.57	3.63
	Average	3.56	3.63	3.47	3.55

All respondents give positive response to the performance of chemistry learning material on its content, extension, depth, the design, and the language. The value from their responses successively for Chemistry lecturer (average 3.56), Chemistry teacher (average 3.63), and bilingual SHS students (average 3.47) are all categorized as very good (average 3.55). The results showed that the contents of the chemistry material based on the completeness of subject contents, and the accuracy of the content are categorized as very good. The extension of the chemistry topic has been presented clearly, and the derivate of material are also sufficient. The chemistry materials has also been presented in good order, it is consisted of introduction, main concepts, example problems and the solution, and the contextual application of chemistry topic in real life. The design of the chemistry learning material has been presented in good format. The performance of learning material based on their layout, presentation of illustration, table, and images are all categorized very good. The innovated material has also written in English that are suited to the need of bilingual SHS students in Indonesia. The innovated chemistry learning material is categorized as good in accordance with the development of the learners. The science communication used in the learning material is simple, easy to read, the message is written straightforward, and chemistry term and symbol are written accurately. It has been known that the presentation of local contents in the innovated material is found be able to bring the students for contextual learning. It is concluded that innovated chemistry material is assigned to be suited to the need of bilingual SHS students in Indonesia. All respondents are agreed on the performance of the four chapters of chemistry materials that have been designed in printed and electronic bases. The innovated learning material is ready to use as learning media on the teaching and learning activities in bilingual class.

4.3 Students Performance on Chemistry before Teaching Treatments

Student's achievements that are obtained from pretest have been measured before the teaching and learning activities in both experiment and control class, those are obtained from student ability to answer the multiple choice question correctly. The student scores are presented in Table 4. The results reveal that the students did not understand the chemistry topic yet in all class. The results from pretest showed that the students have relatively low performance in chemistry, probably from guessing the answer, where students achievement in experimental class (M = 25.0) almost equal to control class (M = 25.1). These results confirmed that all samples are homogen with relative having the same knowledge on chemistry for all topics in both experimental and control class.

Table 4. Student achievements for Chemistry Subject based on pretest (before the teaching activities has been carried out) on the teaching and learning activities by using innovated chemistry learning materials compare with ordinary chemistry textbook for four chapters. Numbers in table are the average means of the students' scores

Name of Schools	Student achievements for Chemistry Subjects based on pretest									
	Chapter 1		Chapter 2		Chapter 3		Chapter 4		Average	
	Exp. Class	Ctr. Class	Exp. Class	Ctr. Class	Exp. Class	Ctr Class	Exp. Class	Ctr. Class	Exp. Class	Ctr. Class
SHS in Tebing Tinggi	20.2	20.3	26.7	26.8	29.2	29.0	27.8	27.8	26.0	26.0
SHS in Brastagi	25.0	24.8	26.6	26.7	23.7	23.8	24.8	24.7	25.0	25.0
SHS in Kisaran	19.0	19.0	25.9	26.0	27.2	27.3	24.5	24.3	24.1	24.2
Average	21.4	21.4	26.4	26.5	26.7	26.7	25.7	25.6	25.0	25.1

4.4 Implementation of Innovated Chemistry Learning Material in Chemistry Teaching

Innovative chemistry learning material has been implemented in the teaching and learning activities. The influence of learning material to improve student's achievements in chemistry has been investigated as summarized in Table 5. It has been observed that the students in the experimental groups are interested to use developed innovative chemistry materials. The results showed that student achievements in experimental classes (M = 83.0) is found higher than that in control class (M = 73.5), where both are significantly different. The phenomena where the students achievements in experimental class are all higher than that in control class have been observed in three target schools and for all four chapter of the chemistry subjects. Innovated chemistry learning materials are able to help the students to study chemistry. The contents of chemistry in an innovated learning material are adequate to be used as a source of knowledge that make the student improve in their competence on chemistry, and has meet the target criteria that are listed in national curriculum. The facilities in the learning material are able to help the students to learn chemistry by themselves. The scientific facilities that are integrated in learning materials are found very effective for scientific communication on teaching and learning activities. The example that are provided in learning materials are adequate to guided the students to learn and to solve chemistry problems related to chemistry topic. Sets of laboratory experiments that are integrated in the learning material (via e-book) could be viewed by the students, and it is able to help them to extend their knowledge and understanding related to a given theory in the chemistry material without doing the experiment in the laboratory by themselves. However, the students who are interetsed to do real experiment can use the material as it is provided with adequate intruction to do experiment in the laboratory accompany with laboratory data sheet for laboratory investigation.

Table 5. Student achievements based on postest-1 (after completing the teaching and learning activities) on the teaching and learning process in experiment class and control class. Numbers in table are the average means of the students' scores

Name of Schools	Student Achievements for Chemistry Subjects based on postest-1									
	Chapter 1		Chapter 2		Chapter 3		Chapter 4		Average	
	Exp. Class	Ctr. Class	Exp. Class	Ctr. Class	Exp. Class	Ctr. Class	Exp. Class	Ctr. Class	Exp. Class	Ctr. Class
SHS in Tebing Tinggi	88.0	71.3	82.2	76.3	72.2	65.5	81.8	77.0	81.1	72.5
SHS in Brastagi	91.0	86.0	83.4	78.4	78.2	67.3	84.3	71.8	84.2	75.9
SHS in Kisaran	82.0	65.0	84.7	73.5	82.5	78.5	85.7	70.8	83.7	72.0
Average	87.0	74.1	83.4	76.1	77.6	70.4	83.9	73.2	83.0	73.5

The contextual examples that are provided in the learning material are able to help the students to understand the application of chemistry subject in real life. The hyperlinks of relevant material from trust website address are found very helpful to students to extend their knowledge for future study. Innovative learning material has provided adequate scientific information for their needs, interests, and ability to learn. The students are interested to use the electronic version for self study because the designed in flipbook maker format has been adjusted to be compatible with various software for online and offline reading to facilitate the material easy to use anytime and anywhere depend on the students need. The presentations in the innovative learning material are also provided with suitable color and images. The learning material was found to be able to change the students' activities moving from teacher centre learning to students centre learning. Students' competencies have been achieved and they are able to answer the chemistry question correctly and make their achievement on chemistry increased.

Table 6. Student achievements based on postest-2 (after leaving the subject one month away from the teaching activities) on the teaching and learning process in experiment class and control class. Numbers in table are the average means of the students' scores

Name of Schools	Student Achievements for Chemistry Subjects based on postest-2									
	Chapter 1		Chapter 2		Chapter 3		Chapter 4		Average	
	Exp. Class	Ctr. Class	Exp. Class	Ctr. Class	Exp. Class	Ctr Class	Exp. Class	Ctr. Class	Exp. Class	Ctr. Class
SHS in Tebing Tinggi	78.8	67.1	80.9	69.0	70.7	57.3	79.3	72.7	77.4	66.5
SHS in Brastagi	96.0	90.0	90.1	89.8	62.8	53.7	73.0	65.8	80.5	74.8
SHS in Kisaran	84.8	61.2	86.9	62.7	80.2	67.0	82.8	65.8	83.7	64.2
Average	86.5	72.8	86.0	73.8	71.2	59.4	78.4	68.1	80.5	68.5

To investigate whether the developed material can help the students to enhance their knowledge on chemistry, the second evaluation (postest-2) has been carried out again after leaving the subject for a period of one month from learning activities as summarized in Table 6. The results showed that there is increasing progress on student's achievement after the students have been taught with developed chemistry learning material. The average of students achievement on chemistry in experimental class (M = 80.5) is higher than that in control class (M = 68.5), where both are significantly different. Improvement trends on students achievement have been

found in experimental class in all schools for all four chapters of chemistry subjects. However, a slow decline of students achievement in control class was observed. The results have proven that innovated chemistry material is found effective to improve their knowledge on chemistry subjects. The affectivity of the developed chemistry learning material on to the student's achievement on the teaching of chemistry has been investigated by comparing the evaluation results in postest-2 with postes-1, where the average affectivity of the developed innovative chemistry learning material (97%) is found higher than that the existing chemistry textbook (82.5%) they use in the target schools.

4.5 Students Motivation to Learn Chemistry

The motivation of the students to study chemistry in relation to the implementation of developed innovated chemistry learning material has been investigated. The relationship between the students' achievements and students motivations in target schools are presented in Figure 2. The results showed that there are positive correlation between the student's motivations with the student's achievement in chemistry subject, where in experimental class ($R^2 = 0.711$) is higher than that in control class ($R^2 = 0.467$). This high correlation is believed due to the innovated learning materials that are provided in their study. The average value of students motivation in experimental class is categorized as high motivation (M = 95.4), where the students give positive opinion to chemistry learning materials. They are interested to use an innovated material for self learning. The "help" facility provided in learning material is adequate to help students to solve chemistry problems given in the chemistry material. The performances and the visibilities of the developed chemistry learning material motivate the students to use the material as a main source to study chemistry. In contrast, the average value of students motivation to study chemistry in control class is categories as medium (M = 67.8). The results showed that students opinion vary on their intrinsic motivation, extrinsic motivation, and the environmental conditions. It is clear that increasing the student's achievement in chemistry subject is related to their motivation in the learning process.

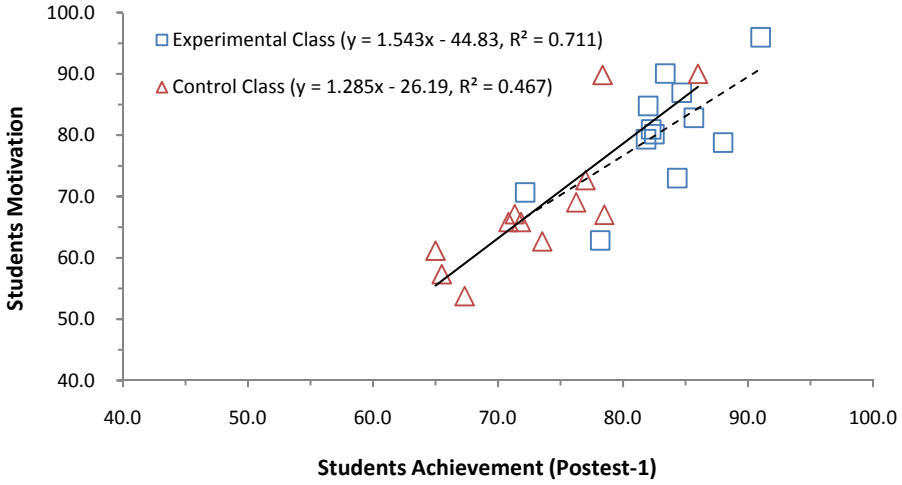

Figure 2. The relationship between the students' motivations with the students' achievements in experimental and control class. An innovative chemistry learning material is implemented in experimental class while existing chemistry textbook was used in control class

5. Discussion

As an innovation has become a trends in the teaching and learning activities, the development of innovative learning material is incouraged to be done in the teaching and learning chemistry in bilingual SHS students. Various techniques has to be implemented to make the material easy to deliver in the classrom or outside classroom. For example, the implementation of inquiry-based learning (Maaß & Artigue, 2013) and project-based learning (Situmorang et al., 2010; Toolin, 2004) have found positive results in science teaching. The innovation of learning material by the the use of technology with interactive multimedia (Noor & Ilias, 2013) and the use of learning media (H. Situmorang & M. Situmorang, 2009) in the class has been reported to be able to improve students achievement in teaching science compared with conventional teaching. The

combination of printed and electronic material is a usefull tools in the development of learning material for chemistry teaching. Therefore, this study with using innovative chemistry learning material that are provided in printed and electronic bases is relevant and very importan when it is applied for the teaching of bilingual high school students.

The development of innovatieve learning material in this study has been conducted through enriching chemistry topic with relevant local contents to make the learner easily understand the chemistry topic they learn. The students is easily absorb the knowledge when it is realated to daily living (Situmorang et al., 2011). Integration of local content into learning material makes the chemistry subject becomes contextual teaching. One of the strength of chemistry learning is the laboratory experiment. The innovation with the integration of laboratory experiment is also been done to bring the laboratory activity to be view in electronic material. It has been reported that visual media affect school performance as it will increase the sensation-seeking, substance use and school problem behavior (Sharif et al., 2010). The video of laboratory experimen can be used as learning media that can be view many times by the students. The scientific contents in a relevant video will help the students to understand the subject clearly before they are doing real experiment in the laboratory. The case study and the hyperlink to relevant website make the student easily to connect the relevant subjects for future reading. It has been reported that the addition of active-learning activities is needed to helpfull the students to learn based on their need (Marshall & Nykamp, 2010). The learning material in printed and electronic book in flipbook maker format in the developed innovative learning material is able to fasilitate the students to choose their learning media because the study has shown that interactive teaching and learning can help the students to learn (Baron & Chen, 2012; Holmes, 2006).

It has been found in this study that the performance of innovative chemistry learning material that is developed in this study has meet the criteria of standard book. It is found that all respondents give positive opinion to the learning material. The material has also been proven to be able to improve students achievement in chemistry. The finding has shown that the respond of Chemistry teacher are all agree with the quality of the learning (average 3.63). The availability of teachers guide to use the materials in teaching and learning process, along with the list of students activities to be done in the class or outside class, are found very helpfull for chemistry teacher that make it different to the existing material they have in the schools. Innovation has been made similar to that in learning module (Situmorang & Simatupang, 2013) and textbook (Situmorang, 2013; M. Situmorang & A. Situmorang, 2014) that suited to the need of bilingual schools. From this finding it is clear that teacher guide and students guide are necessary needed as supplement material on the development of learning material for senior high school.

The finding in this study has shown that high student achievements on chemistry were achieved when implemented an innovated chemistry learning material in the teaching process. The average achievement in experimental class (M = 80.5) is higher than in control class (M = 68.5). Closed looking of the data has revealed that increasing trends are found in all target schools and also applied for all chemistry subjects they learn. This finding support their opinion on the performance of learning material where they are all give positive opinion to the learning material they use with average 3.47 (Table 3). The success on improving students achievement for bilingual SHS students are believed due to the good quality of the innovated chemistry learning material, because the flexibility of the material for learning media is suited to the students need. The results support the finding that a good quality textbook can be used as a source of information related to the topic they learn (Carter & Mayer, 1988). An innovative learning material has provided adequate scientific information that be able to help the students to understand the concept theory (Chambliss, 2001). The availability of help in an electronic makes the electronic book to be used to solve problems any time when the found difficulties in learning chemistry. It is believed that the students are interested on using learning material in teaching and learning activities because it consisted of complete learning materials and it is written in two languages that meet their needs in Bilingual schools.

Another interesting finding of the study is the ability of innovated learning material to motivate the students to learn chemistry. There is a positive correlation between the student motivations with the student achievement in chemistry subject ($R^2 = 0.711$). The students are interested to use innovative learning material not only in the classroom but also after the learning activities has been completed. The results from postest-2 has shown that the average of students achievement on chemistry in experimental class (M = 80.5) is higher than in control class (M = 68.5). Some of the students are having higher score in postest-2 compare to their score in the postest-1 because the students can use the material to analyse their mistake when solving problem in postest-1. The media integrated in a learning material can help the students to remember the chemistry subject longger compare to the existing textbook. It has been known that the innovated learning material provide learning instruction that can

help the student to study science. The results support the finding of Mantzicopoulosm and Patrick (2011) and Terrazas-Arellanes et al. (2013) in the development of science textbook. These results has to be use to encourage chemistry teachers and othe teachers to make innovation onto the learning material as it has been proven that innovative learning material can improve student achievements and be able to motivate the student to learn independently.

6. Conclusion

Innovative chemistry learning material has been developed and standardized to meet the requirement of competence based curriculum for bilingual SHS schools in Indonesia. The learning material has successfully design through enriching the chemistry material with local content. Innovation of the chemistry material has been provided through the integration of laboratory experiment, contextual application, teaching and learning media and strategy, and to provide the hyperlink of relevant website to a chemistry text for future study. Innovative chemistry learning material is designed in an interesting format and provided both in a printed and electronic book to facilitate the student chose the right material on learning chemistry depends on their need. The developed learning materials help the students to learn chemistry easily. The developed material has been used as a media in the teaching and learning process in bilingual SHS schools, and was found to be able to improve student achievements in chemistry. The facilities provided in innovative learning material are able to motivate the students to study chemistry. There is a positive correlation between the student's motivations with the student's achievement in chemistry subject when the developed material is implemented in teaching and learning process. It is suggested to encourage the teacher to use innovative learning material on the teaching and learning activities.

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