DEVELOPING INVENTIVE THINKING AND SCIENTIFIC ATTITUDE THROUGH CONTEXTUAL TEACHING AND LEARNING TO FACE 21ST CENTURY EDUCATIONAL CHALLENGE

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Abstract

This research aims to develop inventive thinking and scientific attitude through contextual teaching and learning of Class XI Science Public Senior High School in Pekanbaru. Samples used in this research are 234 students of class XI Science, selected by stratified random sampling technique that can be seen from the grade of school accreditation (A, B, C). Instruments for data collection use questionnaires and interview. The results showed that the profile of the 21st century skills of Grade XI Science Public Senior High School in Pekanbaru to learn biology from questionnaire obtain an average of 4,0 (Very Good). Result from Anova test shown that there is not significant correlation between achievement and gender, and also there is not significant correlation between achievement and school grade B and C. Otherwise, from the result shown, there are significant correlation between achievement and school grade A, with B and C. From this research we can conclude that student achievement profile is good and it can be developed for all school category. Base on that fact teacher participate very important for developing students skills. Developing of contextual teaching and learning could become student asset facing 21st century educational challenge.

Keywords: *21st Century Skills, Contextual teaching and learning, Inventive thinking, Scientific attitude.*

Introduction

Natural Sciences are necessary in life to meet human needs through the solution of problems that can be identified. The application of science needs to be done wisely to maintain and preserve nature. Science curriculum not only emphasizes the mastery of concepts, but also the development of thinking skills, an understanding of the basic principles, fertilizing scientific attitudes and values through learning experiences that are relevant to learners.

Mandate in National Education System (2003) stated that the national education serves to develop skills and form the character and also civilization of a dignified nation in the context of the intellectual life of the nation. National education also aims to develop the potential of students to be faithful and devout man to Almighty God, noble, healthy, knowledgeable, skilled, creative, independent, become democratic and a commit one to his country. According to the Indonesia Ministry of National Education (2010) personality and strong character absolutely needed for students to encounter future challenges.

In line with the concept of Competency-Based Curriculum and Unit Level Curriculum, implementation of contextual teaching and learning emphasized the learning experience to the students directly on learning of science through the development of science process skills and attitudes. This works aim for students to understand the concepts and be able to resolve the problem. Selected problems should arouse curiosity of the students by connecting it in real life (Sonmez and Lee, 2003). Furthermore (Allen, D., 2006) stated students in group will try to resolve problems through inquiry, and communication through analysis.

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The philosophy of contextual teaching and learning is constructivism, which emphasizes learning philosophy "learn not just memorize". According to Martin et al. (2002) with a foundation of constructivism, students will be able to improve the critical thinking skills and problem solving. Students can improve their skills and have a scientific attitude to solve various problems, and continues to absorb and process the information.

Integrated of character education in the learning process starting from planning, implementation, and evaluation in all subjects. Among the principles that adopted to make learning plan (designing learning and assessment activities in the syllabus, lesson plans and teaching materials), do learning process and evaluation that could develop the characters are the principles of contextual teaching and learning, which has been introduced to teachers.

In meet a demand of education for preparing students to have the 21st century skills to face the global challenges which requires creative learning, and innovative. It requires learners to be active in various aspects of learning, so they can have the skill.

Senior High School is an education which is role to produces generation of intelligent and achievement, to face all the challenges at the levels of higher education and the world of work. Senior High School is expected to always produce generation of students who are creative and have a good achievement in learning.

Based on the observations and interviews with some biology teachers as educators it was obtained that at this time there are still many students who are not involved in learning activities, and cannot emerge the skills which are needed in this century. In fact, students are more likely to memorize concepts given as exam preparation material. So it makes the students ability to analyze and solve authentic problems untrained, can't provide optimal results, so the lessons that they learned do not becoming more meaningful.

The research was conducted with the aim of developing an inventory, designing and developing an active and innovative learning tools. Integrating the values of character and culture of the senior high school subjects Biology Class XI with based contextual teaching and learning reference to the National Standards of Education especially Content Standards and Process Standards. Developing of contextual teaching and learning could become student asset facing 21st century educational challenge.

This research aims to collect the 21st century skill profile, developed science attitude and critical thinking in biology trough contextual learning.

Method

Based on the goal, this study is a research & development using the survey design (Cresswell, 2005). This study Implemented in class XI senior high school at biology learning. The study consisted of two phases: (1) the design of an integration model of values and character high school biology based contextual teaching and learning, (2) validation and testing.

The population of this research consist of Pekanbaru senior high schools. The research sample was class XI Science public senior high school Pekanbaru selected based on stratified random sampling technique. Total respondents is 234 which consist of 80 male and 154 female students.

Instrument of this research adapted from Osman, et.al (2010). Construct validation and reliability testing using SPSS for windows version 17.00 for 51 respondents were conduct

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first. The results of validation with Pearson correlation test known that there are some items declaration statement need to improve. To test the reliability of the instrument Cronbach's alpha test were used, from this test obtained alpha were 0.85-0.87. Based on these results, the instrument could be used in this research. Resarch data were analyzed descriptively and inferential.

Results and Discussion

Students Profile

Based on the data collected and calculated it can be seen the profile of 21st century skills in Class XI science student of Public Senior High School. After analyze the questionnaires, it can be obtained the student profile, and can be seen at Table 1.

Table 1. Student Profile Class XI Science Public Senior High School Pekanbaru

School Grade	Gender		Mean Values	Achievement			Not Having Achievement
				Academic and Non Academic	Academic	Non Academic	
A	Male	57	83.9	11	9	18	19
	Female	112	84.1	16	33	17	46
B	Male	17	80.4	0	2	5	10
	Female	24	81.8	2	1	7	14
C	Male	6	81.5	0	3	1	2
	Female	18	86.8	2	14	1	1
TOTAL		234	83.4	31	62	49	92

Based on the Table 1, can be seen the respondents dominated by female which range from 18 to 112 people, while male respondents 6 to 112 people. Mean value respondents of 7 subjects consisting of Biology, Physics, Chemistry, English, Computer, and Religion ranged from 80 to 87. So it can be seen that for the cognitive assessment class XI science student of Public Senior High School in Pekanbaru has high value criteria, because it beyond the minimum completeness criteria determined.

Table 2. Anova Test On Achievement Of Students Based On Gender

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.423	2	.212	.936	.394
Within Groups	52.226	231	.226		
Total	52.650	233			

From these result known that achievement of students based on gender were not significant. Respondent's achievements consist of academic and non-academic achievements. Academic achievement achieved by 62 students. Academic achievement in the form of achievement in school or champion/class rank, participate/champion in Science Olympiad activities (Math and Science), English Olympiad, as well as blog design competition, and website design. While respondents of non academic achievement are 49 students, with the kind of achievements in sports (football championships, martial arts, badminton), championships in the arts (modeling, painting/drawing, dance, poetry, drama/theater), flag raisers, and the

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scouts. Then, the respondents who are belonging academic and non-academic achievements are 31 respondents.

Table 3. Anova test on Achievement of Students Based on School Grade

(I) School Grade	(J) School Grade	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	2.849*	.4865	.000	1.702	3.997
	C	2.025*	.6096	.003	.587	3.464
B	A	-2.849*	.4865	.000	-3.997	-1.702
	C	-.824	.7183	.486	-2.518	.870
C	A	-2.025*	.6096	.003	-3.464	-.587
	B	.824	.7183	.486	-.870	2.518

Based on table 2 and 3 showed there is no significant between achievement and gender, and have significant between achievement and school grade A with B and C. But there is no significant between achievement and school grade B and C. This research knew student achievement profile is good and it can development for all school category. Based on it teacher participant very important for development student skill. According to Sanjaya (2008) as facilitator teacher must be facilitated the student at learning process. it means student have opportunity for developed their ability and skills.

Inventive Thinking

Based on the analysis data, it can be known profile of inventive thinking in biology learning class XI science of Public Senior High School in Pekanbaru, shown in Table 3.

Table 4. Inventive Thinking Profile Class XI Science Students of Public Senior High School Pekanbaru Indonesia.

No	Statement	Likert Scale					Mean	Category
		1	2	3	4	5		
1	Creative thinking	2 (0.9)	0 (0.0)	30 (12.8)	158 (67.5)	44 (18.8)	4.0	Very Good
2	Ability to complete the task	1 (0.4)	17 (7.3)	73 (31.2)	85 (36.3)	58 (24.8)	3.8	Good
3	Asking	2 (0.9)	3 (1.3)	11 (4.7)	149 (63.7)	69 (18.4)	4.2	Very Good
4	Seeking diverse information	1 (0.4)	0 (0.0)	29 (12.4)	161 (68.8)	43 (18.4)	4.0	Very Good
5	Producing new idea	3 (1.3)	12 (5.1)	107 (45.7)	100 (42.7)	12 (5.1)	3.5	Good
6	Have imagination	5 (2.1)	12 (5.1)	61 (26.1)	104 (44.4)	51 (21.8)	3.8	Good
7	Ability to solve challenging task	1 (0.4)	8 (3.4)	60 (25.6)	130 (55.6)	35 (15.0)	3.8	Good
8	Willingness to go beyond safety zone to make mistakes	13 (5.6)	18 (7.7)	105 (44.9)	82 (35.0)	16 (6.8)	3.3	Good
	TOTAL	**28 (1.5)**	**70 (3.7)**	**476 (25.4)**	**969 (51.8)**	**328 (17.5)**	**30.4**	
	MEAN			**3.8**				**Good**

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Based on the questionnaire answers from 234 respondents in Class XI science public senior high school Pekanbaru, obtained average for profile element inventive thinking that 3.8 (Good). It can be seen that the students are able to inventive thinking in the completion of a given task or problem. According to Osman et al. (2010) that the students who have skills in inventive thinking well, allowing students to recognize and understand a changing constant, and handle positive change by modifying their thinking, attitude or behavior to deal with new problems in the environment.

Sub elements of inventive thinking that have lower category than the other sub-elements are taking risks on statement item 2, 5, 6, 7 and 8 are 3.3-3.8 (good). The yield on risk-taking confirmed that the students will be more willing to go beyond the comfort zone to make mistakes, to creatively resolve the challenges or problems a main purpose of improving personal performance. In addition, they are willing to think about the problems or challenges and to share ideas with others and to listen the feedback given by their friends. According to Osman et al. (2010) students need to be involved in discussions about approaches and potential solutions, also a place that allows them to share ideas, reflect and discuss perspectives and learn new things.

Dimensions 1 and 4 on inventive thinking element, have mean 4.0 (very good), illustrating that students have creative thinking and creative in solving tasks in search of useful information to solve a given problem. The results confirmed that the creativity of the students have been able to act to bring something into existence that is completely new and original. Teacher as facilitator should be involved students in learning activities that are creative and constructive. In addition, students should be given more freedom and opportunity to explore in their learning through student-centered approach. A creative class should allow more time for questions, deviation from the text, and to the development of creative thinking (Wassermann et al., 2000 in Osman, 2010).

Spirituality Element

Based on the analysis of data, it can be known profile of spirituality in biology learning class XI science students of Public Senior High School Pekanbaru described in Table 4

Table 5. Religious Profile Class XI science Students Senior High School Pekanbaru

No	Statement	Likert Scale					Mean	Category
		1	2	3	4	5		
1	Be grateful	1 (0.4)	0 (0.0)	1 (0.4)	64 (27.4)	168 (71.8)	4.7	Very Good
2	Connects religion and science	7 (3.0)	11 (4.7)	23 (9.8)	86 (36.8)	107 (45.7)	4.2	Very Good
3	Knowing the figures of religious scholars	13 (5.6)	42 (17.9)	83 (35.5)	69 (29.5)	27 (11.5)	3.2	Good
4	Connects biology needs with spiritual aspect	8 (3.4)	8 (3.4)	50 21.4)	81 (34.6)	87 (37.2)	4.0	Very Good
5	Realizing Science and Technology could be used to improve the capability of using natural resources as needed	1 (0.4)	0 (0.0)	1 (0.4)	71 (30.3)	161 (68.8)	4.7	Very Good
	TOTAL	**30 (2.6)**	**61 (5.2)**	**158 (13.5)**	**371 (31.7)**	**550 (47.0)**	**20.8**	
	MEAN			**4.2**				**Very Good**

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From the table 5, it can be read that the profile of spirituality in class XI Science Senior High school Pekanbaru on biology learning have an average 4.2 belongs to category of Very Good. Based on the 5 items on the statement given to the spiritual elements of the questionnaire, items 1 and 5 had the highest average when compared to other items are 4.7 (very good). Based on the interviews with the students of class XI Science about their impressions of biology lessons if it is associated with religion, it is known that 100% of the students are indeed aware that learning biology is closely related to all aspects of life, and grateful to be able to learn the lessons and problems of biology. This is also supported by the biology of learning activities in the search for the Quran verses relating to the material being taught. So they knew directly the relationship between the learning materials directly related to religion.

Based on it, they understand that there is a close connection between the science learning with religion, according to the average obtained in item 2 and 4 on the table 2 the category are very good.

Item 3 on the spiritual element from table 2, had a average 3.2 (good). This is because in the biology lessons they don't have to recognize and knowing the religious leaders, so many of the respondents (35.5%) were answered on a scale of 3 (disagree). However, 29.5% of respondents answered agree and 11.5% of respondents answered very agree. It is known that they are aware of religious leaders in the field of Science from biology, from various sources, although teacher not given the emphasis of it in the classroom.

Table 6. Profile 21st Century Skills Class XI Science Student of Public Senior High Shool Pekanbaru Indonesia

NO	ELEMENT	SCALE					MEAN	CATEGORY
		1	2	3	4	5		
1	Digital Literacy	4 (0.3)	10 (0.9)	105 (9.0)	819 (70,0)	232 (19.9)	4.1	Very Good
2	Inventive Thinking	28 (1.5)	70 (3.7)	476 (25.4)	969 (51.8)	328 (17.5)	3.8	Good
3	Effective Communication	70 (3.3)	112 (5.3)	294 (14.0)	1152 (54.7)	478 (22.7)	3.9	Good
4	High Productivity	15 (1.3)	52 (4.4)	209 (17.9)	638 (54.5)	256 (21.9)	40	Very Good
5	Spirituality	30 (2.6)	61 (5.2)	158 (13.5)	371 (31.7)	550 (47.0)	4.2	Very Good
		MEAN					4.0	Very Good

Scientific Attitude

The experiment was conducted in accordance with the steps of *RANGKA* (***R****umuskan*/Conclude, *A**m**ati*/Observe, ***N****yatakan*/State, ***G****abungkan*/Combine, ***K****omunikasikan*/Communicate and ***A****malkan*/Implement) contextual teaching and learning based character education on the subject matter of the regulatory system and the reproductive system in Biology. Learning steps refers to the standards of learning process. At the beginning of the activities initiated by *Rumuskan*, teachers ask the student about prerequisite knowledge and give motivation like some questions to students related to the real situation. With this real situation students are expected to connect the problem with learning materials that would be studied. By the time the teacher asked a question or problem, then students will analyze these questions and find out a formulation from material that will be studied.

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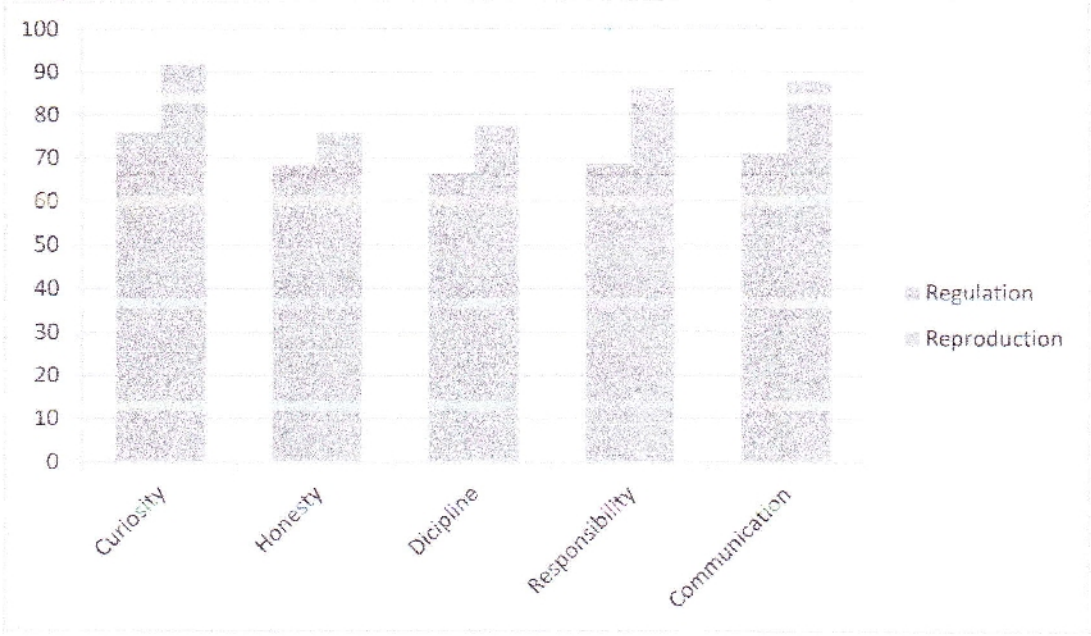
Core activities, consist of 6 phases *RANGKA* contextual teaching and learning, in the form of activities *Amati* dan *Alami*. In this phase, the teacher provides information related to student learning materials, and then asks the students to sit in a group. After that, teachers guide students to understand the discourse that exist in student worksheet, both short discourse at the beginning of the worksheet and the discourse that demands critical thinking skills of students in the activities of two worksheet. In phase 3 *Nyatakan*, teachers directed students to write down the things that have been understood by answering the questions in the worksheet. Fourth phase is *Gabungkan*, the students directed by teacher to discuss with other group members in completion of worksheet. Later in phase 5 is *Komunikasikan*, the teacher guides the students to communicate the results of their discussion. At the closing, a contextual learning phase 6 that is *Amalkan*, where teachers guide students to summarize the learning materials, provide post-test to students and give assignments to students to practice or apply the lessons they have gained in their daily lives.

At each meeting in the implementation of *RANGKA* contextual teaching and learning scientific attitude in the learning process was observed. In the phase of *Rumuskan*, a scientific attitude that arises is curiosity. The phase *Amati dan alami*, scientific attitude that arises is also curiosity. The phase *Nyatakan*, emerging scientific attitude are honesty, discipline, and responsibility. The phase *Gabungkan*. scientific attitude that arises are discipline and responsibility. The phase *Komunikasikan* scientific attitude that emerges are communicative and in phase *Amalkan*, scientific attitude are communicative, responsibility, honesty and discipline.



Picture 1. Scientific Attitude of Students Through the Implementation *RANGKA* Contextual Teaching and Learning based Character Education

In addition to the observations of the scientific attitude, students critical thinking skills also explored through scientific work by working the problems according to indicators of critical thinking that is guided in the work sheet. Critical thinking skills profile as shown in Picture 2.

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Picture 2 Critical Thinking Skills of Students Through the Implementation *RANGKA* Contextual Teaching and Learning based Character Education

Table 5. Profiles Cognitive Ability Through the Implementation of *RANGKA* Contextual Teaching and Learning based Character Education.

No	Interval	Category	Regulation System	Reproduction System
1	90 -100	Excellent	-	1 (2.8)
2	80- 89	Good	4 (10.3)	16 (41.1)
3	70-79	Enough	18 (46.2)	9 (23.7)
4	< 70	Less	17 (43.5)	13 (33.4)
			39 (100)	39 (100)
	Mean		**77,61**	**82,36**

Development of scientific attitude according the character education is reflected in every learning activity. This is because the students are trained to apply and experience problem in appropriate subject matter with reference to real-world and related the problem to their roles and responsibilities and also closely linked to the real experience. Contextual teaching and learning activities developed in each Student Worksheets.

In addition to character development, contextual learning also emphasizes higher-order thinking skills, which in this study students are trained to use thinking skills in understanding an issue or solve contextual problems. Starting from analyzing the problem, define the problem, gather data / finding information for problem resolution, resulting in problem solving and assess the results of solving the problem.

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Learning activities designed to stimulate the development of character because it is integrated in learning activities. So that the development of thinking skills: integrate domains of cognitive, affective and psychomotor; focusing on science and religious, and development of a scientific attitude can be achieved. According to Anderson and Krawthwohl (2010), problem solving occurs when students have an idea how to achieve the goals he has never achieved, ie, understand how to change actual condition to the desired condition. In addition, the focus of meaningful learning in accordance with the view that learning is a construct knowledge, which is students try to understand through that view.

Steps of *RANGKA* Contextual teaching and learning, can make students work in groups to solve a wide range of authentic problems. Each step of the learning activities is expected to emerging the scientific attitude of students so that these things will help students to build their own knowledge and students concepts retention will be stronger if compared to just hear an explanation from the teacher alone. Life skills are also important to developed through a learning process. One's ability to succeed in life, are determined by the skill of thinking, especially in an effort to solve the life problems that it faced.

Through *RANGKA* Contextual teaching and learning, teacher facilitates the students to relate the material being taught by real-world situations and encourage students to make connections between the knowledge they have with the application in their daily lives so that trained students construct their own knowledge and skills when he was learning, and learning-centered the student will be achieved. According to Suryawati, et al. (2010), in addition to emphasis on cognitive aspects, ie critical thinking skills, contextual learning also emphasizes the affective aspect, because in biology education it is necessary and can be loaded with character education and also can be reflected through the development of a scientific attitude. The existence of a base character education that emphasized in contextual learning approach RANGKA is expected to strengthen and enhance the characters of students, which some of them were belong to the components of the scientific attitude.

Through *RANGKA* Contextual Teaching and Learning, is expected not only cognitive aspects of students is more prominent, but also followed by affective aspects such as character values that reflected through the scientific work based on the scientific attitude. Since the determinant of one's success not only by cognitive intelligence, but must be in line with the affective value.

Conclusion

Development of *RANGKA* contextual teaching and learning based character education in learning at senior high school in biology has the potential to be developed and implemented by teachers so that students cognitive, affective, and psychomotor could be optimize. For future Research it must developed according to the needs and development of the national education curriculum. Developing of contextual teaching and learning could become student asset facing 21st century educational challenge.

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