The Competency Based Approach and Biology Students' Higher Order Thinking Skills in Secondary Technical Schools in The Buea Sub Division of The South West Region of Cameroon.

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ABSTRACT

This study investigated the extent to which the Competency Based Approach affects higher order thinking skills in Biology in Secondary Technical School Students' in the Buea subdivision of the South West Region of Cameroon. Three research hypotheses were formulated to test the effect of the competency-based approach on students' ability to analyze, synthesize and predict. The quasi experimental design was used and 120 Form five students were selected purposively. The experimental group was taught using student-centred methods with remediation (Competency Based Approach) while the control group was taught using the traditional lecture method only. An Achievement Test (AT) with items to measure competences in the fourth, fifth and sixth levels of the Cognitive domain of Bloom's Taxonomy of Educational Objectives, formulated by the researcher and validated by experts in the field of Biology was used to measure Higher Order Thinking Skills. Data were analyzed using mean scores, standard deviation and t-test to test the hypotheses stated at $p \leq 0.05$ level of significance. The results revealed that the experimental group significantly acquired HOTs more than the control group. Recommendations were made.

Keywords: Competency-based, higher order thinking, Biology, Secondary school, Cameroon

Introduction

Secondary education has increasingly become a central policy concern of developing countries (UNESCO,2000). Secondary education creates a pool of qualified people with the knowledge and skills to

contribute significantly to economic development and allows individuals to expand their choice and improves personal and work-related skills amongst other benefits. One of the abilities able to support secondary school leavers in facing the present times is high level thinking skills also referred to as higher order thinking skills (HOTS) (Anggraini, Budiyono and Pratiwi,2019).

Technical and Vocational Education is mainly concerned with the development of employability skills. In order for graduates of technical and vocational education to remain relevant, they ought to be able to develop capacities to learn continuously through thinking and reasoning, problem solving, decision making and interpersonal competence (King, Goodson, & Rohani, 2011). Thomas (1992) argues that vocational education in particular must enhance HOTS because occupations are becoming more reliant on cognitive capacities. The changing work environment requires flexibility and adaptability to changing conditions; and vocational education provides a real-world context for cognitive development. The preparation to cultivate the students' ability to think at a higher level has been an important theme for redesigning and reforming learning systems (Kim, 2005). Teaching approaches that permit the learners construct and apply knowledge are important in enhancing HOTS. This paper attempts to find out the extent to which the Competency Based Approach enhances the HOTs of Secondary Technical School students of Biology in the Buea sub-division of the Southwest region of Cameroon.

Review of Literature

Theoretically**,** there are several approaches to constructivist theory with major branches, those built on philosophical theories of learning and those focusing on psychological theories (Olsen,1999). The constructivist theory of learning is reflected in the developmental theories of Piaget and Vygotsky. In Cognitive constructivism from the work of Piaget, a student's reactions to experience leads to learning. From the work of Vygotsky, social constructivism plays an important role in the construction of meaning from experience. The basic idea behind competence based education is to help learners to develop and construct their own knowledge and seek ways to make optimal use of other people's competence in their learning journey. This is what social constructivism is about. For learning outcomes aimed at developing individual and personal competences, the approach must take the diversity of learner needs into consideration to meet the learners' goals and objectives. This requires an open approach or student-centred teaching which includes dialogues between learners and educators (O'Sullivan and Bruce, 2014). Constructivism theory underpins a variety of teaching methods such as problem-based learning, inquiry–based learning, project-based learning, case-based teaching, and discovery based learning which promote active participation in the classroom (Makgato,2012). Teachers must have an understanding of constructivist theory, principles and pedagogy in order to enhance HOTS in teaching and learning in the classroom.

Higher Order Thinking Skills in Biology

The ultimate goal of education is to help students develop their higher order thinking skills to enable them to face the challenges of daily life, through experiences that encourage students to use higher order thinking skills such as critical, reasoning, reflective and science process skills (Aktamis & Yenice, 2010). All human

beings are capable of thinking, however, most of them need to be encouraged, taught and assisted to the thinking processes. These thinking skills are teachable and learnable. Students who are trained to think demonstrate a positive impact on the development of their education. Higher Order Thinking skills (HOTs) is a thinking process, which is made up of complicated procedures and based on different skills such as analysis, synthesis, comparison, inference, interpretation, assessment, and inductive and deductive reasoning to be employed to solve unfamiliar problems (Zohar and Dori, 2003; Simon, 2013). The characteristics of students with HOTS are open-mindedness for risk-taking, curiosity, planning, having a systems thinking process, thinking carefully, using evidence to think rationally and frequent self-monitoring (Shari in Budsankom, et al. 2015). The students with HOTS are able to create new knowledge and make appropriate and logical decisions. .

The concept of higher order thinking (HOT) is derived from the of cognitive domain Bloom's taxonomy of Educational Objectives introduced in 1956 (Forehand, 2010). Human thinking skills can be classified into two major groups; low-order thinking skills (LOTS), and higher order thinking skills (HOTS). LOTS are the first three levels of Bloom's taxonomy, which are remembering, understanding, and applying. HOTS are the last three aspects of Bloom's taxonomy namely analyzing, evaluating, and creating (Moore & Stanley, 2010). Analytical thinking is the ability of individuals to classify objects logically, assessing the relationships of certain elements, how they contribute, how they relate to each other, how they work, and what the most important parts are (Marzano, 2001). Analytical thinking skills are critical in today's advanced technology work place. It is necessary for every country to develop its future human resource to be able to think analytically, critically, know how to solve problems, develop creative thinking skills, know how to acquire knowledge from multiple sources, learn and construct bodies of knowledge by themselves, adapt themselves in time for the ever-changing situations and be prepared to confront various challenges (Tang, 2017). Earl and Timperley (2015) assert that evaluative thinking provides the tools for systematically gathering and interpreting evidence that can be used to provide information about progress and provide feedback loops for refinement, adjustment, abandonment, extension and new learning. Creative thinking is a type of effort toward solving a problem based on the capacity of the individuals to suggest an authentic and new design, generate different hypotheses, solve the problem with the help of discovering and finding new applications (Glass, 2004; Young & Balli, 2014).

The aim of teaching Biology is to provide biology-related learning experiences for students to develop scientific literacy, so that they can participate actively in our rapidly changing knowledge-based society, prepare for further studies or careers in the fields related to life science and become life-long learners in science and technology (Conrad, 2001). In Biology, higher order thinking skills are needed to solve many questions in real life (Cimer, Timucin & Kokoc, in Sabu, 2018) and also help students to solve new problems (Janssen & Waarlo, 2010) not only in the examination but also in their daily lives. The emergence of a highly competitive and integrated economy, rapid scientific and technological innovations, and a growing knowledge-base will continue to have a profound impact on lives. In order to meet these challenges, Biology, like other science subjects, will provide a platform for developing scientific literacy and building up essential scientific knowledge through decision making, problem solving, experimentation, conducting investigations, classifying organisms and comparing different organisms (Marzano, 2007).

The Competency Based Approach (CBA)

Competence is defined as the developmental capacity to interactively mobilize and ethically use information, data, knowledge, skills, values, attitudes, and technology to engage effectively and act across diverse situations. Carracio et al (2002) asserted that there was no single definition of Competency-Based Instruction, however it can be identified by the following characteristics: Spell out exactly what it is that trainees should learn, provide high quality of instruction, help students learn one thing well before going on to the next and require each trainee to demonstrate competency. Thus competency-based approach focuses on measurable and useable knowledge, skills and abilities (Richards and Rodgers, 2001). It consists of teachers basing their instructions on concepts expecting to foster deeper and broader understanding. CBA curricula fostering learner-friendly teaching and learning strategies, could engender a shift from sheer memorization to the development of higher order intellectual skills and life skills, including communication, social and emotional and other relevant skills. Scwhab (2016) states that at least 10 competencies are needed by workers in 2020. Those competencies are complex problem solving, critical thinking, creativity, people management, coordinating others, emotional intelligence, judgment decision making, service orientation, negotiation, and cognitive flexibility. According to Bloom's taxonomy of Educational Objectives, those competencies are categorized as high order thinking skills. This includes to analyze, to evaluate, and to create. It focuses on learning and pupils' activities (learner-centered) rather than on the teacher's role (Jeager,2003).

The advantages of the competency Based Approach include the fact that participants will: achieve competencies required in the performance of their jobs; build confidence as they succeed in mastering specific competencies; receive a transcript or a list of the competencies they have achieved; use training time more efficiently and effectively as the trainer is a facilitator of learning as opposed to a provider of information; devote training time to working with participants individually or in small groups as opposed to presenting lectures and devote more training time to evaluating each participant's ability to perform essential job skills (Rojewski and Hill, 2014 and Sullivan, 1995).

HOTS can be taught and learned. Thus the issue lies with how best to teach this highly needed skill (Chinedu and Kamin, 2015). The CBA uses approaches that integrate differentiating, organizing, attributing (to break into constituent parts) and determine how these parts relate to one another and also to an overall structure and purpose (Yunos et al., 2010; Zohar & Dori, 2003). Teaching students to learn to develop evaluation techniques should comprise of activities that includes: coordinating, detecting, monitoring, testing, critiquing and judging. They further explained that exposing students to these kinds of activities would provoke their minds into recognizing patterns, distinguishing patterns and exposing the ideal problem (Anderson, et al. 2012)

Mkonongwa (2018) asserts that philosophically, competency-based teaching and learning has its roots in the social constructivism. Therefore, learners engage in a process of constructing their own knowledge by interaction with their environment, rather than as a process of absorbing the knowledge that the traditional teacher might try to transfer to them and so proposes the following teaching methods for competency-based teaching: Cooperative, interactive learning, Discovery learning, Reflective learning and Personal learning. A multidisciplinary approach is also important (O'Sullivan and Burce, 2014).

Statement of the Problem

The performance of Biology students in secondary school end-of -course exams for a period of eight years has not gone beyond 59%. Furthermore, biology students are for the most part unable to apply the knowledge acquired in the study of Biology in solving real life problems upon graduation. They are unable to apply the knowledge gained to improve and maintain the health of the individual, demonstrate resourcefulness, relevant technical skills and scientific thinking, relate and apply relevant biological knowledge and understanding to various situations in their communities and more. In Biology, higher order thinking skills are needed to solve many questions in real life and also help students to solve new problems. This indicates that the students do not possess higher order thinking skills. Higher order thinking skills are teachable and learnable. The teaching strategy is of prime importance is enhancing HOTs. CBA enhances a shift from mere memorization to HOTs and life skills. Thus this study aims at finding out the extent to which the use of CBA can enhance HOTs in secondary school Biology student. Findings will provide a basis for teacher professional development.

Hypotheses

Three hypotheses guided the study as follows:

- The CBA has no significant effect on secondary school students' ability to analyze
- The CBA has no significant effect on secondary school students' ability to synthesize
- The CBA has no significant effect on secondary school students' ability to predict

Methodology

The study made use of a quasi-experimental design. Participants consisted of 120 purposively selected form five students who study Biology. Intact classes were used. Form 5A had 70 students and Form FB had 50 students who took biology as a subject. Form 5A was the experimental group while Form 5B was the control group. A pre-test was administered to both the control and experimental groups before the introduction of the treatment to the experimental group. A combination of student-centred methods including discussion, cooperative learning, project method and experimentation method coupled with remedial teaching were used to teach eight lessons for the experimental group while only the traditional lecture method with no remedial teaching was used to teach the same lessons to the control group. Achievement was measured using a test bearing competences drawn from the cognitive domain of Bloom's Taxonomy of Educational Objectives namely: analysis, synthesis and prediction (evaluation). Thirteen items constituted the assessment instruments: five of them on analysis, five on synthesis and three on prediction. The results of both groups were compared using means and a student t-test to find out the extent of the difference in performance of both groups.

Results

The statistical analysis technique used to compare the performance on ability to analyse, synthesize and predict for both groups to see if they differ in performance significantly before the treatment with CBA was the independent t-test. The results of the analyses are presented in Table 1:

Table 1: Independent t-test analysis of pre-test scores for analysis, synthesis and prediction (120)

Analysis	N	Mean	SD	t-value
Control Group	50	3.34	1.59	-0.273
Experimental Group	70	3.44	1.62	
Total	120			
Synthesis				
Control Group	50	4.02	1.720	-0.780
Experimental Group	70	4.26	1.595	
Total	120			
Prediction				
Control Group	50	1.828	.805	-0.682
Experimental Group	70	1.929	.791	
Total	120			

*p<0.05, df=118; critical t = 1.98

The result of the analysis in Table 1 reveals that at a 0.05 level of significance with 118 degrees of freedom. The calculated absolute t-values of 0.273 is lower than the critical t-value of 1.98. This result implies that there is no significant difference in performance between the control group and the experimental group. So, there is no significant difference in the ability to **analyse** between the control group and the experimental group before the introduction of the treatment.

The calculated absolute t-values of 0.780 is lower than the critical t-value of 1.98. This result implies that there is no significant difference in performance between the control group and the experimental group. So, there is no significant difference in the ability to **synthesize** between the control group and the experimental group before the introduction of the treatment.

The calculated absolute t-values of 0. 682 is lower than the critical t-value of 1.98 which implies that there is no significant difference in performance between the control group and the experimental group. So, there is no significant difference in the ability to **predict** between the control group and the experimental group before the introduction of the treatment.

Three hypotheses guided the study as follows:

- The CBA has no significant effect on secondary school students' ability to analyse.
- The CBA has no significant effect on secondary school students' ability to synthesize.
- The CBA has no significant effect on secondary school students' ability to predict.

A post-test was administered to both the control and experimental groups after the introduction of the treatment to the experimental group. The statistical analysis technique used to compare the performance on the ability to analyse, synthesize and predict for both groups to see if they differ in performance significantly was the independent t-test. The results of the analyses are presented hypothesis by hypothesis

Hypothesis One: The CBA has no significant effect on secondary school students' ability to analyse.
The independent variable in this hypothesis was the CBA, while the dependent variable was students' ability to analyse. The scores of the dependent variable were got from the scores recorded from the test administered to the two groups after the introduction of the treatment (CBA) to the control group. The statistical analysis technique used to test this hypothesis was the independent t-test. The result of the analysis is presented in Table 2.

Table 2: Independent t-test analysis of post-test scores for analysis (120)

Analysis	N	Mean	SD	t-value
Control Group	50	4.30	1.930	-2.33*
Experimental Group	70	4.99	1.440	
Total	120			

*p<0.05, df=118; Critical t = 1.98

The result of the analysis in Table 2 reveals that, the calculated absolute t-value of 2.23 is higher than the critical t-value of 1.98 at a 0.05 level of significance with 118 degrees of freedom. With this result the null hypothesis was rejected and the alternative accepted. This means that the CBA has a significant impact on students' ability to analyse.
Since there is a significant influence of CBA on students' ability to analyse, a further examination of the influence reveals that the mean value of CBA on students' ability to analyse (mean = 4.99) is higher than the mean value of non-treatment of CBA on students' ability to analyse (mean = 4.30). Therefore, the use of CBA proves to be a more effective tool in students' ability to analyse.
Hypothesis Two: The CBA has no significant effect on secondary school students' ability to synthesize.
The independent variable in this hypothesis was the CBA, while the dependent variable was students' ability to synthesize. The scores of the dependent variable were got from the scores recorded from the test administered to the two groups after the introduction of the treatment (CBA) to the control group. The statistical analysis technique used to test this hypothesis was the independent t-test. The result of the analysis is presented in Table 3:

Table 3: Independent t-test analysis of pre-test scores for analysis, synthesis and prediction (120)

CBA	N	Mean	SD	t-value
Control Group	50	3.92	1.226	-5.343*
Experimental Group	70	5.14	1.243	
Total	120			

*p<0.05, df=118; critical t = 1.97

The result of the analysis in Table 3 reveals that the calculated absolute t-value of 5.343 is higher than the critical t-value of 1.96 at 0.05 level of significance with 118 degrees of freedom. With this result the null hypothesis was rejected and the alternative accepted. This means that there is a significant influence of CBA on students' ability to synthesize.

Since there is a significant influence of CBA on students' ability to synthesize, a further examination of the influence reveals that the mean value of CBA on students' ability to synthesize (mean = 5.14) is higher than the mean value of non-treatment of CBA on students' ability to synthesize (mean = 3.92). Therefore, the use of CBA proves to be a more effective tool in students' ability to synthesize.

Hypothesis Three: The CBA has no significant effect on secondary school students' ability to predict.

The independent variable in this hypothesis was the CBA, while the dependent variable was students' ability to predict. The scores of the dependent variable were got from the scores recorded from the test administered to the two groups after the introduction of the treatment (CBA) to the control group. The statistical analysis technique used to test this hypothesis was the independent t-test. The result of the analysis is presented in Table …

Table 4: Independent t-test analysis of students' ability to predict (120)

CBA	N	Mean	SD	t-value
Control Group	50	1.86	1.030	-6.05
Experimental Group	70	2.97	0.963	
Total	120			

*p<0.05, df=118; critical t = 1.97

The result of the analysis in Table 4 reveals that the calculated absolute t-value of 6.05 is higher than the critical t-value of 1.96 at 0.05 level of significance with 118 degrees of freedom. With this result the null hypothesis was rejected and the alternative accepted. This means that there is a significant influence of CBA on students' ability to predict. Since there is a significant influence of CBA on students' ability to predict. A further examination of the influence reveals that the mean value of CBA on students' ability to predict (mean = 2.97) is higher than the mean value of non-treatment of CBA on students' ability to predict (mean = 1.86). Therefore, the use of CBA proves to be a more effective tool in students' ability to predict.

Using an alpha level of 0.05, a dependent-samples t-test was conducted to evaluate if there were any significant differences in the pre-test/post-test performance for the control group and the experimental groups.

Control Group

The result of the analyses to see if the pre-test scores differ significantly from the post-test scores in students' ability to analyse, synthesize and predict for the control group are presented in Table …

Table 5: Results of dependent t-test and descriptive statistics for the control group on students' ability to analyse, synthesize and predict (50)

	Pre-Test		Post-Test		Γ_{xy}	t-value
	$\bar{X}$	SD	$\bar{X}$	SD		
Analyse	3.36	1.588	4.30	1.930	0.095	-1.705
Synthesize	3.66	1.610	3.92	1.226	0.366	-0.912
Predict	1.83	0.805	1.86	1.030	0.866	-0.170

*p < .05, df=69, Critical t = 2.01

The result of the analysis on Table 5 reveals that the calculated absolute t-value of 1.705 is lower than the critical t-value of 2.01 at 0.05 level of significance with 49 degrees of freedom. This result implies that there is no significant difference in the mean scores for the pre-test post-test scores of students' ability to analyse for the control group.

The calculated absolute t-values of 0.912 is lower than the critical t-value of 2.01 at 0.05 level of significance with 49 degrees of freedom. This result implies that there is no significant difference in the mean scores for the pre-test post-test scores of students' ability to synthesize for the control group.

The calculated absolute t-values of 0.170 is lower than the critical t-value of 2.01 at 0.05 level of significance with 49 degrees of freedom. This result implies that there is no significant difference in the mean scores for the pre-test, post-test scores of students' ability to predict for the control group.

Experimental Group

The result of the analyses to see if the pre-test scores differ significantly from the post-test scores in students' ability to analyse, synthesize and predict for the experimental group are presented in Table 6:

Table 6: Results of dependent t-test and descriptive statistics for the experimental group on students' ability to analyse, synthesize and predict (70)

	Pre-Test		Post-Test		Γ_{xy}	t-value
	$\bar{X}$	SD	$\bar{X}$	SD		
Analyse	3.90	1.621	4.99	1.440	0.000	-4.017
Synthesize	3.86	1.585	5.14	1. 243	0.000	-5.600
Predict	1.93	0.791	2. 97	0.963	0.000	-6. 893

*p < .05, df=49, Critical t =1.99

The result of the analysis in Table 6 reveals that the calculated absolute t-value of 4.017 is higher than the critical t-value of 1.99 at 0.05 level of significance with 69 degrees of freedom. This result implies that there is a significant difference in the mean scores for the pre-test post-test scores of students' ability to analyse for the experimental group.

Since there is a significant influence of CBA on students' ability to analyse. A further examination of the influence reveals that the mean value of CBA on students' ability to analyse (mean=4.99) is higher than the mean value of pre-treatment of CBA on students' ability to analyse (mean = 3.90). Therefore, the use of CBA proves to be a more effective tool in students' ability to analyse for the experimental group.
The calculated absolute t-values of 5.600 is higher than the critical t-value of 1.99 at 0.05 level of significance with 69 degrees of freedom. This result implies that there is a significant difference in the mean scores for the pre-test, post-test scores of students' ability to synthesize for the group of students exposed to the CBA.

Since there is a significant influence of CBA on students' ability to synthesize. A further examination of the influence reveals that the mean value of CBA on students' ability to synthesize (mean=5.14) is higher than the mean value of pre-treatment of CBA on students' ability to analyse (mean = 3.86). Therefore, the use of CBA proves to be a more effective tool in students' ability to synthesize for the experimental group.
The calculated absolute t-values of 6. 893 is higher than the critical t-value of 1.99 at 0.05 level of significance with 69 degrees of freedom, which implies that there is a significant difference in the mean scores for the pre-test, post-test scores of students' ability to predict for the group of students exposed to the CBA.
Since there is a significant influence of CBA on students' ability to predict, a further examination of the influence reveals that the mean value of CBA on students' ability to analyse (mean=2. 97) is higher than the mean value of pre-treatment of CBA on students' ability to predict (mean = 1.93). Therefore, the use of CBA proves to be a more effective tool in students' ability to predict for the experimental group.

Discussion and Conclusion

The result obtained from the data analysis revealed that there was a significant improvement in students' achievement in the experimental group from the pre-test to post-test scores after the use of student-centered method of teaching as compared to the control group who were taught by traditional method. Therefore, applying CBA is effective in improving the achievement of secondary school students' HOTS. HOTS can be taught and learned. Thus the issue lies with how best to teach this highly needed skill (Chinedu and Kamin, 2015). The findings of the present study support the assertion that CBA is a strategy that leads to higher achievement of students. This finding is well supported by the studies of Chelli, (2015), which found out that there were statistically significant differences on first year students' writing achievement in the Department of Foreign Languages at Biskra secondary school, due to the Competency Based Approach. The most important characteristic of competency-based education is that it measures learning rather than time. Students progress by demonstrating their competence, which means they prove that they have

mastered the knowledge and skills (competencies) required for a particular course (O'Sullivan and Bruce, 2014). The advantages of the CBA far outweigh the advantages of the more traditional approaches to education that rely more on knowledge and skills acquired than on whether the knowledge and skills can be appropriately and reliably applied in the ever-changing complex situations that graduates will face (Saucier et al., 2012)

According to Piaget, meaningful learning means that the learner can organize the information and assimilate them in his /her knowledge framework. Leou and Liu (2004) suggested that learning can be enhanced if the learning involves interaction, that permit learners construct their understanding in order to make learning organized and meaningful. CBA is therefore supported by constructivism (Markow and Lonning, 1998). Throughout the process, it is important for the teacher to make adjustments to the activities based on each student's unique learning needs, language proficiency, and progress (Toe, Shaw, Chen, and Wang, 2016).

With regard to recommendations, training sessions and workshops need to be organized to better inform and drill teachers on how to go about the competency based approach. Teachers are expected to be drilled on the type of instruction methods to use, how to develop test items to suit the learning objectives, what teaching resources are appropriate and most importantly, they are expected to be informed that the approach is highly student-centered making teachers facilitators.

In evaluation of student learning outcomes, the competency-based assessment or criteria based assessment approaches should be used. Students assessment has also referred to "authentic assessment" that relates to solving day to day riel life problems. Those types of assessment are, especially, project-based, problem-based, portfolio, and self assessment (Sutartu, 2017).

Also, since the CBA employs student-centred teaching approaches an increase in human and material resources are paramount. The education system should get into partnership with industries in the society. This will help maximize competences required by students during the teaching learning process and better prepare them for the job market

References

Aktamis, H., & Yenice, N. (2010). Determination of the science process skills and critical thinking skill levels. In H. Uzunboylu (Ed.), Innovation and creativity in Education (Vol. 2, pp. 3282-3288).

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., . . . Wittrock, M. C. (2012). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives, abridged edition. White Plains, NY: Longman.

Anggraini, N. P., Budiyono and Pratiwi, H. (2019). Analysis of higher order thinking skills students at junior high school in Surakarta. *Journal of Physics*. doi:10.1088/1742-6596/1211/1/012077. Retried from https://iopscience.iop.org/article/10.1088/1742-6596/1211/1/012077/pdf

Bader, F. (2007). Writing under the Competency-based Approach The Case of Second Year Middle School Pupils (Unpublished master's thesis). Mentouri, Constantine, Algeria

Budsankom, P., Sawangboon T., Damrongpanit,S and Chuensirimongkol, J. (2015). Factors affecting higher order thinking skills of students: A meta- analytic structural equation modeling study. *Educational Research and Reviews*, 10(19), pp. 2639- 2652

Carraccio C. , S. D. , R. Englander , K. Ferentz, C.Martin. Shifting Paradigms: From Flexner to Competencies. Academic Medicine: May 2002, Volume 77 - Issue 5 - p 361–367, 2002.

Chelli, S. (2012). the effects of the Competency-Based Approach on learners' writing Achievement: case study of first year students at biskra (Unpublished doctoral dissertation). Mohamed kheider , Biskra, Algeria.

Chinedu, C.C and Kamin,Y.(2017). Strategies in Improving Higher Order thinking Skills in Teaching and Learning of Design and Technology education. https://www.researchgate.net/publication/321059251

Cimer, A., Timucin, M., & Kokoc, M. (2006). Critical thinking level of Biology classroom survey: Ctlobics. *The Online Journal of New Horizons in Education*, 3(1), 15-24.

Earl, L., & Timperley, H. (2015). Evaluative thinking for successful educational innovation. Paris, France: OECD

Ellis D (2009). Critical Thinking. IL: Houghton Mifflin Company.

Ennis RH (2002). A Super-Streamlined Conception of Critical Thinking. California: Critical Thinking Press and Software.

Forehand, M. (2010). Bloom's taxonomy. Emerging perspectives on learning, teaching, and technology. Retrieved from http://projects.coe.uga.edu/epltt/index.php?title=Bloom%27s_Taxonomy H. Uzunboylu (Ed.), *Innovation and creativity in Education* (Vol. 2, pp. 3282-3288).

Glass, T. (2004). What gift? The reality of the student who is gifted and talented in public school classrooms. Gifted Child Today, 2(4), 25-29ublishing. doi:10.1787/5jrxtk1jtdwf-en

Harvey D (2010). The Enigima of Capital and the Crises of Capitalism. London: Profile Books.

Holsinger, D.B and Cowell ,R.N (2000). Positioning secondary school education in developing countries: expansion and curriculum. UNESCO, IIEP [3374]. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000122425

Janssen, F., & Waarlo A.J. (2010). Learning Biology by designing. Journal of Biological Education, 44(2), 88-92.

Kim, M. S. (2007). Genre-based Approach to Teaching Writing. Online. Retrieved from http://www.hpu.edu/CHSS/LangLing/TESOL/ProfessionalDevelopment/20068 0TWPfall06/07Kim_Genre.pdf

King, F., Goodson, L., & Rohani, F. (2011). Higher order thinking skills: Definitions, strategies, assessment. Center for Advancement of Learning and Assessment. Tallahassee, FL: Florida State University.

Krulik S, Rudnick AJ (1993). Reasoning and Problem Solving: A Handbook for elementary school teachers. USA: Allyn and Bacon A Division of Simon and Schuster, Inc

Marzano RJ (2001). Designing a New Taxonomy of Educational Objective. Thousand Oaks. California: Corwin Press, Inc.

Marzano, R. J., & Kendall, J. S. (2007). The new taxonomy of educational objectives (2nd edition). California: Corwin Press.

Mkonongwa, L.M. (2018). Competency-based teaching and learning approach towards quality education. Retrieved from http://www.tenmet.org/wp- content/uploads/2018/12/Competency-based-teaching-and- learning-approach-towards-quality-education.pdf

Moore, B., & Stanly, T. (2010). Critical thinking and formative assessments., .*Research in Business and Social Sciences*, 8(1), 889–898.

O'Sullivan, N and Burce, A(2014). Teaching and learning in competency-based education.*The Fifth International Conference on e-Learning (eLearning- 2014), 22-23 September 2014, Belgrade, Serbia.* https://www.researchgate.net/publication/269810124_Teaching_and_Learning_in_Competency_Based_Edu_cation/link/54970e120cf20f487d3164b3/download

Olsen, D. (1999). Constructivist principles of learning and teaching methods. Education. Vol 120. N0 2

Richards, J. C., & Rodgers, T. S. (2001). Approaches and methods in language teaching. Cambridge: Cambridge University Press.

Rojewski, J.W & Hill, R.B. (2014). Positioning Research and Practice in Career and Technical Education: A Framework for College and Career Preparation in the 21st Century. *Career and Technical Education Research*, 39 (2), 137-150.

Saucier, D., Shaw, E., Kerr, J., et al., 2012. Competency-based curriculum for family medicine. Canadian Family Physician 58, 707–708.

Sabu, N. (2018). The Need for Creativity in Teaching Higher Order Thinking Skills in Biology. International

Journal of Academic Research in Business and Social Sciences, 8(1), 889–898.

Scwhab, K. (2016). The Fourth Revolution Industry in The World Economic Forum. Geneva, Swiss: WEF Pub

Simon,C. (2013). How to Encourage Higher Order Thinking .Urbana, Illinoions IRA/NCTE Retrieved < July2013>, from :http://www.readwritethink.org/parentafterschool-resources/tips-howtos/encourage- higher-order-thinking- 30624,htul?maintab=3

Sullivan, R.S. (1995). The Competency-Based-Approach to Training. Washington D.C.: USAIDS

Sutarto, H.P(2017). Articulation of High Order Thinking Skills in Competency-Based Instruction in Indonesia Vocational and Technical High School. Advances in Social Science, Education and Humanities Research, volume 102. Atlantis Press.

Tang, K.N. (2017). Development of Analytical Thinking Skills Among Thai University Students. *The Turkish Online Journal of Educational Technology* – October 2017, Special Issue for INTE 2017

The Competency-based Approach in Algeria : A Necessity in the Era of Globalization roach in Algeria. Retrieved fromhttp://archives.univ-biskra.dz/bitstream/123456789/3566/1/the%20Competency-Based%20Approach%20in%20Algeria%20a%20Neceesity%20in%20the%20.pdf

Thomas, R. G. Cognitive Theory-Based Teaching And Learning In Vocational Education. Information Series No. 349. Columbus: ERIC Clearinghouse on Adult, Career, and Vocational Education, 1992. (ED 345 109)

Young, M. H. & Balli, S. J. (2014). Gifted and talented education: student and parent perspectives. *Gifted Child Today*, 37(4), 236- 246. doi:10.1177/10762175145.

Yunos, J. M., Kiong, T. T., Heong, Y. M., Mohamad, M. M. B., Mohamad, B. B., & Othman, W. B. (2010). The Level of Higher Order Thinking Skills for Lower Secondary Students in Malaysia

Zohar, A., & Dori, Y. J. (2003). Higher order thinking skills and low-achieving students: Are they mutually exclusive? *The Journal of the Learning Sciences*, 12(2), 145-181.