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INFLUENCE OF A TEACHİNG MATERİAL DEVELOPED WİTH REGARD TO ARCS MODEL OF MOTİVATİON TO CONCEPTUAL CHANGE

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ABSTRACT

The general purpose of this study is to determine its structure in terms of its attention-relevance (A-R) and confidence-satisfaction(C-S) sub-dimensions of ARCS Model of Motivation of Locating Scientific Concepts Comic Booke (LSCCB) and explaining the relation of these sub-dimensions with conceptual change. The design of the research is pre-test-post-test without control group experimental design. The study has been actualised with the participation of 212 (105 boys; 107 girls) 7th-grade learners (age of 13-14), who continue their educations, from two different state secondary schools in İzmir province, the centre of Bornova district. The working group has been defined in accordance with an appropriate sampling method. Quantitative data of the research has been collected by using the diagnostic test of energy misconception of living things and teaching materials motivation scale , on the other hand, the qualitative data has been collected by using the semi-structured interview. In the analyses; quantitative data descriptive statistical techniques, analysis of variance and correlation and regression analysis techniques have been used. As a result of the research, it has been reached a conclusion that, the attributions of LSCCS support the conceptual change, it has a motivation structure at a level of AR and CS, in the conceptual change,a motivation at a level of AR and CS has been effective.

Key Words: Comic Books, Conceptual Change, Motivation, Science Education, misconception

1. INTRODUCTION

There are important contributions of conceptual change to the development of method and techniques and strategy related to the teaching and learning science (Treagust & Duit, 2008). The studies of conceptual change not only support observing the cognitive skills in learning more detailed and revealing structural characteristics of science concepts but also it gives a new point of view to researchers and to teachers (Din, 2004; Chung, Hsiao& Chi, 2010, Gavin, 2013). The studies of conceptual change have shown that it is a difficult process (Vosniadou & Ioannides, 1998, Michelene, 2005).

When examining the studies between 1980-1990 on the field of conceptual change, it is seen that it concentrated on cognitive factors, the current schema of the students, teaching strategies and materials (Sinatra, 2005). The basic strategies of these studies are a contradictory event, dissatisfaction and developing scientific learning (Scott, Asoko & Driver, 1992). Undoubtedly the success of conceptual change in the learning environment that these strategies are used is higher level than traditional approaches (Duit ve Treagust (2003). common traits of these studies are that they are based on only cognitive structure. This approach, which doesn't take any notice of the effective properties of the learners, has been named cold conceptual change (Pintrich et al., 1993). The researchers have been indicated that the conceptual change should be paired with the motivation. After this phase, some

opinions have been suggested that how learners can be motivated by conceptual change. Dole and Sinatra (1998) describe the motivation is the complementary factor of the conceptual change; in addition to this, they evaluated the social structure and dissatisfaction as the motivating factors. The contributors stated that the learners could be motivated when they see one of their peers has already been motivated in the topic or get themselves motivated by experiencing dissatisfaction. In another approach on this subject is learners should be motivated to the matter of the subject (Limon, 2001). They stated that the learners who aren't motivated to the matter of the subject could not associate to alternative concept to the scientific concept. On the other hand in the concept of the material, there are very few experimental studies that examined the influence of the motivation to the conceptual change. Therefore one of the purposes of this study is to study the motivation value of the Comic Books, which were prepared with due regard the strategy of conceptual change, and the influence of this motivation to conceptual change. When evaluating different approaches related to the conceptual change, it is seen that they share similar opinions related to the cognitive process of the change. In the cognitive process first of all the learner should be dissatisfied. the process follows this when false beliefs replace by scientific concepts; the conceptual change will be actualised (Vosniadou, 2013). To be experienced this process the learner needs to have a high level of interaction with the concepts. Lin et al. (2013) stated that the most important factor of increasing the level of the learners' interaction with the concept is to present the concept by making it interesting and enjoyable. And so, the most important responsibility of those who prepare the learning environment that aims conceptual change is to design the materials that make the learning enjoyable and draw interests of the learners. In this respect, some materials have been produced based on digital technology (Chung, Hsiao& Chi, 2010). As the same as digital technologies, Comic Books are also effective tools that scientific learning can be presented arrestingly (Roesky & Kennepohl, 2008; Weitkamp & Burnet, 2007; Tatalovic, 2009) because humour is a characteristic that Comic Books already have in their nature. With this characteristic, Comic Books catch many of the learner's attention. Many learners think Comic Books are enjoyable. These attributions of Comic Books make us think that they can be important materials of the process of conceptual change. The studies that search for the influence of Comic Books to conceptual change are quite a few. For this reason one of the purposes of this study is to research the influence of the material, which was developed is predicated on comic book technique, in conceptual change.

Energy concept is one of the concepts that have the widest sphere of influence in science both its use of social practice and its role in teaching science. Therefore learners' intellection related to the energy concept is effected from both daily and scientific concepts (Boyes and Stanisstreet 1990; Jin and Anderson 2012). The concept in the social practice has different meanings, and it is also intangible; therefore it induces developing alternative concepts. (Millar, 2005; Nordine et al., 2010). It is known that these alternative concepts not only influence of the learners' intellection related to the concept but also it prevents the learners to learn the concepts related to different disciplines. Many studies on energy concepts of the learners focused on physics concepts. On the other hand, the studies on biology field are quite limited (Opitz ve diğ., 2014). Although the learners learn the concepts related to energy conservation of physics concept, they have difficulties in relating these conceptual structures to biology subjects. In the experimental studies conducted, it has been determined that more than half of the learners think that energy in biologic systems is different from physics system. (Chabalengula et al., 2011). Boyes and Stanisstreet (1990) reached a conclusion in the study with respect to the energy source of plants and animals many of the learners (age of 11-17) described as the Sun is the energy source of plants besides that they accepted that earth, water, and air are also the source of energy. In another study in Biology field, it has been reached the conclusion that the learners have limited intellection in relation to energy in living things (Chabalengula et al. 2011). Another study shows that the learners have problems to link the energy concept to biological events (Jin and Anderson 2012). In the study, which was conducted by participating 7th-grade learners, of Oluk & Oluk (2016), it has been determined that the learners think that main energy source of the ecosystem, the living things that are used as a nutritional source, decomposers and matter cycle. Researchers determined in addition to these faults, the learners also have misconceptions as energy is used again and again in the food chain, vitamins are the main energy sources, proteins are the primary energy sources, the muscles stores energy as they are resting. The studies and the explanations were conducted above show the importance of conceptual change on the subject of energy in living things clearly.

In teaching science, alternative concepts have preventer effect on learning is a subject which many researchers are of the same mind. For this reason, the researchers have set off on a quest that supports a strategy, different techniques and a teaching model and have brought forward a proposal to eliminate the misconceptions. In recent years,it has been considered in the recommended models; the motivation is the part of the learning process. In other words, in the learning processes that aim conceptual change, the motivation factors should be Morrison (2003**),** in the teaching design that is focused on the motivation, to imply ARCS model of the motivation of Keller mooted that this increased the motivation and efforts of the learners. There are a lot of studies that explain the relation between ARCS model of motivation and success. On the other hand, the studies that examined the relationship between the motivation of the learners and conceptual change in sub-dimensions of this model are quite a few.

Due to the abovementioned reasons, the purpose of this study is is to determine its structure in terms of its attention-relevance(AR) and confidence-satisfaction(C-S) sub-dimensions of ARCS Model of Motivation of Locating Scientific Concepts Comic Books (LSCCB) and explaining the relation of these sub-dimensions with conceptual change. Hereunder, the problems of this research have been determined as;

1. What is the motivation value of ARCS model of the motivation of LSCCB in the dimensions of A-R and C-S?

2. What is the influence of motivation of the dimensions of A-R and C-S to conceptual change?

2. THEORETİCAL FRAMEWORK

2.1. Models of Conceptual Change

In the extant period, different conceptual changes have been recommended. Most notable one of these is the conceptual change theory (CCT) based on scientific revolution theory model of Khun (Posner et al., 1982). In accordance with the scientific revolution theory, when scientists encounter a new phenomenon, they try to explain this phenomenon with an existing paradigm. However, when existing paradigms of the scientists are insufficient, they develop new paradigms to explain the new phenomenon, and they leave the old paradigms. (Zhou, 2010). Posner et al., (1982) alleged in the process of learning science concepts, the learners act like scientists in order to explain new facts, so they obtain new concepts by leaving the old ones that are insufficient. From the point of view of the learning process, in accordance with CCT, which is based on constructivist learning theory the learner responses to a new fact with existing schemes, assimilation occurs. If preliminary learning is insufficient to explain the facts, the learner will become dissatisfied. In the circumstances, the learner most probably leaves his/her insufficient preliminary learning, and instead, he/she accommodate new scientific concepts that have the high problem-solving ability. Nevertheless, to actualise conceptual change can be possible with the learner is dissatisfied with the existing concepts and he / she finds the new concept intelligible, advisable, and effective (Posner et al., 1982)

Chi, Slotta, de Leeuw (1994) suggested the model that explains the conceptual change in the context of ontological structures. In accordance with this model, the living things and the objects are classified as matter, process and mental states in the universe learners live in. Every matter in the world belongs to one of these three ontological categories. In this regard, the concepts accommodate to the appropriate categories in according to their associative qualities within the learning process. With reference to the researchers; prior concepts of the learners belong to the subject category; on the other hand, their scientific concepts belong to the process category. If the ontological category of these two concepts is same, conceptual change occurs easily. Nevertheless, if two concepts are in the two different ontological categories, conceptual change will be difficult. In accordance with the researchers in the same ontological categories, conceptual change occurs with assimilation, yet in two different ontological categories, the change occurs with accommodation (Chi, Slotta, de Leeuw, 1994).

Another model of conceptual change models is frame theory (Vosniadou &Skopeliti, 2014). Frame theory is based on cognitive enhancement studies. Theory is to present a wide perspective related to the actualization mechanisms of conceptual change in the process of teaching science. Frame theory is

the skeleton of the conceptual structure. In accordance with this theory, the naive concepts of children constitute a frame relatively consistent and explanatory. This structure is based on ontological, epistemological and symbolic links, which are the deepest and efficient, to make sense of the world and his/her environment. Children react to their environment with these frames. Vasniadou & Skopeliti (2014) explained the explanatory power of these structures with their ontological structures and relation of causality. The naive structures of frame theories may conflict with scientific concepts. For this reason, in the process of teaching science, frame theories of children should be restructured by ensuring conceptual change. The researchers indicated to actualise conceptual change; the change should be ontological, epistemological and symbolic aspects. Changing the location of Alternative concepts with scientific concepts isn't an instant event; on the contrary, it happens slowly and gradually.

2.2. Conceptual Change and Teaching Method

Many teaching models that aim conceptual change based on three main strategies as contradictory event (Posner ve ark., 1982; Nussbaum & Novick, 1982), conflict between opinions (Champagne, Gunstone & Klopfer, 1985) and developing ideas (Brown & Clement, 1989; Niedderer, 1987) (Scott, Asoko & Driver, 1992). In accordance with these strategies, conceptual change is possible when the learner is dissatisfied with the situations to meet a new concept by confronting a cognitive dilemma. In this regard, in the studies of conceptual change that confronting cognitive dilemma has been used, it has been indicated that the strategy supports conceptual change (Tsai, 2000; Duit, Roth, Komorek, and Wilbers, 2001; Zohar and Aharon-Kravetsky, 2005).

Conceptual change occurs by the learner replaces alternative concepts with scientific concepts and reorganise mental models (She,2002,2003). The researcher stated that at the point of the learning environments are organised as so supporting the conceptual change; the learners will be motivated to restructure their concepts. She (2002, 2003) developed a conceptual change model, Dual Situated Learning Model (DSLM) by associating strengths of the theories in science education and cognitive psychology. DSLM has four condition s to support conceptual change. these are i) The process of conceptual change should be based on the nature of science concepts and the learners' beliefs , ii) dissatisfaction should be created in the existing learning of the learners with DSLM events, iii) To actualise conceptual change, the learners should see the new mental structure as intelligible, logical and effective, iv) To succeed in conceptual change, challenge opportunity in an activity/event to the learners in order to see the implementation of their new mind structures to another situation after revising.

2.3. Conceptual Change and Motivation

In the studies, which was conducted the years between 1982 and 1993, aimed at conceptual change, the conceptual change was tried to explain by focusing on the inefficacy of cognitive structures. By contrast with this, the studies related to the motivation conflicts with the idea of only cognitive structures' insufficiency for conceptual change (Boyle, Magnusson &Young, 1993). These approaches, which focus on cognitive elements without taking any notice of the affective qualities of a learner, named cold conceptual change (Pintrich et al., 1993). The authors alleged that the models that focus only cognition could not explain the reasons for deactivation of their preliminary learning. According to Pintrich (2000), motivation is the complementary part of the conceptual change because motivation causes high cognitive processes by increasing the performance of the learner. The learners who have high inner motivation participate in conceptual learning process more efficient. If the learner isn't motivated to the content, he/she cannot figure out the relationship between his/her own concept and scientific concept (Sinatra and Pintrich, 2003). In addition to this, social content and dissatisfaction of the learner have been defined as the potential motivating (Dole and Sinatra, 1998). According to the authors, there are opinions as the learners, who aren't motivated sufficiently, can be motivated by seeing achievements of their peers. In addition to these, motivational beliefs don't affect directly to conceptual change, but however, they affect the aims of learning. In this regard, Pintrich (1999), alleged if motivation affects the opinion of the learner upon learning, it may increase the occurrence speed of conceptual change. On the other hand, Gregoire (2003) indicated that conceptual change process contains the aims of a person, previous beliefs, and motivation factors. As the

researchers above reveals, it can be said that motivation is one of the important factors that affect conceptual change.

In Science field, there are quite lot studies that examine the relation between the level of learners' motivation and academic success. Tuan, Chin and Sheh (2005), indicated that there is a relation between motivation and general purposes and tendencies of the learners. In another study related to the subject has been stated that there is a positive relation of the motivation tends to learn science and academic success of the learners (Demir, Öztürk and Dökme, 2012). Yenice, Saydam & Telli, (2012) found similar results between the motivation level and science success of the learners. The researchers determined that the learners, who have a high level of motivation towards science, involve the classroom activities more and within this context, they have an important increase in their academic success. In the study, Cavaş (2011) conducted he reached the results as the learners, who have high motivation to tend to learn science, have high manner and academic success towards science. As summarised above, background studies summarise the relation between learning science and academic success.

The learning of the influence motivation on knowledge and behaviour is not new. By contrast with what motivation means or how it can be used in teaching design is not known well enough (Dede, 2003). ARCS model of motivation presents a general framework to the educators on the fundamental principles in the implementation of design provides motivation (Gürol & Demirli, 2006). ARCS Model of Motivation has been revealed as a result of a synthesis of the theories of cognitive psychology, social learning theory and motivation theory (Shellnut, 1996). The model has been developed to make motivation factor unveiled and lift effectiveness of teaching environment (Keller, 2006). ARCS Model of Motivation came into existence of the abbreviation of the initials of the words; Attention, Relevance, Confidence and Satisfaction (Keller, 2000). In the field of Science teaching, some studies were designed by ARCS model of motivation. A study designed by ARCS model of motivation has been revealed that it has a high level of influence on the academic success of the learners and retentive of learning (Cengiz & Aslan, 2012). A similar study on this subject has been reached the result of it is effective to increase the learner's success and motivation (Feng & Tuan, 2005). As is seen above studies, there are few studies that examined motivation structures influence conceptual change. For this reason, in this research to determine the relation between ARCS model of motivation structures and conceptual change as a fundamental problem.

2.4. Conceptual Change and Comic Books

Multimodal materials are ingenerated at least two of the four elements which are gestures and facial expressions, images, sounds and writings (Bearne & Wolstencroft, 2009: 2). Multimodal materials improve the teaching environment of the learners who have different learning styles by appealing to. Thus the learners are incited to learn by multi-perspective approach (Hazari, 2004). Concepts in the multimodal learning environments are presented more than one sensorial mood (audio, visual, inscriptive). This situation increases the attention level of the learner and makes it more efficient. In this way learning performance increases. Influence of these kinds of materials on learning is related to present the words with the pictures. This influence is defined as "multimedia effect" (Mayer, 2003). Wherefore in multimodal materials, meaning occurs when the parts that generate the whole are interpreted together (Kress, 2010: 163-167). Shah &Freedman (2003), have been explained the influence of the encouraging learning of multimodal materials;(1) encouraging learning by transmitting learning through a different message, (2) supporting more detailed processing of learning, (3) they are explained by keeping the learner constantly awake by making the learning more attractive and motivating. In this context, multimodal materials provide a better understanding of complex learning.

Comic books is one of the multimodal materials. Several different modes of multimodal materials (e.g., moving, verbal, and symbolic) are used in LSCCB, developed in accordance with conceptual change strategies on a comic book format. Stories are told with sequential panels and visuals. The learning about the concept is represented by a combination of visual and verbal expression. The words are given in dialogue in the speech bubbles. Learners are actively involved as they fill the gaps between the two panels while reading the LSCCB (Rota and Izquierdo, 2003). The learner finds the

concept he does not understand in words, and the words he does not understand in the visuals. By combining the meanings in the images with the meanings in words, learners develop their ability to understand the message (Marie and Williams, 2008), their ability to understand what they read and read (Khoii and Forouzesh, 2010). The use of visual presentations provides a better understanding of the subject (Eilam & Poyas, 2010; Meriç, 2013). Moreover, the learning represented by images is kept in memory easier and remember easily (Paivio, 1971; Anderson, 1978) because visual characters support a better understanding of concepts (Purnell and Solman, 1991).

Experimental studies examining the effects of comics on science education are very limited. Some positive effects of comic books have been reported in studies conducted. Weitkamp & Burnet (2007) found that children who used comic books as instructional materials had a higher level of involvement in the discussion process than those who used plain texts in reading and discussion-based activities. Liu (2004) found that comic books increased the comprehension skills of low-level learners in the study of ELS learners. Özdemir (2010) denoted that educational comics are effective in teaching the concepts of heat and temperature in his work with 6th-grade learners. Topkaya (2014) found that educational comics had a positive influence on the attitude towards the course with the academic success. Lin et al. (2015) and others have concluded that educational comic books have become interesting and at the same time fun to learn. Gillenwater (2009) found that when working with learners at the secondary school level, the cognitive motivation levels of learners were raised to critical reading in the class in which the course was taught with educational comics. Delp and Jones (1996) found that participants who were informed by comic books responded more correctly to questions than those who were informed by traditional materials. As we have seen in the studies done above, the features of comics like supporting inner motivation, directing learners to critical reading and supporting their participation in the discussion processes, developing their reading comprehension skills, presenting the learning in a very modal manner have become effective in the selection of comics as materials.

3. METHOD

3.1. Research Design and Working Group

The design of the research is design without a pre-test-post-test control group. The study group consisted of 212 (105 Erk .; 107 girls) 7th-grade learners (13-14 years old) who continued their education in two secondary state schools in the district of Bornova in İzmir province. The study group was selected according to the appropriate sampling method (Cohen and Manion, 1989; Fraenkel and Wallen, 2006). For the equivalent of the learners with regard to misconception the three phases, Energy Relation in Living Things Misconception Diagnose (ERLTMDT) has been applied as a pre-test. The collected data were analysed by t-test, and the learners in the study group were found to be in agreement with each other regarding misconceptions.

3.2. Locating Scientific Concepts Comic Booke (LSCCB)

In developing a process of LSCCB, for the motivational design of the learning process, the design principles Keller (2000) suggested were used with She (2002, 2003) model as a general framework. LSCCB design has occurred at the stages below.

Collecting data related to the concept and the learners: In this stage, scientific concepts defining energy relations in living things at a middle school 7th-grade level were determined and analysed regarding related and unrelated characteristics of concepts. In the second stage following this, alternative concepts that are frequently encountered in learners are listed. For this purpose first of all national and international literature have been examined, with teachers and learners have been interviewed, and it has been decided misconceptions that are seen on the learners commonly. From collected data, three-phased ERLTMDT is developed. In the conceptual framework determined at the end of the study, 23 alternative concepts have been accommodated related to energy concept, the fundamental energy source of ecosystem, plant nutrition and energy source, photosynthesis, essential nutrients and energy, food chain, ecosystem, plants and photosynthesis concepts.

Analysis of the Participants: the working group of ERLTMDT has been applied to the learners as a pre-test and determined misconceptions of the learners (Oluk & Oluk, 2016). To determine the

features to be motivated the learners in the process, the data collected from attributions of LSCCB and the pilot schemes.

Analysis of Current learning-Searching: At this stage, the techniques used by the teacher in the classroom, instruments and equipment were examined. At the end of the examination, it was determined that the teacher had adopted the presentation strategy, the textbook has been used as the main resource in the teaching process and projector has been used as a teaching technology, and they have not practised a special strategy for learner misconceptions.

To Determine the Aims of Learning and Evaluations: The goal of the study is to eliminate the misconceptions that are determined in the process of determining the concepts. For the level of achieving the goal, ERLTMDT has been applied as post-test.

List of possible strategies, selection and design of strategies: In this stage, the applicability of ARCS motivation model that support the processes for conceptual change and She (2002, 2003) model strategies have been evaluated.

The use of strategies in teaching: Learner-centred processes have been adopted as learning strategies. This process was carried out in the form of individual, small group and large group discussion.

Selection, development and evaluation of materials: It has been planned to develop LSCCB in the context of comic book technique as teaching material. The LSCCB was developed by the researcher according to the first three steps collected. LSCCB has been prepared as a material to support conceptual change for 23 alternative concepts in relation with energy concept, the fundamental source of the ecosystem, solar energy and green plants, photosynthesis, the main source of plants, energy concepts, photosynthesis and respiration, food chain and energy flows with ecosystem concepts. As preparing these concepts, mathematical processes and chemical equations haven't been used, only related features of the concept have been considered. Thus, the concepts were adapted to the cognitive skills of learners. For instance, the features of energy concept like "life without energy is impossible", "energy can neither be created nor destroyed, but can be changed from one form to another", "energy can only be stored in matters as chemical energy. The design of LSCCB has been done in compliance with the model demonstrated table 2. Panels; (1) Problem presentation, unveiling prior learning and create awareness: The goal of these panellists is to reveal the subject's prior learning of the subject and to raise awareness about the mental structures. On the panels, the learner who is not approved by the specialist character is directed to pass the prior learning (anx1, is.1). (2) Presentation of scientific concepts: Learners meet new concept in the panels where the scientific concepts are presented. In these panels are presented scientific concept toward misconception. (anx1, is.2). (3) Presentation of scientific concepts and reinforcement panels: In these panels are the panels that scientific concepts are presented, and the learner accepts the new concept. Additional learning supported new concept is presented in these panels. The character who has misconception at the beginning repeats, expert character approves the opinions of the learner. Conceptual change is expected to occur at this stage. (Apx 1, is 3). Questions that are scrutiniser have been placed in the spaces left on the right of the panels. Expert opinions on the prepared draft material were received. A pilot scheme has been done and with the 7^{th} grade learners (N=36) who are not in the draft material working group and made the material ready to use (table,1).

3.3. Application of ARCS Model of Motivation Strategies in Instructional Material

Strategies to Raise and Maintain Attention: LSCCB has been prepared colourful, and it hasn't come up with unnecessary explanations, unnecessary exaggeration on gestures and facial expressions haven't been included in order to get the learner's attention at the beginning of the lesson and maintain the attention. Therefore any distracted factors have been prevented. The prepared material is aimed to embody the learning, conflict and conflict, sense of humour, diversity, participation and inquiry, and the continuity of attention in the learning process of the learner.

Eligibility and Perseveration Strategies: LSCCB has been prepared in conformity with cognitive level of the learners. The importance of the contribution of each learner has been expressed by talking about the purpose of the study in the learning process, For instance; the teacher has been requested to say to the learners "Here is a scientific study, each of you is part of this work as a scientist. With this

approach, it has been tried to emphasise the importance of the study. The study aims to explain the effects of correct learning on your future learning as "to recognise and correct our mistakes that we know correctly".

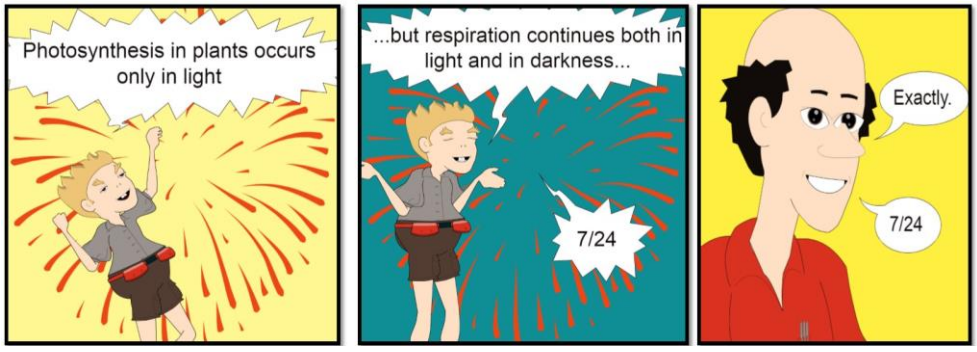
Trust and Retention Strategies: The content was prepared in accordance with the cognitive skills of the learners and presented consistently, and the question-answer-feedback system was used on every page. In order to facilitate the conceptual change, figures and analogies are placed in the material. Summarization and reinforcement of the subject that they learned have been ensured by placing reinforcement panels in the final chapters of LSCCB. It has been thought that the process can systematically monitor each other, solve problems that they have previously failed to solve or increase their confidence in themselves.

Satisfaction strategy: In the ARCS motivational model, satisfying learners are required to have positive thoughts about their learning experiences. In this context, the examples have been chosen from the learner's life in LSCCB. Thus, the learner aims to gain a new point of view by solving a problem that he has not solved in life before.

Table 1. Panels related to the misconceptions of photosynthesis and respiration

Episode 1
Do you agree with child? Why?

Episode 2
Do you have life without energy?
Why?



Episode 3
Do you agree with child?
Why?

3.4. The pattern of the Research

The experimental model of LSCCB prepared for application is as follows (table, 2).

Table 2. Experimental Design of the Study

School	Group	Pre-test	Application	Past-test
A	SG	ERLTMDT	LSCCB	ERLTMDT – TMMS, SSI
B	SG	ERLTMDT	LSCCB	ERLTMDT – TMMS, SSI

(SG; Study Group; ERLTMDT; Energy Relation in Living Things Misconception Diagnose Test, LSCCB; Locating Scientific Concepts Comic Booke; TMMS; Teaching Material Motivation Scale; SSI; Semi-Structured Interview)

As is seen in Table 2 ERLTMDT has been applied as pre-test and post-test, TMMS has been applied as post-test. In addition to this 40 learners have been interviewed from the study groups for SSI. A total of 160 minutes of training, 80 minutes per week, have been given to the six science teachers who will carry out the experimental studies before the application. In the first week of two weeks training, teachers have been informed about misconceptions in the context of energy associations in living things, and the educational material prepared have been examined together. The review process was informed about the technical structure and development strategy of the LSCCB. In the review process,

they have been informed about the technical structure and development strategy of LSCCB. In the second week, the guidelines that aimed at eliminating conceptual misconceptions and concept teaching have been shared with teachers. The application process has been discussed with the teachers by making a detailed examination of each instruction. The process of application of the instruction in the environment that teachers it has been applied to first 17 panels of LSCCB. The deficiencies of the teachers have been tried to remedy. Experimental practices have been completed in 3 weeks (12 lesson hours), with periods of 2 hours (40 minutes per lesson).

The learners in the study groups to which the LSCCB will be applied have been divided into 4 groups, and one spokesman has been selected in each group. It has been requested to change the group spoken at each session. Thus, each learner in the group has been provided with a speech. Evaluation and feedback have been given at the end of each stage. The teaching process aiming at conceptual change has been summarized in table 3.

Table 3. Application Process Modelling the Conceptual Change

	Motivation	
	↓	
	Problem presentation	
	Revealing the prior knowledge	Minor Group Discussion
	↓	
Teacher/Feedback	Major Group Discussion	
	↓	
Conflicting Cognitive conflict	Presentation of scientific knowledge	Minor Group Discussion
	↓	
Teacher/Feedback	Major Group Discussion	
	↓	
Development of conceptions	Defending scientific knowledge and reinforcement	Minor Group Discussion
	↓	
Teacher/Feedback	Major Group Discussion	

As can be seen from the instruction in table 2, the studies for a misconception take 3 sessions and about 35-40 min. The study has been completed at 12 sessions. 12-course hours of instruction has been given to the teachers. Details of a sample instruction have been shown in table 4.

3.5. Data Collection Tools

3.5.1. Energy Relation in Living Things Misconception Diagnose Test

Quantitative data of the research has been collected with ERLTMDT that has been developed by the researcher (table 5). Reliability of the scale, which was prepared by the researcher and consisted of 10 items, has been tested for with KR 20. According to the correct answers to the scale, the KR 20 value is 0.62; According to misconceptions, 0.66 is found. The construct validity of the scale has been determined according to factor analysis, positive and negative deviation values. Factor analysis results showed that the substances were collected around two factors. The first factor has a reliability level of 0.56 and the second factor has a reliability level of 0.60. In calculating the positive and negative deviation values, only the data obtained in the first and second stages of the scale are used. The positive deviation value in the study has been calculated as 22%, and the negative deviation value has been calculated 4.2%. Hestenes and Halloun (1995) stated that a negative deviation of less than 10% is sufficient for construct validity. These results suggest that the structural validity of the scale is sufficient. The mean discriminated value of the items in the misconception test is 0.39. From these results, it is understood that the test substances are very good at separating. The mean average strength of the test items is 0.25.

Table 4. Implementation of a session in the experimental process

Duration	Instruction/Misconception Elimination
34 min.	**Introduction:** The teacher starts the lesson with the expression "There are widely known characteristics of respiration and photosynthesis. Now we are going to conduct a study related to the subject." **1a)** Each pupil is requested to individually read the 1st page of the comics they are given. **1 min**. **1b)** The teacher asks the pupils to individually answer the questions within the box, **2 min.** **1c)** The teacher asks the pupils to discuss first with the ones next to them and then within the group **3 min.** **1d)** The teacher reflects the instructional comic on the first page and the questions by means of a projector and then lets the pupils to find the correct answers upon discussing within the classroom environment. **5 min.** **2a)** Each pupil is requested to individually read the 2nd page of the comics they are given. **2 min**. **2b)** The teacher asks the pupils to individually answer the questions within the box, **3 min**. **2c)** The teacher asks the pupils to discuss first with the ones next to them and then within the group. **3 min.** **2d)** The teacher reflects the instructional comic on the first page and the questions by means of a projector and then lets the pupils to find the correct answers upon discussing within the classroom environment. **5 min.** **3a)** Each pupil is requested to individually read the 3rd page of the comics they are given **1 min.** **3b)** The teacher asks the pupils to individually answer the questions within the box, **2 min.** **3c)** The teacher asks the pupils to discuss first with the ones next to them and then within the group. **2 min.** **3d)** The teacher reflects the instructional comic on the first page and the questions by means of a projector and then lets the pupils to find the correct answers upon discussing within the classroom environment. **5 min.**

Table 5. Example of the three-phase concept misconceptions test sample

1. Which of the following do the green plants provide the energy they need to survive?

A)Earth B)Sun C)Water D) Carbon dioxide

2. BECAUSE

A) Nutrients are energy sources. While green plants receive nutrients from the soil, they also take their energy.

B) Green plants produce their own food by photosynthesis. All energy required for photosynthesis is obtained from the sun.

C) In the absence of waterless life, the most important energy source is water.

D) Plants clean the air by taking carbon dioxide from the air. Plants clean the air by taking carbon dioxide from the air. They also take their energy from carbon dioxide.

3. In response to my question;

A)I am sure B)I am not sure C)I have guessed

3.5.2. Teaching Material Motivation Scale (TMMS)

TMMS measures the level of motivation of learners in the teaching process (Keller, 2006). The original name "Teaching Materials Motivation Survey" was developed by Keller (1987c) based on the ARCS Model of Motivation. The original name "Teaching Materials Motivation Survey" was developed by Keller (1987c) based on the ARCS Model of Motivation. The scale that was adapted to Turkish by Kutu and Sözbilir (2011) consists of 24 items. The first 10 items of 5-point Likert type consist of attention-fitting (A-F) and the next 13 items of confidence-satisfaction (C-S) dimension. Learners have reacted each of the five different levels as "I do not agree at all" (1), "I agree a little (2)", "I moderately agree (3)", "I strongly agree (4)". Validity and reliability studies were carried out before the scale was applied. The opinions of three educational science experts were taken for content validity. For construct validity, an exploratory factor analysis (Directoblimin) was applied. It has been reached a conclusion at the end of the analysis that the scale has two factors. Sub-factor 5 of the measure has been eliminated from the scale because the difference between the load values is less than 0.10. The reliability of the scale (Cronbach Alpha) internal consistency coefficient was 0.84 for the total questionnaire and 0.73 and 0.79 for the sub-factors, respectively. Some of the scale items measuring TMMS response at A-f and C-S levels have been shown in table 6.

Table 6. Sample Materials for TMMS 'A-F and C-S Dimensions

Sub-Dimension	No	Sample Material
A-F	1	When I first learned the contents, I saw some interesting things in this lesson that got my attention.
	6	I learned some remarkable new learning in the lesson.
	9	Materials used in the lesson were suitable for me.
C-S	13	When I first examined the content, I understood what I would learn within the context of this lesson.
	17	After studying the lessons, I have grown more confident that I can pass this.
	20	Complementing the practices/exercises in the whole group made me feel a success.

5.6. Qualitative Data

The learners' opinions on the material have been collected by semi-structured interview method (Bryman, 1992). For this purpose, the learners are ranked according to their post-test (ERLTMDT) scores. The learners have been divided into three levels as lower, middle and upper, and the significance levels of the post-test post-test point differences were investigated by the Kruskal Wallis test because they did not satisfy the homogeneity rule [X2 (2) = 182,04; p <0.001]. As a result of the analysis, it was found that the difference between the group post-test scores was significant. The learners to be interviewed have been determined with the stratified random sample. By sampling, five of the learners with the correct number 2-3 (N = 42) (Lower level) and 7-9 (N = 54) (Upper level); 10 learners selected from 4-6 (N = 132) (middle grade) have been selected. Negotiations were conducted within the framework of the questions given in appendix 1.

5.7. Data analysis

Pre-test, post-test ERLTMDT and TMMS data from the study group were analyzed by SPSS 15 (Statistical Package for Social Science) program. The significance level of the difference between the ERLTMDT pre-test and post-test scores was analysed by t-test (paired-samples). The relationship between conceptual change and motivation has been investigated by simple correlation and linear regression analysis. Data collected from TMMS sub-dimensions and post-test applications have been used in the analysis. The normal distribution of the total and subscale scores of the TMMS for the SCSCS 'motivation score has been tested.

6. RESULTS

Table 7 shows the associated t-test results applied to pre-test and post-test (ERLTMDT) data to investigate the conceptual change effect of LSCCB. Table 6 shows the associated t-test results applied to pre-test and post-test (ERLTMDT) data to investigate the conceptual change effect of LSCCB. According to this, the performance of the learners after LSCCB has been applied by ERLTMDT shows a significant difference according to the application (t = -49,7; p <0,001). This result shows that LSCCB supports the preliminary reviewing learning, forming cognitive conflict, overcoming the conflict period and the process of replacing alternative concepts with scientific concepts. (Eta square=3,4).

Table 7. Analysis of pre-test and post-test data by associated t-test

	N	SD	t	Eta Square
Pre-test; Post-test	212	1,05	-49,7*	3,4

Learners at different scoring levels the learners' views on the features of the LSCCB to support conceptual change have been searched with the following questions: "Have you remembered the concepts you know about the subject while you are learning the concepts you encounter in the comic book? Have you ever run into a contradiction as learning? " The analysis results of the learners' opinions are given below.

Lower level: I remembered some of them. I have difficulty learning concepts. It was not an easy subject for me. I cannot say anything about the contradiction like the energy sources of plants we have discussed with friends in general (K1). I recall that I had learned some things beforehand. The concepts in the comic books are as if they were chosen specially. Mostly, I was on the horns of a dilemma. I asked my group friends, and we discussed with them (K3). I learned new learning about the

concept of energy and reinforced my previous learning. Some learning on the comic book was a bit different from everyday life. For example, we knew vitamins as energy sources, but they did not. I discussed with my friends (K5).

Medium Level: For me, the study was a good revision of the environment subject. I've made a lot of mistakes, but I've corrected them. Not only me but my friends also got some mistakes. We talked a lot about our mistakes. So we corrected our mistakes (K12). I think I have a good understanding of life and energy relations. Because during the study we have renewed our previous learning, informed our learning, corrected our mistakes. We discussed the things we prepossessed with our friends. Sometimes we had heated debates (K9).

High Level: We have reinforced our concept as we were taught our lesson with comics. We all had some mistakes on the subject that we thought we knew right. During the study, we gave both absurd and correct answers. We both corrected our mistakes; we also learned new learning. We helped each other in places where we fell in disarray. We have helped each other as we are running into a contradiction. Every friend in the group told their idea. We responded open-ended questions together by discussing (K15). We learned new learning and review our previous learning. Especially photosynthesis and respiration I think photosynthesis and respiration are very confusing subjects. Almost every subject has discussed within the group. We had an exchange of ideas. Strictly speaking, there were a lot of questions in my mind; I understood everything with this study (K20). I remembered my preliminary learning like plants photosynthesises. Then I remember the sun, our main source of energy. I learned new concepts. Sometimes I had a contradiction. As in all groups, we discussed the controversial issues and concluded. I do not confuse photosynthesis and respiration concepts anymore; I can explain better (K18).

From different levels of learners' opinion, it is understood that LSCCB shows differences in the level of impact on learners during the conceptual change. When the learners are evaluated regarding the conceptual change, it is understood that some of the lower-level learners have recalled preliminary learning and have experienced cognitive conflict, some of them do not experience in these processes, and preliminary learning has remained in conflict and recall in middle and high-level groups. In general, it can be said that the material is a success regarding recall and dissatisfaction of the learners in the preliminary learning. When the middle and high-level learners are more successful in conceptual change, the material shows that new mental structures are understandable and logical.

6.1. Motivation and Conceptual Change in LSCCB Context

The results of the analysis of data collected from the TMMS are summarised in Table 8.. The lowest total score is 29; the highest is 101of the scale. According to normality test analysis results $\bar{X}$ = 71,8; SD = 13.4; median = 73; the coefficient of skewness= -0.513. The lowest score in the A-F subscale of the scale was 14, the highest was 43 ($\bar{X}$ = 32.5, SD = 6.7, median = 34, skewness coefficient = -0.558); In the C-S dimension, the lowest score is 15 and the highest score is 58 ($\bar{X}$ = 39.2, SD 9.5, median = 41, coefficient of skewness = -0.351). These results from the TMMS show that SCSCS is an important material in motivating the learners, both in the total scale score and in the sub-dimensions.

Table 8. Results of LSCCB Motivational Analysis

Variables	N	Mnimum	Maximum	$\overline{X}$	SD	Median	Skewness
Total Motivation	212	29	101	71,8	13,4	73	-0,513
Attention-relevance (A-R)	212	14	43	32,5	6,7	34	-0,558
Confidence-satisfaction(C-S)	212	15	58	39,2	9,5	41	-0,351

In order to determine the conceptual change effect of developing motivation in the LSCCB context, Pearson correlation analysis has been performed for the relationship between the two subscales of TMMS and post-implementation performance of the learners (Tablo, 9). The results of the analysis show that there is a strong correlation between the final test scores of the learners and the A-F and C-S dimensions of the scale.(P<0,001).

Table 9. The relationship between A-F and C-S Dimensions with Post-test Scores

Pearson correlation	N	A-R	C-S
Post-test	212	0,455*	0,366*

The results of the stepwise analysis of the data collected from the subscales of scale and post-test (ERLTMDT) performances of learners to determine the effect of conceptual change of motivation scale A-F and C-S subscales are given in Table 10. According to this, the conceptual change that occurs as a result of experimental applications has been explained; 13% (F (2-211) = 54,9; p <0,001) and 0,5% GT (F (2-211) = 35,8; p <0.001) sub-dimensions motivation.

Table 10. Summary of Results of Regression Analysis

	Beta	B	t	F	R^2
A-R	0,372	0,83	5,83*	54,9*	0,138
C-S	0,234	0,37	3,66*	35,8	0,054
*p<0.001					

The following questions have been asked for learner views on motivation at the A-F level of the LSCCB; Have the comic book used in the lesson caught your attention? Have you learned any new learning? What was there in the comic book that attracted your attention and made it easier to learn?

Lower Level: Comic Book has caught my attention like an animation. It is interesting to me the subject why we are tired and how we unwinded (K3). When I took the book, it caught my attention because it was consisted of cartoons and coloured from beginning to end. I learned some concepts I did not know. I think that supporting the book with pictures, short and colourful learning makes learning easier (K1).

Middle Level: We had a lot of fun doing the work as they say "we learned while having fun", we had something like that. The earth wasn't food substance of plants. It was interesting to me that it was the raw material source of the soil plants (K11). I loved this work very much because it was fun to teach. So this study never put me to sleep. I am a bit surprised when I thought that some of the learning I know was true and that it was wrong. For instance, vitamins were not our source of energy, but I knew that vitamins were the source of energy. In my opinion, since the book is in the form of a comic book and open-ended questions made it easier for us to learn (K6). I quite like this study, it was fun. I think it is fun to make the learning with cartoons and pictures. I learned that there is something called chemical energy in the land and that this is the only form of energy stored in nature. It was Interesting to me. (K13).

High Level: I've found this study very successful. We had a lot of fun as doing the study. I learned that the energy does not disappear and that it can turn into different types of energy. I like the comic book because of its characters, colour, and movements of the characters very much. I think it is easier to learn the short and self-contained information in the speech bubbles. The subject becomes so much more fun. I think everyone should try it. Space puzzle was great (K17). This lesson was different and more fun than our normal lessons. Cartoons and talking on the comic book made it more fun and interesting. I think it's useful to discuss open-ended questions. For the first time, I saw everyone in the class taking part in a lesson and focusing on the study with full attention (K19).

From the learners' views on the A-F dimension, it is understood that the LSCCB attracts the attention of the learners at different levels of the class. The LSCCB has become the preferred material in learning environments because the material is coloured, the words are given in speech bubbles, the information is given in a short and targeted manner, the open-ended questions in the material are supported by gestures and mimics.

The main questions have asked the learners related to the supporting feature of LSCCB on C-S level are these: "Do you think that learning with a comic book is useful to you?; "Do you think that will be more successful in this lesson on the process of learning science concepts with comics?; "When you have finished studying in general, were you happy to be in the study?". The results of the analysis of the learners' opinion are as in follows.

Lower Level: I think this study has been helpful for me. I didn't have any difficulties to understand the statements in the speeches. Open-ended questions were difficult for me. I couldn't learn all the concepts yet the ones I learned, I learned well (K2).

Middle Level: As we were doing this study, we gained a lot of information. I recalled the subject that we learned in the past. It made a lot of contributions to me. There are concepts in the comic book that

create confusion for example; the concepts like photosynthesis, respiration, etc. I don't think I understood this subject completely (K6). I think it was very useful. I've reinforced our previous knowledge, I've learned new concepts. The comic book was educational. I think I've learned the subjects successfully. I'm sure I will score high in the exam (K15). These subjects were difficult for me. I had difficulties in learning them before. However, I have learned with the comic book easily. I've answered the questions with ease. I think I will be more successful in the exams. I've had a great experience. I would like to thank everyone who prepared this (K13).

Higher Level: I have trouble completing the first pages. But I've done the next pages faster. I felt an ambition I learned the concepts of falling into contradiction. As I felt ambition, I continued to work harder. I think I have learned very well and eliminated from my contradictions. I had a great experience. Thank you very much. If there is a repetition of this study, I will take part again (K16). As I was doing this study, I realised that I had some mistakes the concepts that I learned before. I made an effort to correct my mistakes. I worked hard, but I didn't get tired. I think I've completely corrected my mistakes (K18). This study contributed me a lot of things. We went to the details of the subjects while we were studying. The deeper we went into the details, the more curious we felt. We wanted to learn more as we learned. Although I've had confusion on some subjects sometimes, I've pressed the issue, and I've learned the logic. I reinforced the information with examples I learned. I am very pleased to be involved in such a study (K20).

A learner in the high level categorises that his new learning influences his / her perspective: "Talking about the concept of ATP changed our view of energy concept. It has developed a broader view of energy. I have better understood the functions of living things in the ecosystem and that there is no excess in nature. I now know the differences between photosynthesis and respiration (K16).

From the learner views on the C-S context of the ARCS motivation model, it is understood that the SCSCS supports motivation in the C-S context. While low-level learners were focused on whether the task is easy or hard, middle and, high-level learners thought their successes to their abilities and efforts. Moreover, learners' expectation of success in learning outcome can be considered as another indicator of motivation in confidence context. They should be satisfied as a result of the learning, the expectation of a high score in examinations and the expressions of acquiring a new perspective can be interpreted as motivating the level of satisfaction of the material.

7. DİSCUSSİON AND CONCLUSİONS

The above findings show that the LSCCB organised according to the ARCS motivation model, is an effective material supporting the conceptual change. It is very important for the learners to know the level of readiness of the learners to follow the conceptual changes and to eliminate the mistakes Fen (Griffiths et al., 1988). The inadequacy of traditional teaching approaches to overcome learners' concerns has been shown in a number of empirical studies (Cliff, 2006, Chiu, 2007, Güneş, Güneş & Hoplan, 2011).

A significant difference between the ERLTMDT measurements performed before and after the 12-hour LSCCB application is in favour of the post-test. This result shows that alternative concepts and scientific concepts in students are replaced. The results obtained in the research support the findings of She (2003, 2004a, b). Supporting the instructional process targeting the researcher conceptual change with motivation strategies suggests that the learners will present important opportunities for restructuring their knowledge.

Today's learners live in an increasingly complex information environment. Preparing learners actively and consciously in such an environment is one of the many challenges faced by educators. The need to teach texts that involve more than one information mode and require the active participation of readers, such as comics, is becoming more and more evident (Harris, 2006) because comic books and other non-traditional sources of information convey the message more simply and economically. It was observed that in this study, adolescents preferred information sources that were able to produce solutions solely at the same time, instead of using only information resources equipped with texts, and that the resources that provided information in different modes were more interested in the students.

The results of this study emphasise the importance of motivation in the process of conceptual change taking place in the context of LSCCB. It has been found out that the results of the conceptual change of students are significantly related to the results of learners A-F, C-S and total motivation. The results obtained show that motivation at A-F level is more effective in conceptual change. Attention is the mechanism that starts to learn. For this reason, it is the first step to attract the attention of the learners in the teaching process designed according to the ARCS motivation model. The learner becomes motive focused on the attention material (Keller and Suzuki, 2004: 231). Attention and curiosity are necessary for motivation, but not enough. Teaching objectives for motivation to gain a sustainable qualification during teaching; consistent with student goals, suited to learning styles, and linked to past experiences. Compliance arises when teaching content is linked to learners' future academic needs or internally interesting issues (Keller and Suzuki, 1988). Compliance arises when teaching content is linked to learners' future academic needs or internally interesting issues (Keller and Suzuki, 1988). In this context, it can be said that the motivation at A-F level is effective to move the preliminary information in the conceptual change. This feature of LSCCB can be explained by the fact that it was developed in the context of comic book format. Visual components and details of comics increase learners' reading enjoyment (Wright & Sherman, 1999). The learner who reads a comic book for a few minutes feels a great success because this is very easy for his/her (Atkinson. 1978; Cüceloğlu, 2002). The source of this sense of achievement is visual support (Wright & Sherman, 1999). Combined with a sense of success, humour perception in the inner structure of comic books, and other details in the material preparation process, it can be thought that the A-F may have been motivated. The dimension of A-F is followed by C-S dimension. When the learning process begins, learners also increase their confidence in tasks that challenge them when they experienced the success (Mills, 2004). In this research, it should be particularly pleased that middle and high-level learners are satisfied, high score expectation in examinations and seeing as a result of their ability and effort to learn new expressions of viewpoint and LSCCB provides motivation in the level of C-S can be interpreted as motivation. It can be said that the possibility of actualising the conceptual change is higher when the learners with high A-F motivation are more likely to when they realise that the learning environment enhances the achievement of test scores and the ability to meet expectations of high-scoring and science learning exams. This can be interpreted as a self-supervised control of the LSCCB-based learning process. The effect of self-supervised learning in conceptual change supports the conclusions of Pintrich et al.'s (1993) and Sinatra and Pintrich's (2003).

This study has also resulted in the fact that LSCCB is a feature to support conceptual change among its qualities. The cognitive conflict of some students coincides with the results obtained from studies based on conceptual change. In these studies, it has been reported that in many cases, learners cannot make a meaningful cognitive conflict or become dissatisfied with the idea (Chan, Burtis & Bereiter, 1997; Dykstra, Boyle & Monarch, 1992). This result can be evaluated that the learners don’t have information the two concepts. Since both are reasonable for the learner in this situation, and for this reason, cognitive conflict does not occur (Hewson and Hewson, 1984). In general, it can be said that the material is a success regarding recall and dissatisfaction of the learners in the preliminary information. Although students are dissatisfied, conceptual change takes place at different levels, and this supports the conclusions of Scott et al. (1992). Researchers have stated that even if the student forms a meaningful cognitive conflict, it is not certain that it will result in conceptual change. She (2002, 2003) emphasises the need for learners to apply new mental constructs in other contexts, as well as understandable, logical and useful ideas in order to actualise for conceptual change. In this context, it can be said that SCSCS supports the conceptual change the student dissatisfied with the preliminary knowledge he/she has and by making the new mental stage clear, logical and useful in the following stages.

In this study, the activities were learner centred, carefully designed to get rid of the conceptual misconceptions, and the process was followed carefully from the beginning. It can be said that these factors contribute to conceptual change. However, some learners cannot show sufficient success in conceptual change. This result can be attributed to their lack of motivation. Accordingly, learners with low levels of motivation were not sufficiently integrated into the teaching process. Highly motivated students have made enough use of the possibilities LSCCB has provided for conceptual change.

8. SUGGESTİONS

Integrating comic books into classrooms and curricula is not only a tool for dealing with basic skills and concepts, but it can also be a chance for students always to present a refreshing and enjoyable atmosphere. For this reason,LSCCB should be included in textbooks, and books that feature educational comic books will make books more fun. The scope of this study is to demonstrate the relationship between conceptual change and ARCS motivation sub-components. In further studies can be done by conducting a deeper analysis of ontological constructs of students 'misconceptions, hybrid concepts, gender variation and students' concepts.

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Questions appendix 1.

Have you remembered the concepts you know about the subject while you are learning the concepts you encounter in the comic book? Have you ever run into a contradiction as learning?

Have the comic book used in the lesson caught your attention? Have you learned any new learning? What was there in the comic book that attracted your attention and made it easier to learn? Do you think that learning with a comic book is useful to you?;

Do you think that will be more successful in this lesson on the process of learning science concepts with comics?; "When you have finished studying in general, were you happy to be in the study?".