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The Effect of 3D Video Animation on BT2 I Students' Motivation, Comprehension and Academic Achievement in Computer Course at a Private Vocational Institute in Mount Lebanon

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Abstract **– This study took place in a private vocational institute located in Mount Lebanon where researchers are teaching computer course for vocational students, BT2I class (2nd year Baccalaureate technique-Informatics and accounting). The aim of this research is to look for the effectiveness of using the three- dimensional (3D) video animation on students' motivation and comprehension in order to minimize the students' lack of interest, lack of comprehension and low grades in computer course in general and Hard Disk Drive (HDD) functioning topic in specific.**

Researchers in this study used quantitative action research where data were collected through two questionnaires (pre and post questionnaire) and two test scores of 14 students before and after using 3D video animation in explaining the topic. Analysis and results, which were done using SPSS (Version 22) and Excel 2013, answer main questions regarding the expectations in using 3D video animation and provide the necessary recommendations.

By using 3D video animation, students were motivated and interested; they showed more comprehension and were able to discover new things. An improvement in students' grades was noticed after teaching by using 3D video animation. The most important recommendation that researchers should take into consideration while creating a new 3D video animation, is the technical design of content diversity of learners and audio visual lessons in design, then upload the 3D video animation on the internet, to be viewed by students later on.

Keywords **– Motivation, Blender, SPSS, 2D Videos, 3D Video Animation.**

I. INTRODUCTION

Teaching tools and techniques are constantly evolving to keep up-to-date with the technology evolution. The digital society is moving quickly, from desktop computers to mobile devices. The low price of these devices facilitated their purchase. As a consequence, the number of students using smart phones is increasing constantly, facilitating the integration of technology into education and indicating also that the inclusion of these devices in teaching will make learning easier and accessible as demonstrated in several studies that lead us to compare traditional teaching method with the new one.

Before when researchers had to use static images to teach, it always caused difficulty for students to imagine and see in their minds what he expected them to see. In exploring the ways in which students struggle with some complex abstract concepts, Students fail to comprehend dynamic events because they seek causality according to shared perceptual properties [1].

In the case of students trying to understand data transfer between Hard Disk Drive (HDD) and motherboard, they might see the HDD and they would be able to assemble it or disassemble, but they won't figure out how data is being transferred between motherboard and the HDD. For this, researchers believed that students' comprehension for things that they cannot see with their own senses or microscope may increase whenever they will be able to visualize how things are done.

Recently, 3D video animations are becoming one of the most modern resources for teaching and learning. The 3D video animations facilitate the visualization of abstract content and, thereby giving the same level of learning for everyone [2]. Animations, which allow communication of abstract ideas, concepts and processes to the students, can be created for teaching many topics such as biology, chemistry; physics [3]. They can be also visualized via internet in any part of the world with latest technologies such as tablets, and smart phones, helping teachers and students to create and view 3D images or videos at anytime and anywhere. That is why, researchers thought that 3D video animation may play a key role in computer science education to support students understanding the complexity of hardware functioning.

A. Statement of the Problem

Through the observation of BT2I students in computer course, researchers used to notice uninterested students, less motivated too. Even if they were calm researchers could sense their diversion into many other distracted areas. Students presented a lower interest in computer course in specific hardware chapter and its functioning, they talked and they were distracted. They did not participate or interact with researchers. They presented symptoms of boredom and sleepiness. Moreover, their motivation was so low. Both motivation and comprehension constituted a threat to the learning process. Their low grades for true or false questions indicate their level of comprehension, which was not reinsuring. So after detecting the problem in the class, researchers thought that students are supposed to assimilate information when learning is connected with dynamic images than when connected with static images. Researchers suggested developing a 3D video animation by using a 3D free modeling and animation software such as Blender. Blender is an excellent choice for 3D creation and it is a good tool to support the learning process. Besides, it enables the development of all technical steps of an animation film [4]. Many challenges faced researchers, such as: learning the software in a limited time, the time spent for creating animations, not including the CPU processing time to render a minute of animation. As a

consequence, researchers replaced this solution by downloading readymade 3D videos animation created with Blender from YouTube about the topic requested, edited those videos by the use of Adobe Premiere and added subtitles and narration to explain the chapter. For the voice over researchers used Sony Sound Forge®, a sound editor software.

II. Review of Literature

The rapid evolution of computing devices with affordable prices has made the use and integration of technology increased in our daily activities. All the adjustments are driven by economic pressures and demand for freshly graduates to be able to function in a knowledge society [5]. Learning institutions are searching for quality in teaching and learning by changing the teaching from traditional methods into learning with technology and they are currently moving towards a more multimedia oriented classroom to keep up with the progress done [6]. Traditional educational content is now being transformed into interactive multimedia content.

The integration of technologies into teaching and learning process is changing the conventional teacher-centered teaching approach into student-centered learning approach. This integration of multimedia into teaching and learning has forced teachers to attend multiple workshop and sessions in order to change their instructional strategies in education by using interactive and multimedia technology to enhance the student's learning process and for the purpose of creating new ideas, creativity and imagination. The use of a three dimensional environment allows the creation of a virtual real scene with a strong visual impact that may encourage the students to assimilate the topic, to be engaged and captivated the entire scene. The subject that was chosen to be the domain of this study is a topic in computer science education, about the HDD parts and its functioning. This topic requires a careful and detailed explanation, as there are many theoretical complex concepts that cannot be fully understood by the students.

In this part of literature review we will review the four learning theories and discuss Mayer's Cognitive theory of Multimedia learning, and the use of 3D animation in multiple courses as Science, chemistry.... Finally, we will present studies about 3D animation in computer science education.

1. Learning Theories

Theories of learning have been developed over the past years. Instructional designs and methodology changed depending on the learning theories adopted. In today's world, Students want to learn on their own rhythm anywhere and at any time with the teacher acting like a facilitator. With the help of the computer and internet easy accessibility these things are becoming true. The design of learning must follow one of these theories that have its own concepts and views. The following sections will describe these three primary principles in learning. Understanding these principles is important in order to understand the lessons prepared and used and the recommendations written to design a multimedia course in the future.

1.1. Behaviorist Theory

The theory of behaviorism means that responses which occur prior to a satisfying state of affairs are more likely to be repeated, and responses prior to an annoying state of affairs are more likely not to be repeated. The use of reward and punishment is also said to be a part of modifying a behavior. The goal of education was to teach students some survival skills for themselves and society [7]. The role of the teacher was to enhance behaviors that contributed to survival skills, and making behaviors that did not contribute to survival skills, disappear.

The implication of behavioral theory in this study is useful too. The topic and subtopics have been well structured in order to assist in smooth learning. The learning process of the system responds to the objectives and to the order of the level of difficulty from less difficult to most difficult. In computer science, information processing theories attempt to describe how information enters through our senses, becomes stored in memory, is retained then used or forgotten [8].

1.2. Cognitive Theory

Cognitive theory is based on information-processing approach. Students are considered as seekers and processors of information. Information processing include the notion that memory and thinking have a limited capacity. The learner's perception coordinates with memory, processing, and application of information [9]. It means new knowledge is interpreted in a way that is appropriate with existing knowledge or beliefs. But this new knowledge may become so clear, that existing knowledge must change in light of the new knowledge [7]. According to the cognitive theory, to understand better, humans need to see things in a concrete manner [9].

The implication of the cognitive theory in this study is that information about the topic is displayed in a systematical order. Students can use the rewind or forward arrows for re-learning and strengthening their memory. The objectives of the learning subject are told at the beginning of the animation.

1.3. Constructivist Theory

In constructivist theory, learning is a unique product 'constructed'. Individuals have learned when they have constructed new interpretations of the social, cultural, physical, and intellectual environments in which they live [10]. What we learn and construct as a new knowledge is not constructed by the individual, but by social groups where each learner combines new information with existing knowledge and experiences [11]. Anchored instruction assumes that a learning environment should be embedded in a situation like the real world [7].

In this study, we were able to combine new information with existing knowledge and experiences to make students understand new concept. We compared the HDD to the human brain where we store data and memory for a long period of time. We used the regular school bus to represent parallel Advanced Technology Attachment (ATA) cables that carry data where it's supposed to be. This concept is used so that students can relate the usage of a school bus with the same idea related to parallel ATA cables that transfers data. Bits were represented by human being. All

these concepts are part of constructivist approach to learning.

1.4. Cognitive-Constructivist Approach theory of Multimedia

Cognitive constructivism has an approach to education that emphasis how learners must individually discover and transform complex information to make it their own. Student-centered learning gives students greater autonomy and control over the choice of subject matter, learning methods and ways of study [12]. Students don't have to listen passively and absorb the delivered information. Students must be active information seekers, active learners. They have to learn through a series of discoveries, interactions and problem-solving situations [13]. Interactive multimedia can be designed to allow users accessing information according to their interests [14]. Hypermedia feature is educationally better than traditional media because it simulates the real life situation of the students allowing them to explore the module on their own in a non-linear fashion, students can learn better in a student-centered environment [9].

By uploading those 3D video animations on YouTube, we can allow students the capability to explore the module on their own and do their proper research even before the explanation of the chapter.

1.5. The Multimedia Learning Model by Mayer

Throughout the 1990s and beyond, Mayer has conducted multiple researches investigating the nature and effects of multimedia presentations on human learning. His experiments were concentrated on the auditory/verbal channel and the visual channel that are processed through separate and distinct information processing channels'. The process by which people build mental representations from words and pictures was the focus of Mayer's cognitive theory of multimedia learning [15]. It means that we have to present material on two channels in order to give learner twice as much exposure to the explanation. Students may learn more deeply from words and pictures than from words alone. [15] So learning occurs when multimedia is supported by different sources of information being handled together in order to understand and memorize a given content.

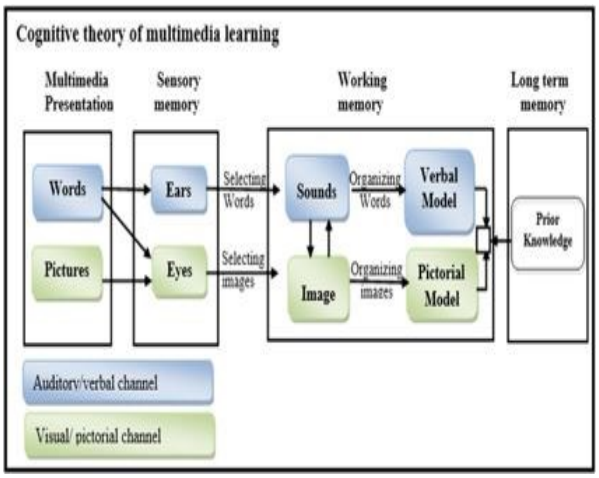

Fig. 1. Visual Representation of the Cognitive Theory of Multimedia Learning (Source: Mayer 2002)

Figure 1 represents sensory memory which holds incoming images and sounds; working memory which allows for mentally manipulating a small amount of the incoming visual and verbal material; long-term memory which is the learner's permanent storehouse of knowledge [16]. Figure 1 represents cognitive processing as arrows which transfers some of the incoming images and sounds to working memory for additional processing and organizing the images into a pictorial model, the words into a verbal model in working memory which connects the models with each other and with relevant knowledge activated from long-term memory [16]. Mayer's cognitive theory of multimedia learning presents the idea that when a multimedia message enters the cognitive system through the learner's ears and eyes, the brain will select and organize dynamically words, pictures and auditory information (the first row represents the verbal channel and the second row represents the visual channel) to produce logical mental constructs [17]. Mayer underscores the importance of learning when new information is integrated with prior knowledge. The instructional design principles described in Figure 2 suggest ways of creating and designing multimedia presentations in ways that help people build mental representations [18].

With the recent rise of computer technology with powerful specifications that allow creation and editing of graphics, teachers has now the ability to enrich their materials with pictorial modes of instruction and presenting it in many visual ways. However, not all pictures are equally effective [19]. It is important to understand how to design effectively learning presentations with multimedia instruction that promotes learning.

1.5.1. Basic Principles of Multimedia Learning

So adding pictures to words as mentioned before could be a way of helping people for a better understanding. However, not all pictures are effective. It is important to understand how best to incorporate pictures with words. Just because technologies are available, it does not mean that instructors are advised to use them. What is needed is how to educate teachers to design multimedia instruction that promotes learning. Mayer's theory on multimedia learning involves twelve principles that can be applied for the design of multimedia messages as indicated in Fig.2.

In the design and development of the 3D video animation for the topic of HDD parts and functioning, Researchers were able to apply Mayer's principles with some restrictions.

These restrictions were:

1. The inclusion of some pictures and scenes was not necessary. Researchers tried to cover it up with voice over.
2. The animation was so fast in consequence researchers were obliged to speak faster so words will correspond with animated pictures.
3. Researchers added on- screen text for the technical words that must be memorized.
4. Some of the animation sequence didn't add any value to the content. They were only done in order to show graphic designer competencies.

Multimedia Principle: Students learn better from words and pictures than from words alone.
Spatial Contiguity Principle: Students learn better when corresponding words and pictures are presented near rather than far from each other on the page or screen.
Temporal Contiguity Principle: Students learn better when corresponding words and pictures are presented simultaneously rather than successively.
Coherence Principle: Students learn better when extraneous words, pictures and sounds are excluded rather than included.
Modality Principle: Students learn better from graphics and narrations than from animation and on-screen text.
Redundancy Principle: Students learn better from graphics and narration than from graphics, narration and on-screen text.
Signaling Principle: Students learn better when cues that highlight the organization of the essential material are added.
Segmenting Principle: Students learn better from a multimedia lesson is presented in user-paced segments rather than as a continuous unit.
Pre-training Principle: Students learn better from a multimedia lesson when they know the names and characteristics of the main concepts.
Personalization Principle: Students learn better from multimedia lessons when words are in conversational style rather than formal style.
Voice Principle: Students learn better when the narration in multimedia lessons is spoken in a friendly

Fig.2. Twelve Research-based Principles for the Design of Multimedia Messages (Mayer, 2001)

1.6. Animation in Computer-Based Instruction

With the advent of new techniques, we have started to explore computer animation in education for presenting multimedia materials for learners. Animation refers to simulated motion pictures showing movement of drawn objects. It is however still debatable if computer animations help in learning, or whether animation aids learners' understanding of dynamic phenomena [20].

If a learning task only requires learners to visualize fixed objects, then the use of static visuals would be sufficient. If a learning task requires learners to represent ideas which involve changes over time then the use of animated graphics are probably much better than static graphics at because of its ability to implement motion, therefore concretizing abstract temporal ideas [21]. Interesting pictures gain and maintain learner's attention in instructional text [22]. Good pictures motivate learners and encourage curiosity [22]. In this sense, learners can be attracted to animated visuals that include unique effects. Attention correlates with students' achievement more highly than poor learners having poor attention [23].

For that reason, animated graphics is applied to learn dynamic abstract concepts that are difficult to visualize such as the movement of the platters in contemporary HDDs and the read-and-write head. Only well-designed animation can be an efficient aid to learning compared to static graphics. [9]

1.7. Three- Dimension Animation in Teaching

Today's animation is three-dimension (3D) animation. Three-dimension video animation is where graphics and images' illustrated are created using computers with the help of respective graphic hardware and software such as Blender. It is used to replace physical models and create realistic elements with action. 3D animation in education is becoming more and more popular. 3D Animation in education provides more options and opportunities to improve the productivity of learning, creating powerful immersive environment through which learners can acquire knowledge and develop higher level thinking skills [24]. The higher level of immersiveness happens from the fact that a very precise simulation of the real world is realized helping students to understand and remember information since the advent of powerful graphics-oriented computers. In summary, researchers stated that animation will more likely enhance learning. The use of 3D video animation in computer science subjects have resulted better student's understanding and performance. The difficult topics in some computer science subjects were visualized using animation brought some cognitive gains as well as contributed to some motivational factors to students. It has enhanced and improved learning. Studies have proved that well-designed animations may help students learn easier and faster. They are also excellent aid to teachers when it comes to explaining difficult subjects. The difficulty of subjects may appear due to the involvement of imagination. The information exchanged between the different parts of a computer, the electric current which is invisible and difficult for students to understand at the beginning. With the aid of computer animations, teaching and learning become easier, faster and amusing.

To better illustrate how hardware operates in order to make student's comprehension arise. Researchers tried their best in creating and editing 3D video animation by using Adobe Premiere and Sound Forge from multiple 3D videos animation downloaded from YouTube and created via Blender.

III. METHODOLOGY

This study is a quantitative study; The aim of this research is to look for the effectiveness of using the three-dimensional (3D) video animation on students' motivation and comprehension in order to minimize the students' lack of interest, lack of comprehension and low grades of vocational students in computer course in general and Hard Disk Drive (HDD) functioning topic in specific. The study was carried out with BT2I class of a private institute in Mount-Lebanon for two-months from October 2015 till November 2015 with the collection of data. The sample group consisted of 14 students aged between 16 and 18 years. The computer course is taught in French, three hours per week and ranks second after accounting in vocational courses. The Computer course is evaluated over 60. In the computer course, each test score is normally the average of two grades one for Excel as applied informatics and the

other for computer hardware and structure which they find difficult to comprehend even though some computer basics must be learned as prerequisite from earlier classes with some update and developed content. Students give more importance to the applied informatics, because they find it easy to understand and apply. They forget that having a degree in vocational study accounting and informatics' specialization necessitates their knowledge for different computer concept. Without even mentioning that 80% of the students in this class choose this specialization because they didn't succeed elsewhere and that they did not acquire many objectives in physics or mathematics to understand some computer concept. Therefore, they will not understand many explained concepts which will lead to less motivated students in class, trying to waste the time in many possible ways because of boredom symptoms. All of these will lead to lower grades and difficulty in the teacher's assessment.

Researchers started explaining the CPU parts and functioning topic by using power point presentations and 2D videos. During the power point lesson, students were sitting in class in traditional form. The lesson started normally by the teacher explaining and sometimes asking few questions to recall things they already know. The hardware chapter in general and CPU parts and functioning in specific included some complex information that is difficult for students to understand especially that the pictures used were static and not moving. While explaining the lesson and after almost 10 min, students started to lose concentration because the content was too difficult for them to understand. They started to talk or they were occupied by doing their homework from another course and some students presented symptoms of sleepiness and boredom. They did not interact a lot with the teacher and participate during the lesson. Researchers- teachers continued the lesson by passing some videos or by demonstrating some parts existing in front of them. It took two periods to explain and discuss it. After finishing the explanation, a small test graded over 10 was distributed to students in order to measure their level of comprehension with this method. Later on a pre questionnaire to the 3D method was distributed to students in order to evaluate researchers' method in explanation and its effect on students' motivation and comprehension.

The next lesson about memory device in general and Hard Disk parts and functioning in specific was explained by using 3D video animation. During the lesson using 3D video animation, students were excited for viewing computer parts on the screen from different angles. The lesson started normally by asking some questions about the lesson, brainstorming and recalling information that students already know. Then, the explanation of the lesson continued through 3D video animation to clarify some concepts. Especially, when explaining how data pass from the keyboard and being saved to the HDD, students were excited and focused more on the lesson. Each bit of data was represented by small character and transferred through tubes between different parts of the computer. 3D video animation was stopped several times during the presentation to answer students' meaningful questions. They discovered and understood new things they were not aware of. They even asked to repeat the 3D video animation because they like it and in order to view little details that they didn't catch up from the first time. They were happy about the 3D video animation, they answered teachers' question, and they interacted and participated. After the 3D video animation, an interactive activity was exposed, and students were excited to discover that they already got the right answers. Students were happy, the teacher was happy. They kept talking about this experience, how joyful and fruitful it was, even after the end of the period. They even requested to repeat this experience for other topics as well. It took two periods to explain this lesson and discuss it. After finishing the explanation, a small test graded over 10 was distributed to students in order to measure their level of comprehension with this method and a post questionnaire to the 3D method in order to evaluate researchers' new method in explanation and its effect on students' motivation and comprehension.

Researchers used the quantitative method by collecting quantitative data from the two questionnaires (Pre and Post questionnaire) and scores of the two tests in order to analyze data and finding solutions. At first, a questionnaire has been distributed to BT2I students based on how they see researchers' way in explaining with 2D videos and power point presentation the Central Processing Unit topic, its parts and its functioning. The questionnaire has been distributed to each student to fill and it contained questions about their motivation and their comprehension. It was rated from 1 to 5, where 1 means Strongly Agree and 5 means Strongly Disagree. The questionnaire was anonymous to let the student feel free to fill his/her answers. The 3D video animation intervention has been carried out in the classroom setting and the duration of the intervention was for 15 min. The content has been repeated and reviewed one more time because students did like it. Care has been taken to ensure complete emphasis to the method of delivery of education using 3D video animation. Another questionnaire has been asked after the use of 3D video animation. This questionnaire has been distributed to students to measure their motivation and comprehension at the end of explaining the chapter by using 3D video animation. Later on and after explaining by using the 3D video animation, a prepared assessment was performed in order to view, whether the 3D's video animation has a similar effect as for PowerPoint and 2D video projections and to compare the results with another topic (CPU lesson) from the same chapter.

IV. Results and Analysis

Data analysis relied on pre and post questionnaires and pre and post- test grades for 14 BT2I students. The pre-test was conducted after explaining the CPU parts and functioning lesson while using power point presentation and 2D video. The students viewed and listened to the explanation then answered the questions of a ten minutes' test. The pre-questionnaire before the 3D method was distributed for students to fill in. As for the post-test, it took place after explaining the HDD parts and functioning lesson

while using 3D animation method. The students viewed and listened to the explanation then answered the same questions of a ten minutes' test. The post- questionnaire after using the 3D video animation was distributed for students to fill in.

Three main levels of analysis shall be perceived after collecting data and analyzing it by using SPSS (V. 22).

a) The comparison of pre and post questionnaire students' motivation.
b) The comparison of pre and post questionnaire students 'comprehension.
c) The comparison of pre- test and post-test students' academic achievement.

Researchers' pro-questionnaire and pre-questionnaire were filled by the students and measured and analyzed through SPSS (V.22). All the grades collected from the hardware unit for CPU parts and functioning lesson without using the 3D video animation were compared to HDD parts and functioning lesson by using the 3D video animation of the same sample were represented and analyzed through Excel. Students' grades were analyzed to see how much students' academic achievement have improved.

Before using 3D animation 21.4% of students agree that they talk during lesson explanation. This could be due to class charter. 57.2% (28.6% neither agree nor disagree and 28.6% Disagree) are not interested in participating in class discussion. Which means a high percentage of students who aren't participating. 21.4% Agree that they feel disoriented in classroom, 57.1% neither agree- nor disagree and 21.4% disagree. It means that most of the students are feeling disoriented in classroom and not able to concentrate while explaining computer course. 28.6% Feel boredom in a classroom, 50% neither agree- nor disagree and 21.4% disagree on feeling boredom in classroom. It means that most of the students are feeling boredom in the classroom. (Table I)

Table I. Pre questionnaire results

	Strongly agree	Agree	Neither – Not	Disagree	Strongly disagree
Do you talk during lesson explanation		21.4%	28.6%	28.6%	21.4%
Do you participate in class discussion?	21.4%	21.4%	28.6%	28.6%	
Do you feel disoriented in the classroom?		21.4%	57.1%	21.4%	
Do you feel boredom in a classroom?		28.6%	50%	21.4%	

The results of the post questionnaire during the use of 3D video animation measuring student behavior and motivation in class indicates that 100% of the students stopped talking during the 3D video animation. 100% of students were able to participate and interact with the teacher whenever he asked a question which means that the comprehension in class was fair as well. The distraction was limited, 100 % of the students were not distracted and they were fully focused. Even by observation, researchers were able to notice students' reactions towards presentation. They were interested by the content and how it appeared. They all were ready to participate and interact with the teacher. As a result, no one showed symptoms of boredom in class. (Table II)

Table II. Post questionnaire results

	Strongly agree	Agree	Neither – Not	Disagree	Strongly disagree
I talked during lesson explanation				50%	50%
I participated and interacted with the teacher	21.4%	78.6%			
I was distracted by other students				71.4%	28.6%
I showed symptom of boredom in class				64.3%	35.7%

Table III. Correlation between variables from Pre-questionnaire

		Do you find the course interesting	Do you participate in class discussion	Do you feel boredom in a classroom
Do you find the course interesting	Pearson Correlation	1	.919**	-.858**
	Sig. (2-tailed)		.000	.000
	N	14	14	14
Do you participate in class discussion	Pearson Correlation	.919**	1	-.970**
	Sig. (2-tailed)	.000		.000
	N	14	14	14
Do you feel boredom in a classroom	Pearson Correlation	-.858**	-.970**	1
	Sig. (2-tailed)	.000	.000	
	N	14	14	14

**. Correlation is significant at the 0.01 level (2-tailed).

A Correlation between three variables indicates that there is a statistically significant correlation between them. There's a negative correlation (r = -0.858) and (r = -0.970) between variables in table 11. It means the existence of an inverse relation between finding the course interesting, participating in classroom and feeling boredom in a classroom. It explains that when students are feeling boredom they are not interested in the course and they won't participate in class discussion. But if they found the course interesting they won't feel boredom in classroom and they will participate in classroom discussion. Students said the more interesting the course is, the more they will participate in class discussion (r = 0.919). (Table III).

A comparison of the two tables below (Table IV and Table V) indicates that the motivation of students during the lesson using 3D video animation increased from the Power

Point presentation and 2D video. In the lesson using 3D video animation, the students did not show symptom of boredom in class. They paid full attention to the teacher. Students participated more and interacted with the teacher, also they were excited toward the 3D video animation lesson. They were not distracted by other students or by any other diversions.

Table IV. Statistics of students' motivation during the PowerPoint and videos presentation

		Did you participated and interacted with the teacher	Did you talked during lesson explanation	Were you distracted by other students	Were you occupied by other various diversions?	Did you showed symptom of boredom in class
N	Valid	14	14	14	14	14
	Missing	0	0	0	0	0
Mean		1.79	4.50	4.29	4.21	4.36
Median		2.00	4.50	4.00	4.00	4.00
Mode		2	4[a]	4	4	4

Table V. Statistics of students' motivation during the 3D animation lesson

		Do you talk during lesson explanation	Do you participate in class discussion	Do you feel disoriented in the classroom	Do you feel boredom in a classroom
N	Valid	14	14	14	14
	Missing	0	0	0	0
Mean		3.50	2.64	3.00	2.93
Median		3.50	3.00	3.00	3.00
Mode		3[a]	3[a]	3	3

While analyzing data in post questionnaire, researchers noticed that the percentage of comprehension for difficult concept in computer class is higher that the percentage of comprehension while using PowerPoint or videos presentation. Students become more active and ready to participate and interact with the teacher, asking more meaningful questions and using 3D video animation in HDD's functioning topic in computer course could improve student's comprehension. As we can see in the table below, students' comprehension for difficult concept were easy to get by using 3D video animation and that by being arranged in a clear and logical way, it helped them for a better understanding. (Table VI)

Table VI. Post questionnaire results

	Strongly agree	Agree	Neither – Not	Disagree	Strongly disagree
I enjoyed viewing the 3D video animation.	28.6%	71.4%	0	0	0
The 3D video animation content covered the objectives.	42.9%	57.1%	0	0	0
The content was arranged in a clear and logical way.	71.4%	28.6%	0	0	0
The difficult concepts were easy to get	15.4%	84.6%	0	0	0
The use of 3D video animation helped me better understand the material.	7.1%	78.6%	14.3%	0	0
The sound was clear.	21.4%	78.6%	0	0	0
The language used in the 3D video animation was easy to understand.	14.3%	57.1%	28.6%	0	0
The discussion in class was very active and helpful.	50%	50%	0	0	0

After viewing the 3D video animation students answered all the questions below with a positive attitude toward 3D video animation.

100% said that they preferred using 3D video animation in teaching. 100% think that using 3D video animation in teaching will motivate them more towards learning. 92.9% found computer hardware unit interesting by using 3D video animation. 92.9% Find that they have learned things quickly in this unit by using 3D video animation and 7.1% didn't learn things quickly in this unit by using 3D video animation because they still find it difficult to memorize some technical terms. 100% found that the 3D video animation is interesting and well organized. 92.9% find the content covered easy to understand. 92.9% found the animation used in the video made the material easier and 7.1% didn't find that using animation made the material easier. 100% feel confident about their knowledge on the subject covered even though; researchers didn't get great scores in the post test. 100% felt excited by learning using a 3D video animation. 100% find it a great idea having the 3D video animation online so they can access it at any time and review the content especially when preparing for an exam. (Table VII)

Table VII. Post questionnaire results

	Yes	No
Did you prefer using 3D video animation in teaching?	100%	
Did you think that using 3D video animation motivates you more toward learning?	100%	
Did you find the computer hardware Unit interesting now?	92.9%	7.1%
Did you learn things quickly in this Unit?	92.9%	7.1%
Did you find that the 3D video animation interesting and well organized	100%	
Did you find the content covered easy to understand	92.9%	7.1%
Did you find the animation used in the video made the material easier?	92.9%	7.1%
Did you feel confident about your knowledge on the subject covered?	100%	
Did you feel excited by learning using a 3D video animation?	100%	
Do you prefer having the 3D video animation online so you can access it to review the content?	100%	

After analyzing the pre and post questionnaires, researchers realize that students have enjoyed viewing 3D video animation. While viewing it, they stopped talking and participated more to the teacher explanation. A higher

percentage indicated that the difficult concepts were easy to get, and the use of 3D helped them to achieve a better understanding. The correlation in the table below indicates that when students enjoyed viewing the 3D video animation they felt motivated (r = 0.767) and when students felt motivated they would participate and would interact with the teacher (r = 0.633). (Table VIII).

After receiving positive feedbacks on the new method used while teaching, a written test was the only way to measure whether an improvement has occurred to students' scores or not.

To show an increase in their academic achievement a first test (CPU lesson) while using Power Point presentation and 2D video indicated that the content was not very well assimilated and understood by all students. The average grades for test 1 was (m_1 = 18.46) over 30. Another test was done after one week to see whether they still remembered the content and the average for the second test was (m_2 = 16.86) over 30. (Table IX).

Table IX. Pre- Test results

Pre- Test1 (m1)	Pre- Test 2(m2)	Average
18.46	16.86	17.66

Table VIII. Correlation between three variables from the Post questionnaire

		I felt motivated by the 3D video animation	I participated and interacted with the teacher	I enjoyed viewing the 3D video animation
I felt motivated by the 3D video animation	Pearson Correlation	1	.633*	.767**
	Sig. (2-tailed)		.015	.001
	N	14	14	14
I participated and interacted with the teacher	Pearson Correlation	.633*	1	.440
	Sig. (2-tailed)	.015		.115
	N	14	14	14
I enjoyed viewing the 3D video animation	Pearson Correlation	.767**	.440	1
	Sig. (2-tailed)	.001	.115	
	N	14	14	14

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

After using the 3D video animation method in explaining the course, two tests were done one directly after finishing the explanation and the average of this test was (m_1 = 22.82) over 30. After one week another test for the same chapter was done and the average was (m_2 = 21.93). This indicates that even after one week students still remembered many details from the 3D animation used for explanation and none of the students got a grade below 15. (Table X)

Table X. Post Test results

Post- Test1 (m1)	Post- Test 2(m2)	Average
22.82	21.93	22.38

In researcher's opinion, the average of the class must be (>21) over 30 in order to conclude that the lesson was fully understood. That was the case in here, the average grades for students' test was 21.79 which means, that students did fully understand the material.

As explained previously, two grades were taken. One grade based on the average of the two tests related to CPU parts and its functioning taught through PowerPoint presentation and 2D video.

The average grade calculated was m = 17.66 over 30. The other test was based on the average of the two tests related to HDD parts and its functioning taught through 3D video animation. The average grade calculated was m = 22.38 over 30. A comparison between the two averages indicated that an improvement has been done between PowerPoint presentation, 2D video and 3D video animation. Without forgetting, that none of the students received a grade below average. So using 3D video animation in HDD's functioning topic in computer course improves students' academic achievement in computer course.

V. Summary, Recommendations and Conclusion

The idea of developing a 3D video animation emerged when 3D video animation seems to be a better solution in making concrete a complex abstract concept and that the primary benefit of 3D in the classroom is thought to aid visual learning [25]. Complex concepts become more easily digested when reduced to imagery. After finding this solution, researchers chose the lesson HDD parts and functioning to be represented in 3D video animation, because researchers already knew by experience that students have great difficulty in abstraction, and comprehension of this lesson. Once the subject was chosen, researchers began by thinking about the concepts that should be involved to facilitate students' understanding and developing a strategy corresponding to objectives.

As a result, students were able to understand greater levels of complexity, as the animations made it possible for students to move from the whole structure to various parts and to move around within to see how things worked. The ability to simplify complex content appeared in the results of the research. They indicated a positive effect of the use of 3D animations on teaching and learning, recall and performance in tests. Under experimental conditions, 100% of students got better grades on the post-test. Within the individuals with better scores, the rate of improvement was 13.33%. Individuals enhanced test scores by an average of 14.02% in the 3D classes. The marked improvement in test scores was also supported by quantitative data which showed that 100% of students agree or strongly agree that

3D video animation in the classroom made them understand things better and 100% of them agree or strongly agree that they discovered new things in 3D learning that they did not know before.

Other facts noted by the research included that students in the 3D class were more likely to recall and remember details and sequence of processes more than in a Power Point presentation.

At the end, some recommendations will be presented for the BT2I class HDD parts and functioning lesson and informatics class in general, some advices for future studies to enhance this path.

5.1. Interpretation of the Results

The results of the collection of data, before and after the use of 3D video animation, were presented in the previous chapter as a general statistic in form of tables for frequencies. As interpretation of the results, researchers found through the results of the questionnaire filled by the students, the mean of motivation increased from the Power Point presentation and 2D video to the 3D video animation. The frequencies increased in the lesson using 3D video animation as it affected students' motivation according to them as well.

By answering other questions in the post questionnaire, students thought that using 3D video animation motivated them more toward learning. They preferred learning hardware chapter through 3D video animation; they found it more interesting and they thought 3D video animation helped them to more understand the hardware chapter.

In addition, when they answered the tests the results showed an improvement in their comprehension and academic achievement and that they still remembered things from the explanation even if the test was after one week or two from the explanation date.

5.2. Limitations

Despite taking the actual learning conditions into account, there were few problems that limited this action research and made it difficult to apply properly.

1) Some of the students still had a lack of interest in this specialization because they didn't choose it voluntarily. They were obliged by their parents because it's the only technical school in the area with only two specializations (Hospitality, Informatics and Accounting.). That explained their lack of interest no matter what.
2) Creating a 3D video animation is costly and time consuming as mentioned before so it's difficult for researchers to do many 3D animation files for the entire hardware chapter.
3) The absence of proper integration of technology in the teaching process since the television is used instead of a screen (giant screen) due to economic factors.
4) To develop an animation, the graphic designer must also know a lot about the studied course. Mayer's cognitive theory of multimedia learning must be applied as a guideline in the development process, to achieve a learner-centered approach in the application. Animations and characters created must be always constructed with respect to the cognitive load theory (Mayer and Moreno, 2003). As a result, the design and prototype prepared could be a guideline if they want to develop courseware for a computer science course.
5) In this study, researchers tried their best to fulfill what's missing by their voice over but still couldn't change the poses of motion sequences, nor even the character used to represent data. Researchers were able to use and apply the various learning theories in the development of 3D video animation for the HDD parts and functioning.

5.3. Recommendations

According to the results of the action research and the problems that limited the research, researchers come out with a few recommendations to help the informatics teacher, by finding the proper solution for the issues of lack of motivation and low achievement in hardware chapter.

The most important recommendations of the study are as follows:

1) Should take into consideration the technical design of content diversity of learners and audio visual lessons in design.
2) Adding interactive features on electronic lessons so it will evolve from video into interactive activity.
3) Uploading these videos on the internet, to be viewed from home later on.
4) Adding the three-dimensional animation videos in Adobe Reader files 3D-PDF to be shared later on drop box where internet is too slow to play 3D animation.

VI. CONCLUSION

This study stimulated a change in researchers' way of thinking and making decisions based upon the data collected and analyzed. The use of technology helped a lot in this action research and solved a major problem according to the results obtained above. Researchers were satisfied when the objective of this action research was accomplished by finding a solution to the issues of lack of motivation, comprehension and low academic achievement found in BT2I computer class by using 3D video animation.

Doing this research about 3D video animation and reading a lot of related resources, helped researchers develop new knowledge such as learning about cognitive theory of multimedia learning and its basic principles, the use of animation in computer based instruction and other related fields. As a consequence, researchers were ready to find a way forward to the next logical project which is learning about all the 3D technologies and creating their own 3D videos animation through modeling software such as Blender.

The thoughts of sharing what we know with other researchers in order to serve as an inspiration for future dissertation makes us feel so responsible and objective as far as we can be in describing the methods, instruments already used and results, limitations, recommendations found. To totally reach the goal, to achieve the target and serve the benefit of the students, one of our recommendations for any computer teacher in the future, was to balance between the multiple methods already used such as hands-on practices, PowerPoint presentation, 2D videos and never rely on 3D video animation only.

REFERENCES

[1] Chi, M.T. (2005). Commonsense conceptions of emergent processes: Why some misconceptions are robust. *The journal of the learning sciences*, 14(2), 161-199.
[2] Smith, D., McLaughlin, T., & Brown, I. (2012). 3-D computer animation vs. live-action video: Differences in viewers' response to instructional vignettes. Contemporary Issues in Technology and Teacher Education, 12(1), 41-54.
[3] Baptista, Manuel Moreira. Development and utilization of 3d animations in chemistry teaching. Diss. Thesis. Programa de Pos-Graduaçao em Química, Unicamp, 2013.
[4] Silva, F. G. (2009, December). Teaching animation in computer science. In ACM SIGGRAPH ASIA 2009 Educators Program (p. 2). ACM.
[5] Franklin, S. & Peat, M. (2001). Managing change: The use of mixed delivery modes to increase learning opportunities. Australian Journal of Educational Technology, 17 (1), 37-49.
[6] Teoh, B.S., & Neo, T.K. (2006, July). Innovative teaching: Using multimedia to engage students in interactive learning in higher education. In 2006 7th International Conference on Information Technology Based Higher Education and Training (pp. 329-337). IEEE.
[7] Alessi, S. & Trollip, S.R. (2001). Multimedia for learning: Methods and development. 3rd edition. MA: Allyn and Bacon.
[8] Yusof, K. M. (Ed.). (2012). Outcome-Based Science, Technology, Engineering, and Mathematics Education: Innovative Practices: Innovative Practices. IGI Global.
[9] Rias, R.M., & Zaman, H.B. (2011). The Effects of Varied Animation in Multimedia Learning: Is the extra effort worthy? International Journal of Digital Information and Wireless Communications (IJDIWC), 1(3), 582-590.
[10] Dick, W & Carey, L. (2005). The Systematic Design of Instruction. Edited by S. Edition. Allyn and Bacon, Boston: Pearson.
[11] Jonassen, D.H. (1999). Designing constructivist learning environments.Instructional design theories and models: A new paradigm of instructional theory, 2, 215-239.
[12] Gibbs, G. (1992). Assessing more students (Vol. 4). Oxford Centre for Staff Learning and Development, Oxford Brookes University.
[13] Neo, T.K., & Neo, M. (2004). Classroom innovation: engaging students in interactive multimedia learning. Campus-Wide Information Systems, International Journal of Technology on Campus. 21(3), 118-124.
[14] Reeves, T.C. (1992). Evaluating interactive multimedia. Educational Technology, 32 (10), 47-53.
[15] Mayer, R. E. (1997). Multimedia learning: Are we asking the right questions? Educational psychologist, 32(1), 1-19.
[16] Mayer, R.E. (2002). Multimedia learning. Psychology of learning and motivation, 41, 85- 139.
[17] Mayer, R.E. (2009). Multimedia learning (2nd ed). New York: Cambridge University Press.
[18] Mayer, R.E. & Anderson, R.B.. (1992). The instructive animation: Helping students build connections between words and pictures in multimedia learning. Journal of Educational Psychology, 84 (4), 444-452.
[19] Mayer, R.E. (2014). Cognitive theory of multimedia learning. The Cambridge handbook of multimedia learning, 43.
[20] Musa, Sajid, et al. "Developing Educational Computer Animation Based on Human Personality Types." arXiv preprint arXiv: 1503.06958 (2015).
[21] Rieber, L.P. (2004). Microworlds. In Handbook of research for educational communications and technology (2nd ed.). Mahwah, NJ: Lawrence Erlbaum Associates.
[22] Keller, J. & Burkman, E. (1994). Motivation Principles In Instructional Message Design: Principles from the behavioral and cognitive sciences. Eaglewood Cliffs: NJ.
[23] Mayer, R.E. & Wittrock, M.C. (1996). Problem-solving transfer. In Handbook of Educational Psychology. New York: Macmillan
[24] Xiao, L. (2013). Animation trends in education. International Journal of Information and Education Technology, 3(3), 286.
[25] Bamford, Anne (2011) "Life: Learning in Future Education. Evaluation of Innovations in Emerging Learning Technologies" in press

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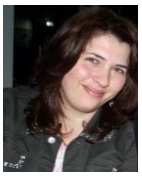

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