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EXPLORING JUNIOR HIGH SCHOOL LEARNERS' MOTIVATION IN SCIENCE THROUGH CONCEPT CARTOON-BASED INSTRUCTION

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ABSTRACT: *This study aimed to determine the effect of concept cartoons on Junior High School (JHS) learners' motivation to study Integrated Science. An exploratory mixed-method design situated in a participatory action research approach was employed for the study. A convenient sampling technique was used to select 45 Form Two learners of Methodist M/A JHS in Winneba. The science teacher and nine of the learners purposively sampled were interviewed after the intervention to assess their impressions about concept cartoon-based instruction. Concept cartoon-based instruction was used to teach selected Integrated Science concepts. Instruments used to collect data before and after the intervention were observation, interviews and questionnaires on motivation before and after the intervention. Quantitative data collected was analysed using descriptive statistics. The learners' responses were organised into frequency counts and converted into simple percentages and presented in tables. The qualitative data was coded inductively, organized and used to triangulate findings obtained from the quantitative data. The study's findings showed that before the intervention, JHS learners were least motivated regarding science learning. However, there was heightened interest in science among the learners after the concept cartoon-based instruction. Learners were highly motivated and developed a passion for science. This was evident in the findings obtained from the responses of the learners on the post-intervention questionnaire and interview. The concept cartoons approach used in the study motivated and increased learners' participation in the teaching of the selected concepts of Integrated Science so JHS Integrated Science teachers are encouraged to use concept cartoons to increase the learners' motivation to learn science.*

KEYWORDS: Concept cartoons, concept cartoon-based instruction, motivation, constructivist learning, science learning.

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INTRODUCTION

Students' success in learning is mainly dependent on their level of motivation. Motivation is a necessity for students to be constantly involved in the learning process; this influences the development of student learning since it plays a role in providing energy, directing and maintaining positive student behaviour. Academic performance in science is said to be linked to students' motivation and interests in academic pursuits (Jegede, 2007; Barmby, Kind & Jones, 2008). Students' high motivation for learning can be linked to a positive attitude towards learning; these students are not more intelligent than unmotivated students, but their quest to know more or to master a concept pushes their thinking. Intrinsically motivated students treat learning like play. As a result, they are more likely to flip the learning on its head to see it from a new angle (Chuter, 2020). According to Osborne and Collins (2001), science learning activities engage students and expose them to meaningful learning situations that continually make them wander in a sustained culture of practice.

One of the essential factors that plays an essential role in effective science learning is motivation. Motivation, which is "the drive to pursue, work toward, and achieve a goal can be described as either intrinsic or extrinsic. Intrinsic motivation refers to the internal psychological impetus an individual has to pursue and fulfill a particular goal because it is enjoyable, interesting, fulfilling, or meaningful to the person. Extrinsic motivation, on the other hand, refers to the impetus that comes from outside an individual in the form of giving or withholding tangible rewards or meting out punishments" (Shumow & Schmidt, 2013). Learners' motivation to learn science declines when teachers make all decisions for the learners. Learner-centred instruction, therefore, becomes beneficial since it increases motivation for learning and greater satisfaction for schools, leading to greater achievement (Smith, 2023). In the view of Alexander and Murphy (2000), personal involvement, intrinsic motivation, personal commitment, confidence in one's ability to succeed, and a perception of control over learning lead to more learning and higher achievement in school. Therefore, making science real, relevant, and rigorous for young children can help them to be more successful (Butler, nd) and highly motivated.

Motivation to learn is of particular interest in science education because of the relationship between motivation, cognitive engagement and conceptual change (Pintrich, Marx & Boyle, 1993). According to Shumow and Schmidt (2013), motivation is situational; it varies depending on the goal and characteristics of the learning environment. Though most schools depend greatly on extrinsic motivation, both extrinsic and intrinsic motivations play a role in igniting learning, as such teachers are more exposed to strategies that attempt to promote learning through the use of external means, such as reinforcements or punishments. Most teachers on the other hand lack the knowledge and techniques for nurturing intrinsic motivation. Butler (nd) stressed that successful basic science teaching must include strategies that encourage students to learn the science that will help them in class and life. Concept cartoon-based instruction is one strategy that teachers can use to encourage and motivate students to learn science since it provides a stimulus to intrigue, think, and provoke discussion to generate scientific thinking (Long & Marson, 2003).

Young children typically have an affinity for nature and science. Connecting the science to be learned to the reality of their lives, the relevance of their age-appropriate experiences, and the rigor

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of the science concepts can make science come alive in unique and meaningful ways for these children (Butler, nd). Concept cartoon-based instruction that involves students constructing their knowledge based on their prior ideas and the reality of their lives is one method that makes science real, relevant, and rigorous.

Research findings show that teachers who are effective at supporting learners via the affective domain also enable improvements in students' learning and academic achievement in science. A study on motivation to learn shows that children are attracted to ideas that address both their cognitive and affective needs. Young children are typically already interested in nature, the environment, and how things work. The teacher's role, therefore, includes creating an environment conducive to learning and encouraging support of students' autonomy, relevance, and relatedness of the material for higher levels of achievement (Davion, 2017).

Concept cartoons are extremely motivating for learners of all ages and backgrounds and in different circumstances, including those students who have emotional and behavioural difficulties. A concept cartoon is an instructional material that has two or more caricatured characters. The characters discuss a problem in daily life. This tool uncovers learners' ideas through discussion and aims to encourage argument (Keogh & Naylor, 1996). In concept cartoons, the opinion accepted scientifically and the alternative opinion which is closer to it are presented together with characters in a poster (Stephenson & Warwick, 2002; Kabapınar, 2005; Ekici, Ekici & Aydın, 2007). The purpose of concept cartoons is to foster deep thinking since the original cartoons do not necessarily have a single correct answer. Therefore, the use of concept cartoons in science education is thought to help students to construct their own knowledge. Learners tend to stay longer on task, with sustained levels of interest, and to interact confidently with their peers. It is suggested that for "less confident students, having voices speaking for them gives them the confidence to discuss their ideas" (Keogh & Naylor, 1999, pp.7). Frequent use of the concept cartoon approach does not only appear to increase the level of engagement of learners (Keogh & Naylor, 1999) but also rescues learners from boring traditional teaching (Birisci, Metin & Karakas, 2010). This is because concept cartoons trigger two levels of inquiry among students—one where they work in groups to engage in reading and experimenting, and the other where they work individually to further their understanding beyond class discussions. Group work can give students the confidence they need to move on to exploring science on their own. Scientific rigour is also a critical aspect of science notebooks, where students can document their scientific experiences in ways they think are important to them. In addition, the consistency in recording information in the science notebook adds more rigour for students, as they consider how the recorded information accents their thoughts (Butler & Nesbit, 2008).

The use of concept cartoons makes science learning fun, causing concepts to be learned in more enjoyable ways. The concept cartoons with alternative viewpoints help learners see the concept from different angles, encouraging active learner participation in the lesson. In a typical lesson with concept cartoons, students discuss the topic among themselves. The cartoons offer the learners the opportunity to play an active role in the lesson. The colourful visual features of concept cartoons also attract students' attention, causing them to focus on the lessons from start to finish. Teaching via visual materials is more effective than traditional methods because students are more interested and engaged, and they retain the taught material longer than they do through traditional

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lecturing.

Concept cartoons create a discussion environment in the classroom where students can improve their critical thinking skills. It also influences in a positive way students' attitudes towards science lessons which may improve students' academic achievement. This study assessed the effect of concept cartoons on the JHS learners' motivation to study Integrated Science. The following research question guided the study: What is the effect of concept cartoon-based instruction on junior high school pupils' motivation towards Integrated Science learning?

THEORETICAL FRAMEWORK

The theoretical framework for the study is organized around interest theory. Academic success depends on interest, a potent motivating factor that drives learning, directs academic and professional paths, and energizes learning (Harackiewicz, Smith & Priniski, 2016). Promoting interest can help learners learn more actively and with greater motivation. Interest theory in education is a framework for creating educational interventions to foster interest in certain learners (Harackiewicz & Knogler, 2017). It is predicated on the notion that student enthusiasm in a subject has enormous influence. Students become more engaged when a subject is related to what they enjoy doing because they are more eager to spend time reflecting, conversing, and developing ideas (McCarthy, 2014). Interest-based learning uses a child's interests as the basis for making decisions about what you are going to teach and for how long (Devitt, 2022). According to Hidi and Harackiewicz (2000), students are more likely to attend class, pay attention in class, become engaged, enroll in more courses, effectively process information, and do well when they are interested in an academic subject.

Interest, according to Renninger and Hidi (2016), is a powerful motivational process that propels learning and directs academic and career paths. Instructors need to harness this motivation and thus help students develop interest through instructional strategies that sustain interest in the learning process. Instructional approaches that allow students to explore their interests as a means of acquiring knowledge and skills are more motivating for students, and it can lead to deeper and longer-lasting learning experiences (Devitt, 2022). Concept cartoon-based instruction, which is the focus of this study, is one strategy that teachers can use to encourage and motivate students to learn science since it aids students to develop important lifelong skills, such as problem-solving, critical thinking, and creativity.

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METHODOLOGY

Research Design

The research approach was participatory action research. The participatory action research approach is the "systematic collection and analysis of data for the purpose of taking action and making change by generating practical knowledge" (Gillis & Jackson, 2002:264, as cited by Phillips, Trevan & Kraeger, 2020:227). The participatory action research process, according to Kemmis, McTaggart and Nixon (2014) and Riel (2019), provides opportunities to empower and support participants to re-think and modify their practices in the teaching and learning process. The study adopted an exploratory mixed method research design (Fetters, Curry & Creswell, 2013), a two-phase approach characterised by an initial qualitative phase followed by a quantitative phase with a final phase of integrating data from the two separate elements of data. This design is used with the goal of exploring a topic before collecting quantitative data.

Sample and Sampling Technique

The target population for the study was JHS learners in the Central Region of Ghana and the accessible population was JHS learners in the Effutu Municipality of the Region. A convenient sampling technique was employed in the selection of the school for this study due to accessibility and availability of the participants. A purposeful sampling technique was used to select 45 (29 males and 16 females) Form Two learners of Methodist M/A JHS. Form Two learners of Methodist M/A were used because they were free from the pressure of external examination and had stayed in the school at least for a year and had been exposed to instructions by the same teacher. Also, the school management consented to the participation of the sample in the study. The Integrated Science teacher, whose learners were taught using the concept cartoons, and nine (9) of the learners were sampled and interviewed. These 9 learners were purposively selected based on their level of participation and enthusiasm during the lesson. The school had no science laboratory with very few resources for teaching science. The teacher had a B.Ed. degree in Science Education with 13 years of teaching experience.

Instruments

The instruments used in this study were an observation schedule, questionnaire, and interview protocol. The observation check-list with 12 items was used in the study. The observation of a science lesson was done prior to the teaching with concept cartoons to have an idea of teaching strategies used by the science teacher in the classrooms, the enthusiasm of the learners, and their level of participation. The observation was also done during the concept-cartoon-based lesson to find out how learners could work independently with minimum support, their eagerness to learn, and their involvement in the lesson, how they planned and performed the experiments, learners' ability to handle materials/equipment, and learner-learner interaction, among others. The researchers were non-participant observers during the classroom observation before the cartoon-based instruction and participant observers when learners were taught with concept cartoons.

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A 29-item closed-ended questionnaire, adapted from Mubeen and Reid (2014), was employed in this study. The items followed a 5-point Likert-type scale format. The questionnaire was about science learning and its relevance to learners' daily lives. The items were categorised into five motivational sub-constructs: learners' career motivation consisted of 2 items, grade motivation consisted of 4 items, self-determination had 4 items, self-efficacy and assessment anxiety consisted of 9 items, and intrinsic motivation and personal relevance consisted of 10 items.

A semi-structured interview schedule based on the use of concept cartoons to teach Integrated Science was used. The interview guide for the teacher's interview session consisted of five items while that for the learners contained four. The interview items were about their perception, effectiveness and challenges of using concept cartoons.

Validity and Reliability

Experts in science education in the Faculty of Science Education of the University examined and determined the suitability of the wording of each of the questionnaire and interview items to ensure face and content validity. Suggestions received from them were used to refine and sharpen the content, making them more relevant and valid for the study. Data from the interview was checked with the respondents interviewed. The written interview was sent to the respondents to check for the accuracy of the records for the analysis.

The questionnaire items were pilot-tested in a selected JHS of a sister school with the same dynamics to ensure reliability. The results from the pilot test helped the researchers to identify areas of difficulty and ambiguity in the questionnaire which were addressed. The data from the pilot test was used to determine Cronbach's Alpha reliability coefficient of the questionnaire. It was found to be 0.79, which falls within the accepted range of 0.5 and 1.0 (Cho & Kim, 2015).

Data Collection Procedure

The study started with the observation of a science lesson of the Form Two learners of Methodist M/A JHS to determine the teaching strategies employed by the science teacher, the existing interaction in the classroom, activities learners were engaged in, and learners' level of motivation during science lessons. After this, all the 45 learners in the science class answered a 29-item closed-ended questionnaire on motivation to determine their level of motivation. Learners responded to the questionnaire items before the concept cartoon-based instruction to determine their level of motivation in a typical Integrated Science class.

The researchers facilitated four concept cartoon-based science lessons. The concepts taught were climate change, communicable disease, the carbon cycle, and energy conversion. The concept cartoons were presented on sheets of paper together with worksheets (adopted from Kruit, Berg & Wu, 2012) adapted to the constructivist 5E model. The worksheets were organized according to the 5E model (having 5 stages to go through during the activity: engage stage, explore stage, explain stage, elaborate stage and evaluate stage). A day after the fourth concept cartoon-based lesson, the learners again responded to the same motivation questionnaire items to determine whether the concept cartoon had a positive effect on their level of motivation. The Integrated Science teacher, whose learners were taught, and the nine purposively selected learners were then

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interviewed on their perception of the concept cartoon-based instruction.

Data Analysis

The data generated from the closed-ended questionnaire were coded and the descriptive statistics function of SPSS version 20 was used to organize the responses into frequency counts and percentages, and presented in tables. Frequency and percentages were used because they are useful means of expressing the relative frequency of survey responses and other data (Why Are Percentages Important, 2021). The responses for the questionnaire items were re-categorised to ease analysis and interpretation of the data. Strongly agree and agree were re-categorised into agree, and strongly disagree and disagree into disagree. The interviews were audio taped, transcribed, and read over severally in order to be acquainted with the data collected. The learners were assigned identifiable numbers, 1 to 9. Interview data was therefore reported using learners 1 to 9 (L1–L9). The qualitative data was coded inductively and presented according to the research questions raised to support triangulating findings obtained from the quantitative data. Evidence gathered from these sources over a period of time provided a broader and deeper understanding of learners' motivation, knowledge, and learning (Sagor, 1992).

RESULTS AND DISCUSSION

Observation of lessons taught by JHS science teachers before the concept cartoon-based lessons revealed that junior high school science lessons were characterized by teacher-centred direct instruction, mostly dominated by lecture-based approaches to teaching. The observation revealed that the pupils were not engaged in the classroom activities, rendering them passive. The only teacher-learner interaction was a mere question and answer while learner-learner interaction was non-existent during the lesson delivery. The majority of the learners were silent throughout the lesson. Very few of the learners through questioning revealed the misconceptions they brought to the learning situation but none of those misconceptions were addressed by the teacher. The teacher attributed the teacher-centred approach to the lesson to a lack of resources. Interactions with learners after the lessons indicated that learners' motivation for science was very low. They indicated that they had low engagement with science activities in and out of school with low expectations of success and negative attributions to failures in science. They seemed not to know why they learned the concepts they were taught in science lessons and the importance of the science learned in their daily lives.

The learners' responses to the questionnaire items on intrinsic motivation and personal relevance are presented in Table 1.

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Table 1: ***Effects of Concept Cartoons on Intrinsic Motivation and Personal Relevance of Learners***

Item	Percentage Frequency		
	Agree	Indifferent	Disagree
I take pleasure in learning science			
Before intervention	29(64%)	7(16%)	9(20%)
After intervention	42(93%)	0	3(7%)
I find studying science interesting			
Before intervention	18(40%)	11(24%)	16(36%)
After intervention	43(96%)	1(2%)	1(2%)
All the science I learn is relevant to my existence			
Before intervention	8(18%)	18(40%)	19(42%)
After intervention	41(91%)	3(7%)	1(2%)
The science I learn has realistic value for me			
Before intervention	12(26%)	7(16%)	26(58%)
After intervention	44(98%)	0	1(2%)
Receiving high grades in science is not as important to me as the science I learn			
Before intervention	17(38%)	10(22%)	18(40%)
After intervention	24(53%)	6(13%)	15(34%)
My personal goals and objectives are associated with my science learning			
Before intervention	12(27%)	13(29%)	20(44%)
After intervention	30(66%)	7(16%)	8(18%)
I want to be challenged by the science I learn			
Before intervention	19(43%)	15(33%)	11(24%)
After intervention	40(89%)	5(11%)	0
Understanding science will bring me success			

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Before intervention	20(44%)	8(18%)	17(36%)
After intervention	41(91%)	3(7%)	1(2%)
How I will apply the science I study is important to me			
Before intervention	20(44%)	13(29%)	12(27%)
After intervention	43(96%)	1(2%)	1(2%)
I think science learning can help me in my profession			
Before intervention	20(44%)	15(33%)	10(23%)
After intervention	34(75%)	8(18%)	3(7%)

Table 1 shows responses to items that were based on learners' intrinsic motivation and personal relevance. Before the intervention, only 40% of the learners agreed that science learning is interesting while as many as 91% found science learning interesting after the intervention. Again, only 18% of the learners found the science they learnt relevant before the intervention. However, this figure rose to 91% after the intervention. The science learners learn should as much as possible have a realistic value for learners, but only 26% of the learners said the science they learned had a realistic value for them before the intervention. After the intervention, however, the figure increased to 98%. Also, 26% of the learners noted that their personal goals and objectives were associated with the science they learnt before the intervention while 66% indicated that their personal goals and objectives were associated with the science they learnt after the intervention. Being challenged by the science one learns is important to make sense of it, but only 43% of the learners were challenged by the science they learnt before the intervention. However, after the intervention, as many as 89% were challenged by the science they learnt. Furthermore, the application of the science learnt in one's daily life is one major aspect of the learning process of science. Before the intervention, 48% of the learners agreed to this assertion but after the intervention, 96% of the learners came to the realization that the application of the science they learn daily is important. Forty-four percent (44%) of the learners before the intervention were of the view that understanding science would bring success to them but, after the intervention, the figure rose 91%. Intrinsic motivation taps into the natural human tendency to pursue interests and exercise capabilities (Ryan & Deci, 2000; Singh, Granville & Dika, 2002).

Learners were intrinsically motivated when they had to design their own experiments, choose materials to be used, perform the experiments they had designed, and provide written reports on what they did. This finding is consistent with what is in the literature. According to Csikszentmihalyi (2000), students who are intrinsically motivated to learn often experience a feeling of enjoyment that occurs when they are concentrating intensely on the task at hand, such as a lab activity The science learners learn became relevant to them when they had the opportunity

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to construct their own knowledge by trying to solve everyday problems based on the visuals presented to them.

The results on self-efficacy and assessment anxiety are presented in Table 2.

Table 2

Effect of Concept Cartoon on Self-Efficacy and Assessment Anxiety of Learners

Item	Frequency and percentages		
	Agree	Indifferent	Disagree
I'm worried about how I will perform in science exams			
before intervention	23(51%)	14(31%)	8(18%)
After intervention	9(20%)	4(9%)	32(71%)
It makes me worried to think about a weak performance in the science exam			
Before intervention	21(47%)	4(9%)	20(44%)
After intervention	41(91%)	0	4(9%)
When the time comes to take a science test, I feel nervous			
Before intervention	36(80%)	4(9%)	5(11%)
After intervention	8(18%)	1(2%)	36(80%)
I believe in my abilities and skills in the science subject			
Before intervention	23(51%)	5(11%)	17(38%)
After intervention	44(98%)	0	1(2%)
I try to perform well in science assignments as compared to other subjects			
Before intervention	24(54%)	1(2%)	20(44%)
After intervention	40(89%)	3(7%)	2(4%)
I am positive that I can achieve a grade 'A' in science subject			
Before intervention	21(47%)	14(31%)	10(22%)
After intervention	40(89%)	4(9%)	1(2%)
I do not like to think about science exercise			
Before intervention	18(40%)	15(33%)	12(27%)
After intervention	2(4%)	4(9%)	39(87%)
I am confident in my ability to perform well in science exams			
Before intervention	28(62%)	3(7%)	14(31%)

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After intervention	45(100%)	0	0
I am sure to perform better in science projects or developments and labs			
Before intervention	12(26%)	7(16%)	26(58%)
After intervention	41(91%)	1(2%)	3(7%)

Table 2 shows responses to items on self-efficacy and assessment anxiety. Before the intervention, 47% of the learners were worried about a weak performance in the science examination but, after the intervention, there was an upsurge to 91%. Also, 80% of the learners became nervous when the time came to take a test in science: this figure dropped after the intervention to 18% due to the positive impact of the intervention. Learners who believe in their abilities and skills make great efforts to perform in a given course of study. Before the intervention, 51% of the learners indicated that they believed in their abilities and skills in the science subject but, after the intervention, as many as 98% were positive about their abilities in the science subject due to their exposure to one effective way of learning science. With regards to achieving high grades, only 47% of the learners were positive they could achieve a grade ‘A’ in the science subject before the intervention. After the intervention, 89% of the learners were positive about their achievement. Though assessment is necessary to measure the progress of the teaching and learning process, 50% of the learners indicated that they did not like to think about science exercises. However, after the intervention, only 4% of the learners had the same attitude. Again, 26% of the learners before the intervention were sure to perform better in science projects or development and laboratory work. This percentage rose to 91% after the intervention—an indication that when exposed to concept cartoons, they could perform better in science projects. Also, the learners realized that science is not always as sophisticated as they perceived it to be but could be simple with resources around them. Students at all levels have a level of anxiety at one point or another regarding tests and examinations.

Data from Table 2 reveals that students worry about their performance in courses they take, leading to nervousness any time a test or exam is announced. This worry however is dependent on the level of interest they have in that subject or course. According to Bandura (1997), self-efficacy is the confidence one has about his/her capabilities to organize and perform the courses of action required to produce given attainments. In affirmation of this, Glynn and Koballajr (2005) referred to self-efficacy as the confidence a student has about his or her ability to succeed in a field of science. Learners after the intervention developed self-confidence, leading to their anxiety problems being minimized and thus their grades being improved. According to Cassady and Johnson (2002), moderate level of anxiety, however, is good since it helps motivate learning. Increased self-confidence and a moderate level of anxiety make learners positive about science. This positivity can lead to increased motivation, resulting in improved performance. Chin and Teou (2009) emphasized that concept cartoons can establish a social learning environment where students feel more comfortable expressing their thoughts and become aware of their abilities. Additionally, teachers take advantage of the opportunity to offer prompt feedback upon noticing patterns of new or preexisting misconceptions in learners. Concepts are more readily acquired and

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abstract concepts become concrete, resulting in increased self-confidence in learners (Sengul, 2011).

The learners' responses on self-determination are presented in Table 3.

Table 3: ***Effects of Concept Cartoon on the Self-determination of Learners***

Item	Frequency and percentages		
	Agree	Indifferent	Disagree
I learn science with great interest and put in adequate effort			
Before intervention	9(20%)	9(20%)	27(60%)
After intervention	40(89%)	3(7%)	2(4%)
I prepare well in doing science tests and laboratory work			
Before intervention	17(38%)	16(35%)	12(27%)
After intervention	36(80%)	8(18%)	1(2%)
I employ different approaches to ensure I learn the science well			
Before intervention	8(18%)	15(33%)	22(49%)
After intervention	36(80%)	7(16%)	2(4%)
I seek help if I find difficulty in learning			
Before intervention	23(51%)	9(20%)	13(29%)
After intervention	40(89%)	4(9%)	1(2%)

The data in Table 3 shows that the self-determination of learners was low in science before the intervention but improved dramatically after the intervention. Only 20% of the learners learned science with great interest and adequate effort before the intervention, while 89% shared the same opinion after the intervention. Preparation before science tests and laboratory work leads to great achievement, but only 38% of the learners prepared well before science tests and laboratory work just because they had no or little interest in science before the intervention. However, after the intervention, as many as 80% of the learners indicated they prepared well before science tests and laboratory work. Also, 18% of the learners before the intervention indicated that they employed different approaches to learning science well but, after the intervention, the number shot up to 80%. Again, 51% of the learners noted that they sought help when they found science learning difficult. After the intervention, as many as 89% of the learners said they sought help when science learning became difficult.

The self-determination of learners increased because they had a level of control over their learning, what to do and how to do it. They designed their own experiment and decided on the materials to be used. Reeve, Hamm and Nix (2003) defined self-determination as the ability to have choices

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and some degree of control over what we do and how we do it. Most people are unhappy when they feel they have lost control, either to another person or the environment. When learners have the opportunity to determine their educational activities, they are more likely to benefit from them (Glynn & Koballajr, 2005). However, when they lack self-determination, it is difficult for them to feel intrinsically motivated. They may come to believe that their performance in science is mostly uncontrollable, and, as a result, they expend less effort on learning. Garcia and Pintrich (1996) emphasized that one way to increase students' intrinsic motivation is by increasing their self-determination. They found that the intrinsic motivation of students increased when the students had input into course policies, such as the selection of course readings and term paper topics, as well as the due dates for class assignments.

The results on career motivation are presented in Table 4.

Table 4: ***Effects of Concept Cartoons on the Career Motivation of Learners***

Item	Frequency and Percentages		
	Agree	Indifferent	Disagree
The science I learn can assist me to find an excellent career			
Before intervention	19(42%)	9(20%)	17(38%)
After intervention	33(74%)	6(13%)	6(13%)
How science will be useful to me is important			
Before intervention	15(33%)	5(11%)	25(56%)
After intervention	43(96%)	1(2%)	1(2%)

From Table 4 on career motivation, only 42% of the learners were motivated career-wise before the intervention. However, after the intervention, 74% of the learners were motivated to take up careers in science. Also, due to the abstract nature of the science they learnt, learners did not see the usefulness of science before the intervention as only 33% of the learners indicated the usefulness of science to them. However, after the intervention, 96% of them realized the usefulness of science in their daily lives. This stemmed from the fact that there was a connection between their prior experiences and what they learnt using concept cartoons. A childhood interest in science has been identified as a potential indicator for later careers in science. Particularly, middle school (now junior high school) has been identified as the time when the majority of youth begin to make decisions about curricular choices for continued study in high school and beyond (Akos, Lmbie, Milsom & Gilbert, 2007). It is, therefore, imperative for science to be taught in ways that will motivate learners to take up careers in science in later life. Teaching using concept cartoons develops learners' scientific skills as they design and execute their experiments. This way, learners see themselves as scientists, motivating them to take up careers in science. Constructivist teaching approaches consider students' beliefs and conceptions towards student-centered pedagogy in science instruction with a focus on the students, their interest, their learning skills, and their needs in actively constructing their knowledge (Treagust & Duit, 2009), and hence pay attention to the

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existence of students' prior knowledge when entering a learning environment (Hare & Graber, 2007). The results on grade motivation are presented in Table 5.

Table 5: ***Grade Motivation***

Item	Frequency and percentages		
	Agree	Indifferent	Disagree
It is essential and valuable for me to get high scores on Science			
Before intervention	24(54%)	2(4%)	19(42%)
After intervention	41(91%)	3(7%)	1(2%)
I expect to achieve better in the science subjects than other students			
Before intervention	27(60%)	5(11%)	13(29%)
After intervention	44(98%)	0	1(2%)
I take my performance in science seriously since it will influence my overall grade			
Before intervention	21(47%)	11(24%)	13(29%)
After intervention	40(89%)	3(7%)	2(4%)
I'm personally responsible if I don't get the science Well and I'm weak In Understanding			
Before intervention	7(16%)	10(22%)	28(62%)
After intervention	34(75%)	5(11%)	6(14%)

From Table 5, the data shows that it was essential and valuable for 54% of the learners before the intervention to get high scores in science. After the intervention, the number shot up to 91%. Sixty percent (60%) of the learners expected to achieve better scores in science subjects than other students before the intervention while 98% of the learners expected to achieve scores after the intervention. Also, only 47% of the learners before the intervention said they took their performance in science seriously since it would influence their overall grade. There was however an increase to 89% after the intervention. It is seen in Table 5 that only 16% of the learners said that they were personally responsible if they did not get the science concept well before the intervention but, after the intervention, 75% took responsibility if they did not get the science well. Motivation has several effects on students' learning and behaviour. It has the potential to increase students' time on tasks (even a difficult one), affecting performance positively. Motivation also leads to increased effort and energy and affects what and how information is processed because motivated students are more likely to pay attention and try to understand the material instead of

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simply going through the motions of learning superficially (Hurst, nd). As learners are motivated to learn, they take particular interest in their performance and grades. They can go to any extent to learn and achieve higher grades. Mallam (2002) defined interest as a differential likelihood of investing energy in one set of stimuli rather than others. This applies to situations in the classroom where the interests of students in academic areas are reflected in actions such as time and effort that they spend studying a particular subject, willingness to engage in additional activities involving the subject area besides that given by the teacher, and voluntarily selecting the subject for further study.

Various researchers have indicated a positive relationship between student interest and learning (Mallam, 2002). Observation during the intervention phase saw highly motivated learners going about their learning. Learners cooperated with their group mates and remained interested and keen throughout the task they were performing. Learners remained positive throughout the task and worked within the allotted time. This was evident in their group discussion which, although heated, ran smoothly and efficiently to produce the expected results in time. Learners never looked tired or bored during the lessons but were rather willing to perform additional tasks. They also presented their results confidently, irrespective of their mistakes.

In science learning, the motivation of science students is described as students' active engagement in science-related tasks to perform a higher knowledge of science (Lee & Brophy, 1996). Barlia (1999) asserted that motivation is a vital educational variable promoting the use of strategy, previously performed learning skills, behaviours, and learning in new ways. Students who actively engage with what they are studying tend to understand more, learn more, remember more, enjoy it more, and are better able to appreciate the relevance of what they have learned, than students who passively receive what they are taught. As teachers, therefore, we are presented with a huge challenge, which is how to encourage and enable our students to engage in the learning process (Park, 2003).

From the results of the study, it was evident that the level of learners' motivation increased after the concept cartoon-based instruction was introduced and the learners were more motivated to learn the topic after engaging them from the very beginning. Intrinsically, they were motivated; they took pleasure in learning science, found science learning interesting, and discovered how science learning was relevant to their existence. They realized the need to be challenged by the science they learned and how their personal goals and objectives were associated with the science they had learned. Mubeen and Reid (2014) opined that if students perceive the value of learning activities, they will actively enjoy these learning activities with positive attitudes to construct a meaningful understanding of a new science concept based on their existing knowledge.

The rationale for using concept cartoons in this study was that concept cartoons are tremendously motivating for learners of all ages and backgrounds. Learners' interests are sustained and they tend to stay long on tasks assigned to them without getting bored. Also, they interact confidently with their peers through discussion of ideas (Keogh & Naylor, 1999). The responses the learners and their teacher gave during the interview to the use of concept cartoons were highly positive. When asked about his views on concept cartoons as an instructional strategy, the science teacher asserted that it is a good teaching and learning material with its colorful nature. Learners, he said, like

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pictures, leading to enhanced understanding when pictures are used in the learning process. They catch the attention of learners. The arguments of the various cartoon characters stimulated the thoughts of the learners, provoking discussion, which is not usually the case in class. He also stated that learners' responses were positive and their full participation, argument, discussions, and debates were very encouraging; even the very reserved learners had something to say in the group.

When asked about his observation about learners' responses to concept cartoons, the teacher noted that learners' responses were positive and their full participation, argument, discussions and debates were very encouraging; even the very reserved learner had something to say in the group. He, however, observed that learners had difficulty filling the worksheet probably because they were not used to it. They asked a lot of questions to complete the worksheet. The teacher also emphasized that concept cartoons were effective in supporting learners to plan scientific investigations because the concept was presented in the form of a problem or question for learners to think about and also to prove that the view they chose was correct, when he was asked about the effectiveness of concept cartoons in supporting learners to plan scientific investigations. When asked about the difficulties he realized in the use of concept cartoons, the teacher stated that some of the learners had difficulty in completing the worksheet and some could not follow the process; so they kept asking questions for clarification.

The outcome of the interview with learners is presented below:

All nine (9) learners said positive things about concept cartoons when they were asked about their views on the use of the innovation. They indicated that concept cartoon learning is interesting, and the lessons were well understood because the cartoons gave them some things to think about. In addition, they said they felt like the cartoons were talking to them and had meaningful discussions among peers when learning. This implies that with the advent of technology, a computer-aided concept cartoon (in the form of animation) will have a more significant impact on learners since learners of today are technology-driven. According to Yu, Lin and Hung (2010), technology provides interactive simulations and virtual labs that allow learners to experiment and visualize scientific concepts in ways that are not possible in a traditional classroom setting. Triplett (2023) also noted many benefits from integrating technology into science education, such as better academic achievement for learners, higher levels of motivation and engagement, improved problem-solving and critical thinking abilities, and better preparation for future professions in technology-driven sectors.

All nine (9) learners responded in the affirmative when asked if they always wanted to use concept cartoons. The reasons they gave include: with concept cartoons, they learnt with their friends and thought together, and they planned their experiment which made understanding better. Also, they can say anything in their mind and if it is wrong, they will be corrected. Some said concept cartoons made learning fun; they could talk to their friends and teacher if they did not understand anything and they were sure they would be helped. They have the space to explore and not their teachers always telling you what to do.

When asked what they found difficult about concept cartoons, they all admitted to the difficulty of completing the worksheet since they were not used to it, as well as the fact that all the cartoon ideas were plausible. Also, selecting the correct idea was challenging. Finally, all nine (9) learners

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reiterated that they need to be taught the report writing process and also use effective strategies to teach science when they were asked how they thought the difficult situation could be improved.

Learners' anxiety problems were minimized with the introduction of concept cartoons because they had the opportunity to construct their own knowledge by trying to solve everyday problems based on the visuals presented to them. This is consistent with Costa da Silva, Miranda Correia, and Infant-Malachias' (2009) view that visuals helped learners strengthen their critical thinking abilities by boosting their motivation and providing them with more opportunities to think. Long and Mason (2003) believed that concept cartoons may be utilized to both solve problems in everyday life and to promote participation in classes. This was evident in this study when learners' self-determination increased after the cartoon-based lesson. They claimed they now learnt science with great interest and adequate effort. They prepared well to write tests and did practical work; they also indicated that they would employ different approaches and seek help to learn the science well if the need arose. Research shows clear evidence that concept cartoons lead to increased motivation and engagement for learners of all ages and backgrounds and in a variety of circumstances. Concept cartoons not only let students have fun but also prompted them to question what they knew (Keogh & Naylor, 1999). Concept cartoons became the focus of interest due to the characters they contained and thus helped to extend the length of motivation.

CONCLUSION AND RECOMMENDATIONS

Motivation is significant and a requisite to learning. It is the door to learning because it leads to engagement and, without engagement, learning is unlikely to occur. Teachers need to know how to plan science lessons for maximum motivation if great learning is to take place. The concept cartoons approach used in the study motivated and increased learners' participation and achievement in the teaching of the selected concepts of Integrated Science. The learners became highly motivated and were able to apply scientific ideas in everyday life after interacting with the cartoon concept which depicted everyday situations. Concept cartoons, therefore, can be captivating and motivating so much that the interest of learners is sustained in science lessons. Therefore, JHS science teachers should be encouraged to use concept cartoon-based instruction to increase the learners' motivation to learn science.

JHS science teachers should endeavour to employ innovative teaching strategies that drive learners to explore their environment to make science learning meaningful. Since children and teenagers love technology, science teachers should as much as possible infuse technology into their lessons to make science lessons practical and interesting. Learners are more likely to be motivated when they are actively engaged. Science teachers should also increase the meaningfulness of science contents and tasks by relating them to learners' lives as well as framing tasks in a local context.

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