

The Effect of CSI Movies on Students' Chemistry Achievement and Attitude towards Chemistry

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Abstract The study aimed to determine the effects of Crime Scene Investigation (CSI) Movies on students' achievement and attitude towards chemistry. A total of 233 students from the BS Criminology and BSED Education programs enrolled in a general chemistry course were randomly assigned to experimental and control groups. The findings of an ANCOVA analysis indicated that students exposed first to CSI movies before the lecture performed better in the achievement test than students who belong to the control group and students exposed to CSI movies after the lecture. Attitude towards chemistry is found to be very positive. However, the attitude of the students did not vary significantly. Properly selected CSI movies may have served as motivation to learn the chemistry concepts. The study recommends the use of well-selected movies and videos to expose students to the application of chemistry concepts in the real world. Moreover, classroom experience must be varied and focused on the latest updates in chemistry and in chemistry education to motivate students for chemistry.

Keywords: *chemistry achievement, chemistry attitude, teaching strategy, teaching intervention, CSI movies*

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1. Introduction

Knowledge in chemistry is important as production of highly relevant chemistry products may spur national growth and development in any nation. Chemistry concepts are demonstrated in nature and in human activities such as in oil and gas production and processes, agriculture, health, environment, solid minerals, textile, cosmetics waters supply and sanitation, crime detection, pulp and paper, and waste management [1]. Moreover, a good understanding of chemistry concepts is an advantage for most professionals. Chemistry has been known as a difficult subject for students by many researchers, teachers and science educators [2]. Poor understanding in chemistry may have resulted due to the abstract nature of many chemical concepts, teaching styles applied in class, lack of teaching aids and the difficulty of the language of chemistry students [3]. Learning difficulties should be addressed to help students learn chemistry in the classroom. The difficulties in chemistry may have something to do with the identified problems and challenges in chemical education such as overloading of contents, isolation of facts, lack of transfer, lack of relevance and inadequate emphasis [4]. Attitude in learning chemistry can also contribute to the learning difficulties encountered by the students [5]. The science teacher considers the development of positive attitude towards science subjects as his center of responsibility [6]. Attitude is the positive or negative tendency of an

individual to any matter [7]. It constitutes one aspect of an individual's personality. Attitudes towards chemistry or science denote interests or feelings towards studying chemistry or science [1]. It is the students' disposition towards liking or 'disliking' science while attitudes in science mean the scientific approach assumed by an individual for solving problems, assessing ideas and making decisions.

Chemistry teachers must take much effort to create an ideal environment for teaching and learning including technological tools in the classroom. These tools are aimed to develop in order to keep pace with the rapid changes in trends in technology. It is not enough to rely on visual materials, mastery of technical skills and techniques, or the correct use of equipment. Technological tools like movie scenes can be used as an alternative learning method in teaching chemistry. Movies are an excellent tool for developing a variety of positive characteristics and behaviors [8]. Thus, based on research to date on effects of teaching with movies, it was hypothesized that positive characteristics and behaviors can be enhanced in university students through a systematic movie-based teaching. This is because educational movies can offer useful alternatives to traditional teaching methods when used appropriately. Most teachers effectively employed movies as an integral part of their pedagogical approach. They are effective teaching tools partly because they appeal to both visual and auditory learners [9] allowing students to perceive things they have not experience Films can virtually transport students to faraway places and/or potentially dangerous situations, while never leaving the

safe comfort of the classroom. Movie series, such as Crime Scene Investigation (Miami), had scenes which show how some of the technologies that are based on chemistry concepts can be used to help solve a crime. The importance of chemistry in the crime investigation is not a surprise. Chemical analysis on gunshot residues, hair or traces of blood, drugs, fiber, glass, fingerprints and arson that can link a suspect to a crime scene is a forensic process. It uses techniques of chemistry and instruments developed for chemistry such as mass spectroscopy, atomic absorption, infrared-red spectroscopy, gas and high performance liquid chromatography. These laboratory instruments are featured as tools in answering some of the most critical questions related to crime scenes. Criminology students are trained to become law enforcers and the use of CSI movies may help them understand their future career better. Learning chemistry is equally important for pre-service teachers for they will be teaching their students in the future as well. Thus this research intends to focus primarily on the effectiveness of using crime scene investigation movies as supplemental material in teaching chemistry on criminology and education students' achievement and attitude in chemistry. Also, it will attempt to compare the group's achievement and attitude based on type of exposure (movie before and after lecture).

2. Methods

The study randomly assigned intact groups of chemistry students to three different treatments. The first group watched CSI movies before the lecture of the chemistry concepts was given. The second group was given lecture on the chemistry topic and then allowed to watch the CSI movies in class. The third group served as a control group which is exposed only to lecture-discussion method and no movies. The exposure to treatments was done for eight to ten weeks. The study made use of a researcher-made achievement test called the Student Chemistry Achievement Test (CAT), which is a 30-item multiple choice test that has been validated by chemistry teachers and science major students. The achievement questionnaire was administered to the students (N=233) as pre-test and post-test. The topics covered in the achievement test are Matter/Scientific Method and Measurement, Atomic Structure of Matter, Ionic & Molecular Compounds/Chemical Nomenclature, Chemical Reactions and Chemical Calculations. These topics are also the topics indicated in the course syllabus for criminology students. The second instrument used in the study was the Attitude toward Chemistry Questionnaire (ACQ). The questionnaire is a 14-item questionnaire with 4-point Likert scale ranging from strongly Agree (4) to strongly Disagree (1). Reliability test yielded a Cronbach alpha reliability coefficient of 0.76 which the researchers considered acceptable for the study. The ACQ specification includes statements as dimensions on: "Likeness for chemistry", "Emotional climate of the chemistry classroom", "Achievement motivation" and "Behavioral tendencies to learn chemistry". The groups were taught by the same chemistry teacher following a strict implementation matrix. To process the data gathered,

descriptive statistics was used such as mean and standard deviation. ANCOVA was utilized to determine difference between the groups as a result of the intervention.

The selection of CSI movies is based on appropriateness for student viewing and relevance to the course. Relevance means that the movies will show to the criminology students the application of the chemistry concepts in solving crimes. For appropriateness for student viewing, the researchers carefully selected CSI movies that do not contain very sensitive scenes (e.g. too much violence, graphic scenes, etc.). The researchers also ensure that the movies are suitable for third year college students (in terms of language and topics). The third year criminology students have courses like crime scene detection and investigation, forensic chemistry and forensic medicine. General chemistry is one of the pre-requisite subjects needed to take those subjects. It is hoped that the knowledge they will acquire or learn from the CSI movies will be applied for those subjects aside from pointing out to students the importance of understanding the concepts to become a good law enforcer. Moreover, the chemistry content of the CSI movies were reviewed by the chemistry teachers in relation to the content of the curriculum. The focus of the evaluation is to ensure that the concepts are clearly and correctly illustrated in the movies. The selected movies were then shown to the school's guidance counsellor for approval. Once approved, the films were shown to chemistry teachers for approval of its appropriateness as chemistry supplemental materials. Consent for the conduct of the study were sought from the school administration and from the students themselves.

Table 1 shows the chemistry concepts covered in the CSI movies.

Table 1 reveals that some of the concepts are repeated by some of the movies. The researchers considered this as beneficial as it provides a review of the concept and since the crimes being solved are different in each movie, it afforded the students the impression that the chemistry concepts are useful in analyzing evidences found in the crime scenes such as fabric analysis, DNA test, blood analysis and in identifying unknown substances among others. In this study, the CSI movies served as an exposure of students to the application of chemistry concepts as well as a strategy in improving their attitude towards chemistry.

Table 1. CSI Movies and the Featured Chemistry Concepts

CSI Movies	Chemistry Concepts
Movie 1	Characteristic of Matter Basic Atomic Theory
Movie 2	Scientific Measurements Chemical Reactions
Movie 3	Chemical Reactions Stoichiometry
Movie 4	Ionic/Covalent Compounds Stoichiometry
Movie 5	Basic Atomic Theory Ionic/Covalent compounds
Movie 6	Characteristic of Matter Chemical Reactions
Movie 7	Basic Atomic theory Chemical Reactions

3. Results and Discussion

The study investigated the effects of CSI movies on criminology and education students' achievement and attitude toward chemistry during the first semester of the academic year 2016-2017 in a local community college in the Philippines. It also sought to determine whether the effects are significantly different because of the order of exposure to CSI movies. Therefore, the following null hypothesis were considered in the study: H_{01} -There is no significant difference in the students' chemistry achievement when grouped according to type of exposure to CSI movies and H_{02} -There is no significant difference in the students' attitude towards chemistry when grouped according to type of exposure to CSI movies.

3.1. Chemistry Achievement

Table 2 shows the students' performance in the achievement test given to them before and after the intervention. The achievement test covers the target chemistry topics or concepts as reflected in the general chemistry syllabus for both criminology and education students enrolled in a community college. Chemistry achievement in the context of the study, is the students' scores in the researcher-made but validated 30 item multiple choice chemistry test.

Table 2 reveals that students have comparable performance in the achievement test during the pretest. However, it was observed that the students' scores in the chemistry achievement test during the posttest did vary with the group that was exposed first to the movie followed by lecture having the highest mean. Movies with chemistry content can help capture students' attention and interest in the theories and concepts under discussion [10]. Once interest is captured, educators may find the teaching of concepts easier as students would tend to be participative and curious during the discussion. It may also result to deeper understanding and easier recall of learned chemistry concepts that can be translated into high academic achievement during the test.

During an informal interview, students expressed enjoyment over the movies used and claimed that they appreciate that the CSI movies could point out to them the importance and application of the chemistry concepts being learned. The students found the movies helpful in making them realize the relevance of the chemistry concepts to their future career.

To determine whether there is a significant difference in the performance of the students exposed to different treatments, Analysis of Covariance was performed. Table 3 shows the results of the analysis.

Analysis of ANCOVA reveals that there exists significant difference in the achievement scores of the

groups of students exposed to three different treatments. The computed F value which is 3.304 is significant at $\alpha = 0.05$. The probability associated with $F = 3.304$ which is 0.038 is less than 0.05. This means that the null hypothesis is rejected. There is a significant difference in the achievement scores of the students when exposed to three different treatments. To determine which group performed best, a post hoc test was run using SPSS.

Table 4 shows the results of the post hoc test.

Table 4 shows that pairwise comparison between students exposed to Movie first then Lecture and Lecture first then Movie yielded a mean difference that is significantly different at 0.05 level of significance. This means that students who were exposed first to CSI movies then given a lecture on chemistry performed better than students who were given lecture first and then exposed to CSI movies.

On the other hand, a pairwise comparison between Movie first then Lecture and control group yielded a mean difference of .825 which is not significant at 0.05 level of significance. This means that these groups of students have comparative performance. It can also be interpreted to mean that the intervention that expose students first to chemistry movies before the lecture can be used as an alternative to lecture discussion method.

The use of CSI movies in the teaching of chemistry concepts may have emphasized to the students the importance of the concepts that they will be learning. Hence, for those who have seen the application first had performed better who have seen the application after the learning of chemistry concepts. While many educators have found that films can be quite effective in helping students learn [11,12,13] others argued that popular films could lead to misunderstanding of science by blurring the distinction between fact and fiction [14]. Thus, educators planning to use movies as supplements to chemistry instruction must exercise prudence in the selection of appropriate materials and ensure more than adequate processing of the chemistry concepts alongside the students. The teacher must be observant of the students' behavior during the film showing and be ready to address the questions raised by the students after the film showing. This is a very crucial time as students are receptive and curious about the movie shown to them.

Table 2. Students' Achievement in Chemistry

Groups/Treatments	N	Pretest		Posttest	
		Mean	SD	Mean	SD
Movie first then Lecture	72	10.24	2.394	21.10	6.340
Lecture first then Movie	73	10.15	3.303	18.52	7.118
Control Group	88	10.20	3.370	20.25	5.814

Table 3. ANCOVA Analysis Results for Students' Chemistry Achievement

Source of Variation	Adjusted Sum of Squares	df	Adjusted Mean Square	F	Probability	Interpretation
Treatment Between	239.998	2	119.994	3.304	.038	Significant
Error Within	8316.827	229	36.318			
Total	102615.00	233				

Table 4. Post-hoc Analysis Results

Groups	Mean Difference	Significance	Interpretation
Movie then Lecture & Lecture then Movie	2.515	.038	Significant
Movie then Lecture & Control Group	.825	1.00	Not Significant

3.2. Effect of Crime Scene Investigation (CSI) Movies on Students' Attitude in Chemistry

Attitude can be described as having a tendency to respond to a certain stimulus which can be constructed into two components consist of cognitive and affective dimensions [15]. Cognitive reflects the belief and knowledge of an individual about the stimulus whereas affective reflects the individual response to emotion through preferences to the stimulus. An individual can show positive or negative attitude towards an object, subject or idea like in a classroom in the form of observable behavior [16]. For example, students who always complete their homework and ask question during chemistry class are said to show positives attitudes in learning chemistry. Students' attitude towards chemistry was also measured before the exposure to the different treatments and was measured again after the exposure to the treatments.

Table 5 shows the profile of the students' attitude during the pretest and posttest.

Table 5 reveals that majority of the students from the different groups are perceived to have very positive attitude towards chemistry with the group that was exposed first to movie then lecture reflecting the lowest percentage of students with very positive attitude towards

chemistry during the pretest. However, during the posttest, this group of students (movie first then lecture) had an increase in the percentage of those having very positive attitude (from 61% to 74%) while the other two groups reflected a change in the distribution with the very positive attitude percentage decreasing by one percent. As the chemistry topics become more difficult during the first semester, it is expected that students' attitude may change.

Students' attitude towards science affects their learning of science subject(s) and their positive or negative attitude has an impact on their academic achievement and future career [17]. In fact, positive attitude towards science leads students to a positive commitment to science and influences their lifelong interest and learning in science [18].

Table 6 shows the attitude of the students towards chemistry taken as a group.

Table 6 shows that majority of the students maintained a very positive attitude before and after the intervention. However, it can be gleaned from Table 5 that students who were exposed to CSI movies before the lecture have higher mean when compared to the other groups.

To determine whether there exists a significant difference in the students' attitude towards chemistry as a result of the intervention, ANCOVA analysis was performed.

Table 7 shows the results of the ANCOVA Analysis.

Table 5. Profile of Students' Attitude towards Chemistry

Groups Treatment	Pretest			Posttest		
	Very Positive f (%)	Positive f (%)	Negative f (%)	Very Positive f (%)	Positive f (%)	Negative f (%)
Movie first then Lecture	44 (61)	28 (39)	0 (0)	53 (74)	19 (26)	0 (0)
Lecture first then Movie	47 (64)	26 (36)	0 (0)	46 (63)	27 (37)	0 (0)
Control Group	61 (69)	27 (31)	0 (0)	60 (68)	28 (32)	0 (0)

Table 6. Overall Attitude of the Students towards Chemistry

Groups/Treatments	Pretest		Interpretation of the Mean	Posttest		Interpretation of the Mean
	Mean	SD		Mean	SD	
Movie first then Lecture	*3	.33	Very Positive	3.2	.35	Very Positive
Lecture first then Movie	3.1	.29	Very Positive	3.1	.34	Very Positive
Control Group	3.1	.30	Very Positive	3.1	.33	Very Positive

* 1.0-1.99 = negative 3.0-4.0 = very positive 2.0- 2.99 = positive.

Table 7. ANCOVA Analysis Results for Students' Attitude towards Chemistry

Source of Variation	Adjusted Sum of Squares	df	Adjusted Mean Square	F	Probability	Interpretation
Treatment Between	.519	2	.260	2.654	0.073	Not Significant
Error Within	22.397	229	.098			
Total	2309.271	233				

Table 7 indicates that there exists no significant difference in the students' attitude towards chemistry as a result to their exposure to the different treatments. The computed F value which is 2.654 is not significant at $\alpha = 0.05$. The probability associated with $F = 2.654$ which is 0.073 is greater than 0.05 which means that the null hypothesis is accepted. There is no significant difference in the students' attitude towards chemistry as a result of the intervention. The findings of this study on attitude may have something to do with the nature of the degree program being pursued by the students. BS Criminology students are expected to become law enforcers in the future and they consider knowledge in chemistry as an asset in terms of understanding how evidences in crimes are processed and interpreted. Similarly, students who pursue teacher education programs are motivated to learn chemistry as this is a course that they might also be teaching in the future. The use of films in learning are found to have core attributes that target student-centered learning, experiential learning, reflective and problem solving learning. Films assist students to overcome limitations and gaps on textbooks [19], it reinforced the content and engage the students [20], and support constructivist context [21] as well as provide real image of science [12]

4. Conclusion

This study aimed to determine the effects of CSI movies on students' achievement and attitude towards chemistry and to establish whether the order of exposure matters. The study was able to establish for these groups of students, exposure to CSI movies prior to lecture is effective in improving chemistry achievement. In atoms or learners first, Mahaffy contends that it is better to motivate learners first with the beauty and importance of the whole rather than asked them to wait until the key pieces of knowledge are in place. This is because when you do the "atoms first", it may lead to disjointed understanding and difficulty in seeing the significance of the knowledge learned [22]. Hence, showing the movie first has a positive effect and CSI movies when properly selected may be use as useful supplements in chemistry classrooms.

Attitude on the other hand is a complex construct. It can be affected by many factors and somehow difficult to influence as it is very strong when intrinsic in nature. Students when properly motivated can stay on track for academic activities and endeavor for the longest time necessary for them to succeed. Higher achievement may be attained from a positive attitude to a course [23]. However, evidence is limited to support this for students in undergraduate chemistry which results from difficulties in quantifying attitude. There is a paucity of data pertaining to the importance of attitude in undergraduates majoring in chemistry [24]. To develop a positive attitude towards a subject is an essential part of the undergraduate experience and educators should encourage students to have it especially when they study chemistry. This is because the development of positive attitude towards science subjects as every teacher's center of responsibility [6].

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