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Article

Flipping the Classroom in Senior High School Textile Education to Enhance Students' Learning Achievement and Self-Efficacy

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Abstract: The study analysed the impact of the flipped classroom (FC) approach on weaving experience, self-efficacy and students' learning achievement. To achieve this purpose, a quasi-experimental (pre-test/post-test) design, with a control group and an experimental group, was implemented. A mixed methods approach was used to evaluate the outcomes of the intervention. Forty- four first year senior high school students of an elective textile education subject participated in the study. An academic achievement test and a semi-structured group interview were employed as data-gathering instruments. Descriptive and inferential statistics (parametric and nonparametric tests), as well as thematic analysis were used to analyse the data collected. Findings of the study indicated that, regarding the acquisition of skill set and the maintenance of academic achievement, the students in the treatment group taught using the FC approach obtained higher levels of achievement juxtaposed with the students in the control group tutored with a traditional teacher-centred approach. The study further established that a flipped-classroom approach was engaging, interactive and exciting for students. The students in the experimental group, via the qualitative inquiry, expressed satisfaction with the practice in weaving and felt elevated in their knowledge, attitudes, self-learning, problem-solving and critical thinking skills acquisition. Therefore, the study recommended that the school adopt the FC approach as a method of teaching studio-based Visual Art subjects to support instructional hours.

Keywords: flipped classroom; loom weaving; self-efficacy; learning achievement; learning experience; senior high school; Ghana; quasi-experimental design

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1. Introduction

Textiles in general, and weaving in particular, form a significant component of Ghana's cultural heritage. Textile weaving is acknowledged as one of the oldest surviving crafts globally and is one of the primary textile production processes [1]. The weaving process involves interlacing a set of longer threads called the warp with a set of crossing threads called the weft on a loom [2]. There are several manually or mechanically automated loom types. Although textile weaving is still being done manually in some developing countries—mostly to add a traditional touch to the aesthetic value of a textile product—it is more mechanised in developed countries.

In the formal education system in Ghana, loom weaving is studied under the textile discipline in the Visual Art programme. Although loom weaving has a theoretical component, it is mainly taught as a studio-based practical course in the first year of senior high school. The instructional approach used in teaching weaving in the senior high school (SHS) is predominantly demonstration; however, this approach encounters some challenges. As the class size increases, it becomes extremely difficult to demonstrate the weaving processes to the students due to the limited teaching and learning resources, especially the learning space for studio-based practice. Furthermore, the instructional hours are not enough to give students theoretical knowledge and practical skill sets in weaving processes. These challenges make teachers adopt mainly lecture-based didactic instructions without providing practical engagement and adequate support, making the passive students learners and simulating their learning achievement and self-efficacy to demonstrate sufficient functional skills in weaving. Furthermore, emphasis is given to memorising considerable content, making the weaving processes less appealing to students. Consequently, there are methodical measures to heighten learning, teaching and assessment of weaving processes at the SHS, using cutting-edge pedagogical approaches backed by digital technologies [3,4].

With the increasing infiltration of 21st-century technologies into classroom activities [5–7], the flipped classroom (FC) approach has gained traction in high school [8]. Further, the FC approach has attained popularity in recent years as a technology-supported instructional innovation that utilises the classroom period for students to actively engage in interactive learning tasks, which incorporate scaffolding and individualised feedback from the teacher, while teachers' conventional teaching approach is delivered via asynchronous video lessons outside of the class period [9,10]. Although research on the FC has been increasing immensely in recent years, there is still a dearth of studies performed in SHS textile education, specifically, the teaching weaving processes. Additionally, there is limited research on how the FC approach impacts students' self-efficacy, learning experience and learning achievement. Researchers have noted that when students are not provided with adequate support when formulating detailed knowledge and proficiency, their learning achievement and self-efficacy may decline substantially [11]. As a result, this study employed the FC approach in teaching students weaving processes to understand the limitations of conventional didactic teaching better. Based on the purpose, the study is guided by the following research questions (RQ):

RQ 1

Compared to conventional teacher-centred teaching, could the FC approach enhance students' learning achievement in weaving processes?

RQ 2

Compared to conventional teacher-centred teaching, could the FC approach enhance students' self-efficacy in weaving processes?

RQ 3

What was the distinction in students' learning experiences when utilising the FC approach compared to conventional teacher-centred teaching in weaving processes?

2. Literature Review

The flipped classroom is a "pedagogical approach in which direct instruction is moved from the group to the individual learning space, and the resulting group space is changed into dynamic, interactive learning conditions in which the teacher guides students as they apply ideas and interact creatively with the subject matter" [12]. The flipped classroom approach is currently quite a popular pedagogical paradigm, and it has appeared in many research and innovation fora [13–24]. If we reflect on the existing literature on FC, we notice there is an agreement that it can benefit and improve students' learning achievement when implemented effectively [22,23,25,26].

Only lately have we identified quantitative studies that have been conducted to determine the influence of the FC approach in high schools [18], whereas similar research in emerging economies, such as Ghana, are nearly non-existent. A study performed in Nigeria found that implementing the FC approach in senior high school chemistry classes resulted in higher student learning when compared to students who exclusively used the conventional approach [27]. Those who engaged in the FC approach had more favourable perceptions toward chemistry than students who participated in the conventional instruction approach. Students expressed a preference for the FC approach over the conventional approach and regarded the approach to be more effective. One study employed a quasi-experimental pre-test/post-test procedure to examine the effect of the FC approach on students' science motivation and achievement in a high school [18]. The study used an FC approach with sixty students and a traditional approach with sixty-two students. There was a statistically significant difference in students' composite motivation levels when they used the FC approach compared to the traditional face-to-face approach, with only the self-efficacy subscale. However, there was no evidence of a substantial difference in learning achievement. Another study analysed the activity of a high school instructor who split his class into two sections and tried out the flipped classroom on a group of students [28]. The teacher analysed the test results between the two groups and discovered that students demonstrated a statistically significant difference in their test scores.

Another study [29] investigated the efficacy of the flipped classroom learning environment on learners' achievement and motivation to learn mathematics concepts and the effects of flipped classrooms on learners with varying levels of achievement in learning mathematics concepts. This study used a pre-test/post-test quasi-experimental design. This study enrolled 82 high school students, who were separated into experimental (n = 41) and control (n = 41) groups. The experimental group received trigonometry instruction via the flipped classroom method, while the control group received instruction via traditional means. The findings demonstrated a significant difference between the two groups regarding learning achievement and motivation, with students using the flipped classroom performing better. Additional analysis revealed a substantial difference in low achievers' performance between the experimental and control groups. Aidinopoulou and Sampson [3] demonstrated that the experimental group's classroom sessions were certainly filled with engaging student-centred activities, which resulted in improved learning outcomes in terms of showing critical historical thinking abilities. Chen [8] examined the flipped classroom instructional pedagogy's influence on a ninth-grade health education class of 64 students. Although there was no statistically significant difference between the experimental and control groups, the increased test scores in student learning with the flipped classroom paradigm argued for its adoption. Davies et al. [30] conducted a quasi-experimental mixed-methods study to examine the impact of the use of technology on the development of technical skills, highlighting the advantages of the FC approach in student engagement, satisfaction and motivation. According to the findings of this study, the simulation-based classroom environments, which were used within a FC approach, were found to be more efficient than the traditional classroom environment.

The FC approach from previous studies has several benefits, including enhanced possibilities to engage with instructional resources, improved positive perspectives, increased motivation to learn science, improved student satisfaction and improved achievement on science assessments among high school students [18]. However, most of the literature has concentrated on students in other disciplines (Science, Chemistry and Mathematics) at the high school level, but not on students in studio-based visual arts disciplines, notably, Textiles. Thus, additional investigation of the FC approach and its influence on textile students' knowledge and skill is necessary for the context of the studio-based Visual Art classroom.

3. Materials and Methods

The study was designed as a quasi-experimental pre-test-post-test design with control and experimental groups and a qualitative research method to solicit the opinions and perceptions of students in the experimental group on the quality of the intervention. The experimental cohort experienced the use of FC to teach weaving skills in textiles, and the control cohort were taught with the orthodox didactic approach. Data were garnered from the control and experimental groups via an achievement test before (pre-test) and after (post-test) the intervention was introduced. The summary of the study design is shown in Table 1. The study used qualitative data collected from students in the experimental group via group interviews to triangulate the intervention results. This action was to affirm whether the perceptions and opinions of the students corroborate the results from the treatment section and whether the issues associated with FC would be evidenced. The study covered one academic term (2020/2021 academic year). The theoretical and practicum of weaving in Textiles were taught and assessed by a Textile teacher. The students did not have prior experience with the flipped classroom approach before the class.

Table 1. Summary of the study design.

Groups	Pre-Test	Procedure for Experiment	Post-Test
Visual Art (1VA1)	PT1	Class taught with Flipped Classroom	PT2
Visual Art (1VA2)	PT1	Class taught with traditional method	PT2

3.1. Participants and Settings

The study was conducted with the participation of forty-four students, of which some were in the experimental group (n = 21), and the rest were in the control group (n = 23). The participants were first-year Visual Art students at the Bompata Senior High School in the Ashanti Region of Ghana. Prior to the commencement of the study, authorisation was given by the school administration and the Head of the Visual Art Department. The participants consented to partake in this study with verbal and written endorsements. In the Visual Arts Department, the classes are formed based on age, mixed-gender and mixed-ability approaches. The approach makes the various classes homoscedastic.

Notwithstanding, the selection of students into a class is made by stratification and randomisation by the school's authorities. During practicum in weaving, the two classes move to a common facility where the students are offered the practical studio session. In this study, two classes were used, with one group assigned as experimental and the other as the control group. Table 2 provides the sociodemographic details of the participating students.

Table 2. Sociodemographic characteristics of the forty-four participants.

		Control Group, *n* (%)	Treatment Group, *n* (%)	Total, *n* (%)
Gender	Male	11 (47.8)	10 (47.6)	21 (47.7)
	Female	12 (52.2)	11 (52.4)	23 (52.3)
Age	15–18	16 (69.6)	15 (71.4)	31 (70.5)
	19–22	7 (30.4)	6 (28.6)	13 (29.5)

3.2. Experimental Procedure

The intervention was conducted with a cohort of forty-four students in the second semester of the 2020/2021 academic year. Ten weeks were used for the intervention. However, the first week consisted of an introductory session in weaving processes and equipment delivered by the class teacher (lead author). The students also seized the opportunity to acquaint themselves and share their viewpoints to experience the best interaction and achieve success in the intervention. Students were exposed to the non-linear/interactive multimedia content (combination of text, graphics, video, audio and animation), assessment criteria, interaction channels and other course mechanics. The students recruited for this study were all residents on campus; hence, they were informed to access the multimedia content from the school's computer lab since they can have full internet connectivity in the lab.

3.2.1. The Flipped Classroom Approach

A lesson plan for the weaving topic was developed before the intervention as part of the flipped classroom didactic instructions. Interactive multimedia lessons and in-class resources for each week were developed following the lesson plan. An interactive multimedia app was designed and edited using Adobe Captivate, as shown in Figure 1.

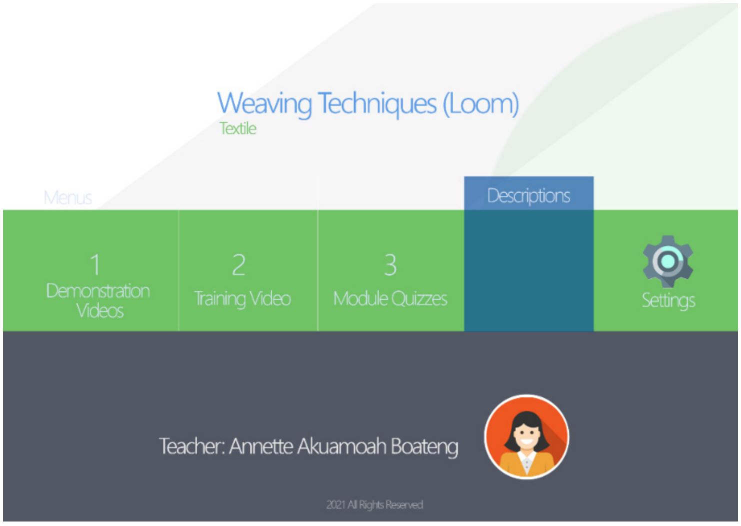

Figure 1. Multimedia app for the Weaving course.

Videos on the practical session of weaving topics were recorded with a camcorder and integrated into the interactive multimedia app. Other practical sessions of the topic which could not be recorded were animated with Adobe Edge Animate. The interactive multimedia app had four phases: the navigation menu, the demonstration (video lesson taught), training (interactive walk-through practice) and the assessment and automated feedback (text and audio). Moreover, the interactive multimedia app automatically sends email reports to the teacher based on each student's interaction with the app's content. The interactive multimedia content was made available on desktop computers at the ICT laboratory, and the lab assistant observed the students interact with the multimedia content. Other resources for the lessons were made available to the students three days ahead of time via the desktop computers in the ICT lab. The teacher consistently reminded the students of the resources deposited on the desktop computers weekly. Figure 2 below shows how the multimedia resources are shown in the app.

Figure 2. Demonstration videos for the Weaving courses integrated in the app.

Measures were taken to entice pupils to join the experimental group. Following the introduction phase, students who could not access the interactive multimedia content were requested to offer comments during the first session. This measure was taken to ensure the students' effective involvement. Additional modifications were made based on this feedback, including reiterating the flipped classroom approach's intents and requesting that anyone experiencing challenges accessing the content for whatever reason to contact the teacher. At the end of the semester, students were given an achievement to illustrate their knowledge and skills acquired.

3.2.2. Traditional Teacher-Centred Approach

The traditional teacher-centred lesson delivery starts with the teacher revising the previous knowledge with students. Therefore, the teacher revises the relevant previous knowledge of students. The teacher leads a class discussion on the topic "loom accessories" and demonstrates different types of weaving accessories for students to discuss their uses. The teacher guides students to draw some of the weaving accessories, after which a class exercise is given. Using the FC approach, a video on the topic (loom accessories) included in the interactive multimedia app is available at the ICT laboratory for students in the experimental group. After revising, students visited the ICT laboratory to watch the video. The students have the opportunity to watch the video as many times as they wish. Students were grouped after watching the video to discuss the content. The class was organised back together to share the individual group's work. Finally, the teacher leads a class discussion on weaving accessories and processes, after which an exercise is given. Examples of activities used to engage the students in the brick-and-mortar classroom include role-play and brainstorming.

As far as role-playing is concerned, students were presented with the case role-played following the course goals. To begin, volunteers were identified. When no volunteers were available, students were chosen by lot. The parts were assigned to selected students. Students were instructed to utilise their lines when portraying their characters, as long as they were pertinent to the situation. Students took up the responsibilities allotted to them. There was no involvement as long as they stayed within the parameters of the case objectives. Following role-playing, we solicited input from students who took on roles. Following that, students were asked questions related to the course objectives, their perspectives were solicited, and the session was rated.

During brainstorming, students were assigned a conversation starter (weaving accessories) corresponding to the course goal and teaching and learning resources supplied before class. A schedule was established (each topic of discussion was allotted 20 min). Due consideration was given to ensuring that each student had an equal opportunity to speak. The board was used to record all of the students' thoughts. When the flow of ideas ceased, the subject of the conversation was redefined. Students received feedback emphasising that their ideas were never incorrect, regardless of the circumstances. Following the debate, the ideas generated on the subject were reviewed and assessed. Table 3 below shows the main differences between the two pedagogical approaches.

Table 3. Comparison of traditional/teacher-centred and FC approach.

Flipped Classroom Approach	Traditional/Teacher-Centred Approach
The peers identify the necessary information, through research, interaction and collaboration. Teacher is a mentor/facilitator of this process	The teacher appears are the main source of information, who delivers content and "truths" to the students
The education process relied mostly on multimedia resources, pictures, infographics and technology-based learning materials	The education process relies mostly on textbooks and written notes
Reciprocal teaching method, where students are the protagonists, assessing their peers and their own work, providing feedback under the mentoring of the teacher	Despite the integration of interactive learning activities, the teacher is the only person who assesses (unidirectional teaching method)

The experimental processes are summarised in Figure 3 below.

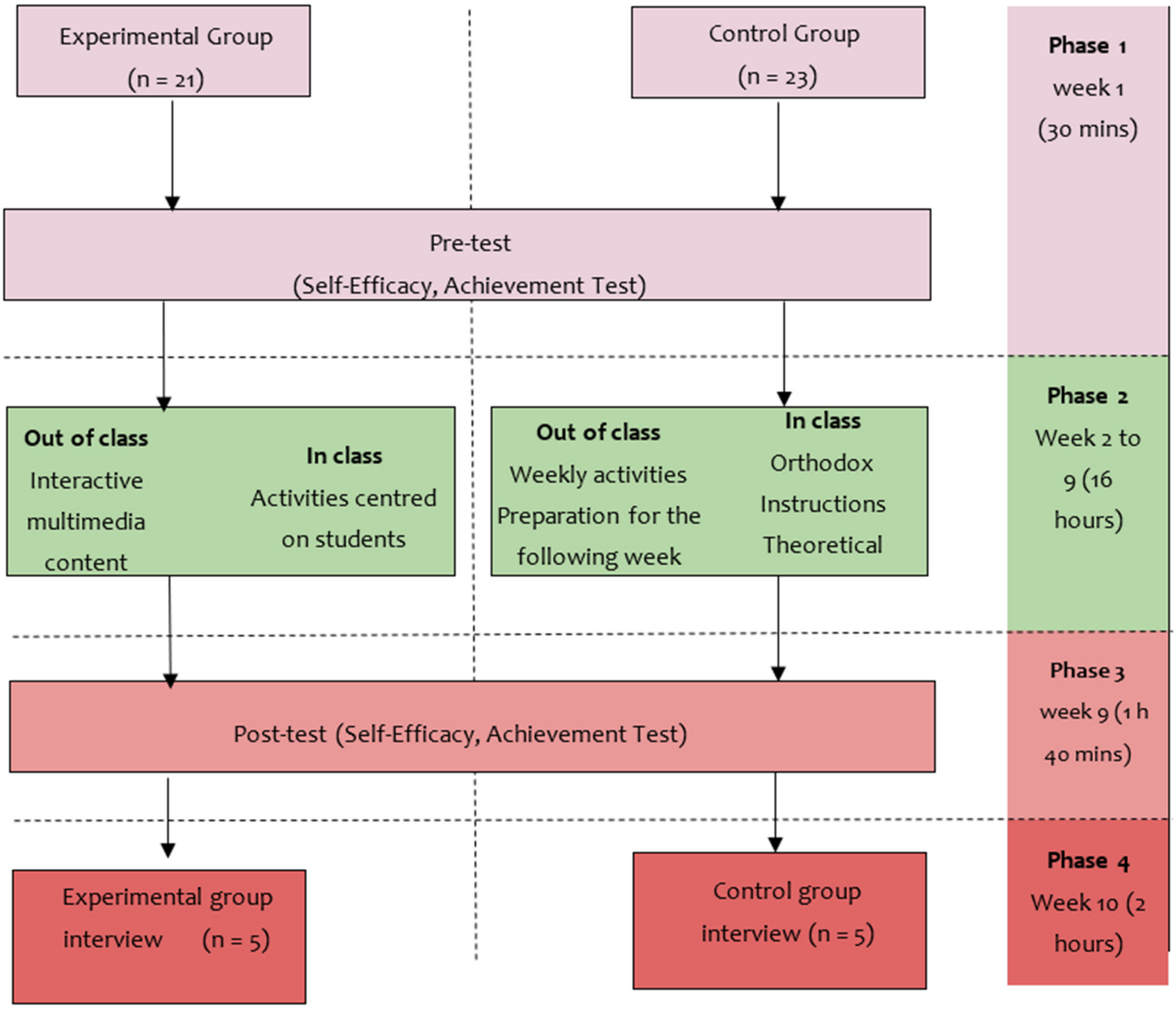

Figure 3. The experimental process of the study.

3.3. Data Analysis

Qualitative and quantitative data were garnered for data analysis in the study using a feedback form (semi-structured) and an achievement test, respectively.

3.3.1. Learning Achievement Test

The end-of-semester course achievement test measured the study's achievement on the experimental and control groups. The achievement test had two sections. The first section contained different types of objective questions of 25 items (multiple choice with single and double selection, matching, ranked order, and short answer type) totalling 100 points. The second section of the test was a studio-based practical examination where students weaved an item within a specified time space. The authors developed the test in conjunction with the teacher who taught the two cohorts. The total time estimate for the achievement test was 50 min; the first section had 20 min, and the second section had 30 min. We obtained internal consistency coefficients of =0.90 and =0.88 for the pre-test and post-test scores, respectively, using the Kuder Richardson-20 (KR20). The coefficients illustrate that the items in the tests were highly correlated. The authors developed the table of specifications based on Ghana Education Service (GES) standards to measure the content and construct validity of the test.

3.3.2. Self-Efficacy Scale

The 8-item self-efficacy scale for learning and performance extracted from the Motivated Strategies for Learning Questionnaire (MSLQ), developed by Pintrich et al. [31], was employed to measure the students' self-efficacy. Each item in the scale is measured on a 5-point Likert-type scale with point values varying between 1 coded as "Strongly disagree" to 5 coded as "Strongly agree". The original scale produced an internal consistency reliability of =0.93. This study obtained a Cronbach's alpha coefficient of =0.94 and a McDonald's omega = 0.94.

3.3.3. Feedback Form Guide

The researchers designed a feedback form to garner comprehensive data about the intervention, then administered it to the experimental group students to assess their perceptions of the flipped classroom. The group interview was held in a single sitting, with the participation of ten students (five from each cohort). One week after the experiment was performed, the discussion was held in person by the lead researcher. The form's purpose is to ascertain the students' adverse and assertive experiences with the flipped classroom intervention and their readiness to advance its use going forward. The researchers gave chocolates, snacks or candies to each student immediately after completing the group interview session as a token of appreciation.

3.3.4. Statistical Data Analysis

Jamovi version 2.0.0 with R Lavaan [32–35] were employed to analyse the data garnered from the students. All statistical significance for the present study was calculated while the estimated probability (p) was equal to or less than 5% ($p \leq 0.05$). Skewness and Kurtosis values were employed to estimate the normality of the data and obtained values between -1.93 and +1.93, which illustrated that the data is normally distributed. Levene's test was conducted to avoid violating homogeneity assumptions, and the test confirmed that the data was homoscedastic ($p > 0.05$). The researchers employed descriptive statistics such as means, standard deviations, frequency (f) and percentages (%) to represent students' sociodemographic profiles and course achievements. Pre-test scores (self-efficacy scale and learning achievement) were used as covariates, while post-test scores (self-efficacy scale and learning achievement) were employed as a dependent variable in the current study. After controlling for pre-test scores, post-test results were compared to observe whether research question 1 was valid for the experimental and control cohorts. As a result, the ANCOVA parametric data analysis test was run. ANCOVA estimated the post-test scores of the self-efficacy scale and learning achievement after controlling for the pre-test scores. The pre-test scores were controlled as the variance generated by pre-test scores of the cohort before the experiment does not modify the experimental process as the experimental and control cohort were not randomly arranged.

The researchers employed thematic analysis for the qualitative data analysis. One of the auxiliary researchers coded the data and then forwarded it to another coder for the second coding step. The Miles and Huberman [36] formula was applied to examine the reliability of the codes given by two coders. Regarding the formula ([consensus number]/[total consensus + number of disagreements]), the cumulative number of codes was split by the number of common codes, and the results yielded a reliability proportion of 0.91 (91%). We concentrated on the 0.9 (9%) variance, and it was acknowledged that this difference is typical for qualitative data interpretation.

4. Results

This section is divided in three sub-sections, covering all three research questions of the study.

4.1. Students' Self-Efficacy in FC Approach

Regarding students' self-efficacy, the sum of the pre-scale score was utilised as a covariate, while the post-scale score was used as the dependent variable. The assumptions of normality, linearity, homoscedasticity of regression slopes and homoscedasticity of variance have been thoroughly validated. The data recorded on students' self-efficacy for the EG was normally distributed (Shapiro–Wilk's test: $W(21)_{EG} = 0.970$; $p = 0.737$) while the data for the CG was not normally distributed (Shapiro–Wilk's test: $W(23)_{CG} = 0.908$; $p = 0.036$). ANCOVAs, on the other hand, are unaffected by this outlier because the distribution was close to normal (Pallant, 2020); hence, no measure was chosen to address this violation. Levene's test validated the homoscedasticity assumption with $F(1, 42) = 0.947$, $p = 0.442$. In addition, the ANCOVA was used to examine the post hoc test scores of the two cohorts after ensuring that [$F(1, 42) = 0.947$, $p = 0.442$] did not violate homoscedasticity of variance, and the homoscedasticity of regression slope. The ANCOVA test results [$F(1, 41) = 9.85$, $p = 0.003$] illustrated (See Table 4) that the FC approach (Mean = 32.70; SD = 3.87) yielded more significant results than the orthodox didactic teaching approach (Mean = 17.10; SD = 3.72). In addition, the FC approach was found to be more effective than orthodox didactic teaching at enhancing students' self-efficacy, regarding the adjusted means of the experimental (Adjusted m = 31.92) and control (Adjusted m = 18.29) groups. The FC approach significantly motivated students' self-efficacy, as the effect size ($\eta^2 p = 0.194$) was more than 0.138.

Table 4. Comparison of experimental and control groups' self-efficacy.

	Sum of Squares	df	Mean Square	F	p	$\eta^2 p$
Overall model	525.4	2	262.71	620.40	<0.001	
Self-Efficacy Score	500.3	1	500.27	196.05	<0.001	0.794
Cohort	25.1	1	25.14	9.85	0.003	0.194
Residuals	104.6	41	2.55			

4.2. Students' Learning Achievement in FC Approach

Regarding learning achievement, pre-test scores were manipulated as a covariate, while post-test scores were used as a dependent variable. The assumptions of normality, linearity, homoscedasticity of regression slopes, and homoscedasticity of variance have been thoroughly validated. Normality test was performed and the data for the experimental cohort was observed to be normally distributed (Shapiro–Wilk's test: $W(21)_{EG} = 0.970$; $p = 0.728$) as well as the data for the CG was not normally distributed (Shapiro–Wilk's test: $W(23)_{CG} = 0.988$; $p = 0.991$). Levene's test validated the homoscedasticity assumption with $F(1, 42) = 0.947$, $p = 0.336$. In addition, the ANCOVA test was used to examine the post hoc test scores of the two cohorts after ensuring that $F(1, 42) = 0.947$; $p = 0.336$ did not violate homoscedasticity of variance. The ANCOVA test results [$F(1, 33) = 182.80$, $p < 0.001$] demonstrated (See Table 5) that the FC approach (Mean = 81.23; SD = 3.26) yielded more significant results than the orthodox didactic teaching approach (Mean = 65.08; SD = 4.20). Furthermore, the FC approach was found to be more effective than orthodox didactic teaching at enhancing students' learning achievements, regarding the adjusted means of the experimental (Adjusted m = 82.8) and control (Adjusted m = 64.7) cohorts. The FC approach significantly motivated students' learning achievements, as the effect size ($\eta^2 p = 0.816$) was more than 0.138. Moreover, the FC approach has the potential to enhance students' learning achievement in textile weaving significantly.

Table 5. Comparison of experimental and control groups' learning achievement.

	Sum of Squares	df	Mean Square	F	*p*	$\eta^2 p$
Overall model	2671.14	2	1335.57	98.124	<0.001	
Achievement Score	2.15	1	2.15	0.147	0.703	0.001
Cohort	2668.99	1	2668.99	182.797	<0.001	0.816
Residuals	598.63	41	14.60			

4.3. Group Interviews

After the end of the semester, group interviews were performed with selected students from the two groups to garner their thoughts on the FC approach. For this study, we randomly selected five students from the experimental group and five students from the control group to interview about their learning experience with the FC approach. The group interviews had a total duration of 200 min, and the researchers made sure that everyone was actively involved in the discussion. Students were requested to appraise the FC approach's positive and negative traits during this interview. Researchers might then analyse how well it worked and whether any of the issues previously reported in the literature were also present during this particular implementation. Table 6 shows the coding results.

Table 6. Group interview coding results.

Themes	Coding	Item Frequency Experimental	Per Cohort Control
Self-efficacy	Interactive content assist in practicing a concept before in-person lesson	5	0
	Opportunity to play the Interactive multimedia content repeatedly	5	0
	Coming to class with understanding of the lesson	5	1
	Enhanced interaction in class	4	1
	Injects fun in the class	4	1
Learning engagement	Focusing on the assignment at hand	5	1
	Concentrating more intently on the class than previously	5	1
	Interesting in practice	4	0
	Actively analysing pertinent information	5	1
Additional feedback given	A new strategy for learning	3	0
	Challenging to take place in discourse in the textile weaving studio	3	5
	Feeling bored from lack of interaction with engaging content	0	2
	Overdependence on the Interactive content	2	0

4.3.1. Group Interview with Students of the Experimental Group

In this group interview, "advancing self-efficacy" and "supporting learner engagement" were two of the most commonly stated benefits of the FC approach by students in the experimental group. Regarding students' self-efficacy, most of them declared that adopting the FC approach helped them illuminate understanding by watching the videos before the in-class session and promoted their confidence in learning textile weaving thoroughly. FC's approach to learning engagement instilled deep motivation, enhanced students' knowledge of textile weaving processes, and allowed them to understand and be competent in several weaving approaches. The following are some examples of student statements conveying this sentiment:

> "In the beginning, it seemed strange to me that I would have to study before class. However, I now believe that the lessons I have learned on weaving will be with me for a long time to come."—Student 1

> "We were always at the studio practising weaving. Most of the points we did not get from watching the videos were addressed by the teacher. Repeatedly watching the videos allowed us to understand the topics of weaving."—Student 2

> "The multimedia content was very interactive, and the feedback was very useful. The system gave me access to other videos on the web when I needed extra information on weaving processes. Questions I could not find answers to were asked in class for the teacher to answer."—Student 4

> "It is more effective to learn through class discussion. Also, when I started studying during prep hours with the teacher's interactive multimedia content, I realised that I could take notes and ask questions about what I did not understand in class."—Student 5

4.3.2. Interviews with Students in the Control Group

The interview data demonstrated that most of the students in the control group perceived the orthodox instruction as a straightforward and uncomplicated method of imparting knowledge. Nonetheless, the students indicated that the limited instructional hours did not give them the opportunity to acquire knowledge and understand the skill of textile weaving. In addition, in- and after-classroom interaction between the students and the teacher was insufficient. The students also indicated that it was difficult to practice what the teacher taught in class since they did not have any reference resources to revisit what the teacher taught. Moreover, the students revealed that the teacher consistently demonstrated orthodox processes rather than state-of-the-art processes in textile weaving during class sessions. The following are some examples of student statements conveying this sentiment:

> "The teacher delivered a professional exposition to demonstrate the textile weaving technique. Although I can memorise the vast majority of educational material, I lack confidence when learning through the conventional teaching method because instruction appears to be disconnected from practical applications."—Student 7

> "I could still not answer several pertinent questions when I was given the loom to practice after attending the lessons on textile weaving."—Student 8

> "The resources in the studio are limited regarding the number of students always present. The teacher assisting everyone in the studio does not help considering the time available for learning. Something should be done about this situation."—Student 9

> "I did not enjoy the practical session teaching as there was no up-to-date resource for the subject. Getting extra resources for learning weaving was challenging."—Student 10

In a nutshell, most students acknowledged that the FC approach could facilitate deep learning and stimulate conceptual challenges associated with learning weaving processes in textile education. It is suggested that the non-linear multimedia content used for the FC approach should include virtual simulations to allow students to practice, especially in situations where students have limited access to physical resources. When the two groups were compared, it was realised that students who used the FC approach had knowledge and cognition of the learning content and comprehended how to involve that knowledge or unravel weaving complications through in-depth reflection. By contrast, people in the control group hesitated to integrate knowledge gained from the learning content. It is determined that interacting with the FC technique can assist students in correlating what they are learning to real-world issues, encouraging in-depth reflection.

5. Synthesis, Conclusions, Limitations and Recommendations

The study's main conclusion was that students in the experimental group who experienced instruction via the FC approach were more successful than students in the control group who experienced instruction via the conventional teaching-centred approach. According to the experimental results, the FC approach improved students' learning achievement in textile weaving knowledge and skill, learning experience, and self-efficacy. Although there is a dearth of literature regarding the FC approach in Textile Weaving processes, studies in other fields support our findings. Regarding learning achievement, the finding is in line with recent studies on flipped classroom approach [13–21,25]. While students' experiences in our study were generally positive, not all students thought the FC approach positively impacted learning, position which is supported in other research studies as well [37,38]. Thus, additional investigation is required to clarify this scenario by considering the numerous factors influencing students' learning achievement when using the FC approach [15].

A statistically significant gain emerged in students' self-efficacy when controlled for pre-test self-efficacy in the flipped classroom. The data indicate that the FC approach increased students' self-efficacy. This finding parallels a study by Dixon and Wendt [18]. Students expressed confidence in their ability to independently attempt and complete practical tasks assigned by the teacher. This finding echoes Bandura's (1977) definition of self-efficacy, which emphasises an individuals' belief in organising and carrying out actions to accomplish specific goals they have established [39]. Additionally, learning becomes more hands-on and interesting with the FC approach, as students can also put together and rethink their knowledge and skills. In general, it can be said that students' self-efficacy expanded because they had the chance to learn about textile weaving and practice the skill in depth by exploring pertinent information in the interactive multimedia content. Students are inclined to learn when they experience interesting and engaging learning activities [9] including hands-on events and tasks that facilitate teamwork [7]. As students attend face-to-face classes and ask their teacher questions about subjects or themes they do not understand in the flipped classroom, this condition increases student self-efficacy and academic achievement.

In general, this study's primary contribution is to give evidence for the effectiveness of using the FC approach in Textile Weaving processes. It should be noted that the adoption of the FC approach in conjunction with interactive multimedia content is insufficient in studio-based Visual Art education, more notably Textile education, in comparison to other fields. For ten weeks, an experimental and control group were taught a Textile Weaving technique utilising various learning approaches and classroom models. The findings of this study indicated that students' self-efficacy and learning achievement increased with the implementation of the FC approach in the Textile Weaving technique. Consequently, students' self-efficacy may extend by instructing Textile Weaving processes with the FC approach. Regardless, the intricacies of whether other characteristics such as critical thinking, reflective thinking, motivation or academic satisfaction affected students' learning achievement were not addressed, which could provide more acuity. This study's findings illustrate that implementing the FC approach in a Senior High School Visual Art class may be invariant with prior findings on student learning achievement (18, 26), which emphasised a 67 to 80% achievement levels. The findings of this study, regardless, reinforce that the FC approach may be useful to some student achievements, whereas extended studies are needed to determine the effectiveness of the FC approach in other Visual Art disciplines and devise more practical learning systems in the future as a critical issue. To acquire the skills needed for weaving in this control group, the focus of weaving is dependent on continuous hands-on practice and keen supervision from the teacher; in effect, more time is to be spent on weaving compared to the FC approach. The ability of the teacher will definitely be the yardstick for the students using the right approach since the skills of the students are limited to the skill of the teacher, void of exploring other possibilities.

However, it is worth noting that this study has some limitations. To begin with, students recruited for this study were only first-year students; subsequent studies may monitor students' development in other classes, allowing for the gathering of more empirical support of the FC approach across the practical sessions in Textile weaving processes. Due to the limited participation of first-year students, the FC approach to Textile Weaving knowledge cannot be extrapolated to other scenarios. Continued studies need to be conducted on the FC approach in other studio-based Visual Art disciplines and Textile Weaving practices to elicit additional evidence of its efficacy. Secondly, when adopting the FC approach in the future, a detailed coding analysis can be embarked upon after exporting the conversation content to examine further the aspects that affect students' learning efficacy. Thirdly, an additional limitation of the study is that it is undetermined whether individuals in the experimental group behaved differently, such as investing more time in watching videos or arriving prepared for class because they were aware of the alternative approach being utilised. When assessing the study's conclusions, it is necessary to consider the study's setting. Finally, Bandura's notion of self-efficacy has been employed in many different studies. It directs people's self-confidence in their ability to learn in an academic and non-academic context, both in general and in specific conditions [39]. However, the instrument used in this study only asked about the specific assignment for Textile weaving.

Several suggestions for future research are made based on the findings and discussion of this study. Textiles is the subject of this study. An extensive study might be conducted to evaluate the effects of flipped classrooms in other areas of Visual Art education. This study aimed to determine the approach's effectiveness through a small group intervention. Further research could determine the approach's viability and effectiveness in larger groups. It is critical to investigate the FC approach's success from various inclinations. Along with the emphases of the current study, which are learning successes, self-efficacy and learning experience, studio-based Visual Art practices have additional key purposes, including problem-solving competence, reflective thinking, critical thinking and learning engagement. Additional studies might be conducted to determine the long-term effects of the FC approach on knowledge retention and transfer to professional practice in Textile Weaving.

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