Using Consensus in Instructional-Decision Making Helps Improve Undergraduate Students' Attitude towards Biology

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Abstract – *The quality of science teaching the students experience is claimed to be the strongest influence in the development of positive attitude towards science, the sine qua non for its public appreciation. In this fully video-documented quasi-experimental study, the effect of using consensus in instructional-decision making on students' attitude towards Biology in undergraduate biological science class was tested. Covering the unit in bioenergetics, two classes were compared. One class was taught using conventional instruction while the other used the consensus process. In the consensus class, students raised an issue in the learning plan, negotiated, proposed an alternative, participated in a 'grand conversation', made decisions using consensus, and adhered to the agreed instructional activities. They were further grouped and were tasked to arrive at a consensus answer on a focus question related to the lesson discussed. Both classes were pre-tested and post-tested with the Attitude towards Biology Scale. Analysis of covariance showed that the intervention is effective in improving students' overall attitude towards Biology specifically in developing a positive perception of the biology teacher, improving keenness to learn Biology and enhancing enjoyment of the subject. Findings provide an empirical support on the use of consensus as an approach in instructional-decision making.*

Keywords – *instructional decision-making, consensus in the classroom, consensus, attitude towards Biology, undergraduate biology*

INTRODUCTION

Concerns about attitude towards science are not new. A phenomenon called "swing from science" was raised in the United Kingdom in the late 60's [1] and thenceforth, mounting evidence of the decline in the interest of young people in pursuing scientific careers continue to endure in many countries such that it becomes and remains an international trend [2]-[7].

Among the reasons implicated for this phenomenon [5] is the students' lessening interest in science and their disaffection with science and technology [8]. It has been argued that for any society attempting to raise its standards of scientific literacy, the decline of interest in science is a serious matter of social concern and debate because it poses a threat to a nation's future and economic prosperity [4]. It has also been recognized that the standards of a country's achievement and competitiveness are mainly based on a highly educated, well-trained and adaptable workforce [2]. Hence, economic performance has a positive relationship with the number of engineers and scientists produced by a society [9].

From these contexts, the development of positive attitude towards science among students becomes an important goal of science education [4],[10]-[16]. For one, holding positive attitude is positively related with increased enrollment in science courses, science achievement and interest in scientific careers [17]. Likewise, positive attitude generated through formal science education could result in public engagement with science which was claimed to be the *sine qua non* of the public appreciation of science [4]. Also, attitude is thought to predict individual's decision-making and action taking [18]. Unlike the often ephemeral nature of knowledge, attitudes, once formed, are enduring and difficult to change [4],[19]. However, the concept of attitude towards science is somewhat nebulous, often poorly articulated and not well understood [4] hence further investigation about it is current and relevant, particularly in an undergraduate biology class.

Several studies point towards the influence of classroom environment as a significant determinant of students' attitude towards science, subject choice [4] and the tendency to continue with science education after high school [20]. Of these, effective pedagogy

[21] or the quality of science teaching the students experienced [22] is claimed to have the strongest influence. For instance, one of the most common reasons given by students for liking or disliking a subject were teacher-related comments [23]. Positive attitude towards science is found to be associated with a classroom environment with a high level of involvement, very high level of personal support, strong positive relationship with classmates, and one that uses a variety of teaching strategies and unusual learning activities [24]. The following variables were found to explain why students' attitude toward science differs from each other: (a) nature of the teacher-pupil interaction in the science classroom, (b) teacher's patterns of communication with individual pupils and groups of pupils, (c) transmission of the teacher's expectations to the pupils, (d) topics that are covered in the lesson, and (e) strategies and tactics within strategies adopted by the teacher [25]. It was also advanced that in an environment when students have opportunities to take control of their learning and to enhance their role for personal autonomy, student engagement improves [26],[27].

These features of a classroom environment that students desire are reflective of an emerging teaching approach that is based on the concept of consensus, a decision-making model utilized by organizations, communities, and groups in coming to a unanimous decision, one that works for everyone. Adapters of this approach premised their arguments on the core idea that students' voices are often left out in their own educational process as they are silenced by the authoritarian, top-down classroom models. They claim that these undemocratic practices discourage optimal students' engagement and block their innate desire to learn [28],[29]. Recognizing the promises and claims of this emerging approach, this investigation put together the two prominent consensus models in classrooms reported in research literature – whole class consensus [28]-[31] and consensus within groups in the context of a lesson [32],[33].

While there are several studies that gave students the opportunity to negotiate and co-construct with teachers the plans and designs of instruction, very few however categorically mentioned that the consensus process was used in making those instructional decisions. Some other studies employed the consensus process, not in making a whole class decision but in the context of a classroom lesson within small groups. Most notably, findings of studies thus far about the benefits and effects of consensus and its variants are limited to the investigators' self-contained classrooms. This setup can inevitably cast reservations as to the generalizability of the reported benefits. There was never a structured and objective attempt to investigate and test the effects of the consensus process using a comparison group, particularly on students' attitude towards the subject. This study is perhaps, one of the very first attempts that developed a protocol in conducting a consensus-based instructional decision-making process in Biology and empirically tested its effectiveness against the prevailing instructional approach.

OBJECTIVES OF THE STUDY

This study aimed to determine whether or not the use of consensus in instructional decision-making can improve the undergraduate students' attitude towards Biology (ATB). Specifically, it compared two classes, one taught using the conventional instruction while the other used the consensus process, in terms of their overall mean scores in ATBS and its components such as importance of Biology, interest in biology lessons, perceptions of the biology teacher, keenness to learn Biology, enjoyment of Biology, anxiety towards Biology, and effort in learning Biology.

METHODS

Development, Validation, and Reliability Testing of the Attitude towards Biology Scale

The Attitude towards Biology Scale (ATBS) is a 51-item researcher-made instrument containing statements of students' feelings towards biology. Students' degree of agreement with each statement was measured along a four-point Likert type scale, 1 as strongly disagree, 2 as disagree, 3 as agree, and 4 as strongly agree. Items were lifted from research literature which covered components of students' attitude towards Biology such as specific feelings towards Biology, motivation to achieve in Biology, biology anxiety, attitude towards biology teacher, attitude towards biology curriculum, keenness to learn Biology, enjoyment in biology learning, disinterest, teacher interaction, importance of Biology, interest in biology lessons and understanding of biology processes. The original draft of the instrument had 66 items but was increased to 67 after it was submitted to three biology education experts for validation. Their suggestions were incorporated in the preparation of the instrument's second draft.

To extract the components of students' attitude towards biology, the revised scale was pilot-tested among 365 freshmen students who had just taken biological science course during the preceding semester from the College of Education, and College of Arts and Sciences in a Philippine state university in the MIMAROPA region. This sample size overly satisfied the desired ratio to run an exploratory factor analysis - that is to have five observations per variable [34] which would have been 335 samples only for a scale of 67 items. The instrument was scored in favor of the affirmative, hence, students' ratings in negative statements were scored in reverse.

When exploratory factor analysis was performed, preliminary data screening revealed a Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy value of 0.896, which is interpreted as a meritorious distribution of values, adequate to conduct the procedure [35]. Based on the computed significance value of Bartlett's Test of Sphericity which is less than 0.05, the distribution was approximately multivariate normal and did not produce an identity matrix. Thus, the data were acceptable to run the procedure.

Table 1. Structure and Reliability of the Attitude Towards Biology Scale

Factor	Label	Nos. of items	Item Placement	α
1	Importance of Biology	10	1, 2, 4, 7, 27 31, 39, 45, 46, 48	0.862
2	Interest in Biology Lessons	8	8*, 19*, 22*, 23* 30*, 38*, 42*, 44*	0.830
3	Perceptions of the Biology Teacher	8	21, 25, 35, 40 41, 43, 47, 51	0.846
4	Keenness to Learn Biology	8	10, 17, 18, 20 28, 29, 33, 36	0.817
5	Enjoyment of Biology	8	3, 5*, 6, 15 24, 26, 32, 37	0.820
6	Anxiety Towards Biology	5	9*, 11*, 14* 16*, 50*	0.764
7	Effort in Learning Biology	4	12, 13, 14, 49	0.790
Total		51		
Whole-Scale Reliability				0.922

* negative statement, scoring reversed

Using Principal Component Analysis as the extraction method and Varimax with Kaiser Normalization as the rotation method, 16 factors were extracted. Since the sample size exceeded 350, a factor loading of 0.30 and above was used as the basis for selecting the items that clustered on a specific factor [34]. But further analysis revealed that only nine out of the 16 factors have items that indicated some plausibility and rationale for clustering. Of these nine, only seven passed the second screening, which was the reliability test for each factor ($\alpha > 0.7$). This gave rise to the final structure of the 51-item scale (Table 1) which generated a Cronbach's alpha value of 0.922 for the whole test, an excellent scale [35]. The factors were labeled as informed by literature and in consultation with experts.

Aside from ATBS, video-recorded class sessions, researcher's journal and informal interviews with students were the other data sources.

Research Design

With the consent and approval of the key officials of the institution where the investigation was conducted, two intact classes of college students enrolled in NatSci 102 (Biological Science) at the College of Business and Accountancy in a state university in the MIMAROPA region of the Philippines participated in this investigation which covered the unit in bioenergetics (metabolism, photosynthesis and cellular respiration) that lasted for 12-hour class sessions spanned over six weeks. They were chosen on the following bases: same academic program, same classroom, comparable class size to achieve the 30 actual samples needed for comparative analysis, and similar day yet comparable time schedule.

With the approved consent of the administration of the University, the researcher took over the classes only during the bioenergetics lesson. One class used consensus in making instructional decisions while the other class employed the prevailing decision-making approach which was mainly based on the teacher's judgment. As to which class would use consensus was randomly assigned. The non-equivalent pre-test-post-test control group quasi-experimental research design was utilized because randomly assigning the students to each group was impossible as this would distract the structure and schedule of classes in the college where the investigation was made. Before the intervention was introduced, four dry-run sessions were conducted for orientation, familiarization, and acclimatization to the video-recording device. Both groups were tested before and after the intervention using the same version of ATBS.

The Consensus Process

The consensus class used consensus process (Fig. 1) in making decisions related to biology instruction. In this class, students were first oriented about the use of consensus in making instructional decisions both involving the whole class and in small groups. Then the learning plan for bioenergetics was presented. Following a modified learning needs analysis protocol [29], students negotiated the teacher-prepared learning plan by raising an issue, negotiating and proposing an alternative, engaging in a 'grand conversation' where students and teacher brainstormed, discussed and built upon each others' ideas, calling for a consensus decision, and adhering to the agreed process [36]. The ultimate purpose was to come up with a decision that would work for everyone including the teacher.

In making a consensus decision, three hand gestures were used: raised open hand for yes; close-open for abstain; and closed fist for block. Those abstaining and blocking were asked, "What one thing would you want to change in order for you to support the decision?" If consensus was attained, the class adhered to the agreed process, otherwise, the grand conversation would continue. Modification or change to the general agreement required another round of consensus process.

In the conventional class, the researcher adhered to the developed learning plan and relied on his own judgment of what he thought was the best way to deliver the topics without asking any input from the students. The students were not allowed to negotiate their learning needs, difficulties and preferences. Thus, all of these aspects remained as teacher's assumptions. Table 2 shows the comparison of instructional activities between the consensus and conventional classes.

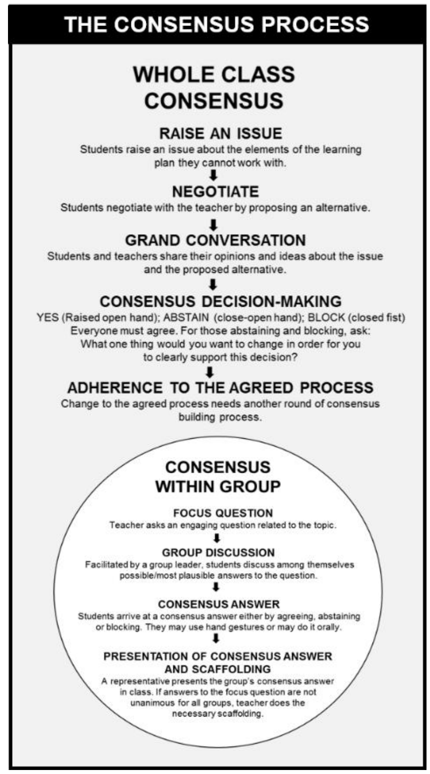

Fig. 1. The consensus process.

Table 2. Comparison of Instructional Activities between Consensus and Conventional Classes

Instructional Activities	**Consensus Class**	**Conventional Class**
Pre-instructional activities and acclimatization to video-recording device		
Pre-test	Attitude towards Biology Scale (ATBS)	
▪ Orientation	Introduction of the use of consensus in making instructional decisions, both whole class and within group consensus. Presentation of the learning plan in bioenergetics. ▪ Negotiation of the learning plan following the suggested whole class consensus process: ▪ Raise an issue ▪ Negotiate ▪ Grand conversation ▪ Call for a consensus ▪ Adhere to the agreed process ▪ Consensus within group ▪ Focus question ▪ Group discussion ▪ Consensus answer ▪ Presentation and scaffolding	Presentation and discussion of the learning plan in bioenergetics. ▪ The learning plan was good as approved. ▪ Students were not allowed to negotiate any part of it.
▪ Negotiation of Learning Plan through Consensus	Items of LP negotiated through consensus: ▪ Medium of education: *Taglish* (mix of English and Filipino) ▪ Checking of attendance: Students sign on the attendance sheet. ▪ If with a valid excuse, the student with absence will not be deducted points. ▪ If with a valid excuse, students' requirement will still be accepted and not be graded zero. ▪ Alphabetical seat plan.	▪ English ▪ The teacher checked the attendance. ▪ One point deduction per absence, excused or unexcused. ▪ Non-acceptance and zero grade for requirement

Instructional Activities	Consensus Class	Conventional Class
	▪ Use of *stootsies* (scorecards which the teacher can easily dispose of in appraising the quality of students' answers. During recitation, the teacher gives the appropriate scorecard that matches the quality of students' answers. The latter just sign their names on the scorecard). ▪ Suggested teaching strategies: trivia, video clips, games, observation activities with worksheets which can be done at home, experiment and hands-on activities, and slide presentation of quizzes with accompanying visuals.	submitted late. ▪ Alphabetical seat plan. ▪ Use of teacher signature in recitation cards. ▪ Pure lecture with a slide presentation. ▪ Quizzes were also administered with a slide presentation.
▪ Implementation of the Learning Plan (Trial)	▪ Instruction was based on the agreed process with additional group consensus activities within the group. ▪ Review of Cell Structures o *Trivia:* What is the largest known cell? o *Video clip with worksheet*: Overview of cell structures o *Consensus group activity (CGA) #1*: Make a consensus group decision about the Top 3 most important structures that are necessary for the cell to survive. Support your decision with convincing reasons.	▪ Based on the teacher-prepared learning plan.
Instructional Activities		
Implementation of the Learning Plan in Bioenergetics	▪ <u>Metabolism</u> o *Video clips:* metabolic pathway; feedback inhibition o *Trivia:* Do you know that those spicy foods can boost your metabolic rate? o *CGA#2:* Based on the video-based experiment, in which cup do you think will the gelatin NOT solidify? Support your decision with what you have learned about the enzymatic activity. ▪ <u>Photosynthesis</u> o *Trivia:* Do you know that the pea aphid is the only insect that is capable of photosynthesis-like energy production? Do you know that the enzyme RUBISCO is just an acronym? o *Video clips:* Light-dependent and light independent reactions. o *Game:* Peel me, I peel you! o *CGA#3:* Which of the materials needed for photosynthesis do you think is converted to plant's food and contributes most to plant's mass? Why do you think so? (10 mins.) ▪ <u>Cellular Respiration</u> o *Trivia:* Do you know that the mitochondrion has a limited amount of DNA? Do you know that yeasts are very important in beverage and baking industries? o *Video clips:* Glycolysis, transition reaction, Krebs cycle and electron transport chain. o *Other visuals:* Use of lego pieces and post-it notes in illustrating the oxidation of glucose by NADH and $FADH_2$ and production of ATP. o *Game:* Traffic lights o *CGA #4:* Do you think plants also oxidize glucose to release energy (cellular respiration)? Why or why not? Be scientific in your consensus answer. o *Experiment:* Swell Lab: Experiment on yeast fermentation o *CGA #5 (During the yeast experiment):* What do you think will happen to the balloon in each bottle? Why do you think so?	▪ Based on the teacher-prepared learning plan.
▪ Poster making (learning outcome)	▪ Evaluated based on criteria generated through whole class consensus.	▪ Based on the criteria set by the teacher.
▪ Post-test	ATBS	

Participants

The participants in this study were all taking up BS Business Administration. The consensus class was composed of 54 students,7 males, and 47 females. However, after those with incomplete data and absences were excluded, all males were forced selected as samples while 23 females were randomly chosen to represent the 30 representative samples from the consensus class in the comparative analysis.

The conventional class, on the other hand, was composed of 64 students, 19 males, and 45 females. After the exclusion criteria, only 8 males and 26 females emerged as qualified samples. From these, the 30 samples (7 males and 23 females) to represent the conventional class in the comparison analysis were randomly chosen. The mean age of actual samples in the consensus class was 17.10 years while in the conventional class was 17 years.

Data Analyses

Differences in attitude between the two classes were analyzed with Analysis of Covariance (ANCOVA) using pre-test scores as covariates. All analyses were conducted using IBM SPSS statistical software, version 16.0. All comparisons were considered significant at $p< 0.05$. Data are presented as means ± standard deviation (SD). Supporting qualitative evidence were analyzed using open and axial coding procedures and presented thematically to support the results of the quantitative analysis.

RESULTS AND DISCUSSION

Students in the consensus class have higher overall pre-test mean scores in ATBS (2.91) as well as in the four components of the scale: TEACH1 (3.00), KEEN1 (2.78), ANXIETY1 (2.97) and EFFORT1 (3.31). Whereas, students from the consensus class scored higher than the conventional group in the following components: IMPT1 (3.29), INT1 (3.02), and ENJOY1 (3.06). However, after the intervention, all the components and the overall post-test mean scores of the students from the consensus class were observed to be higher than the conventional class (Table 3).

ANCOVA showed significant differences between the two classes in the following attitudinal components: perception of biology teacher ($F=9.164$, $p=0.004$), keenness to learn Biology ($F= 4.455$, $p=0.039$), enjoyment of Biology ($F=5.538$; $p=0.022$) and overall attitude towards Biology ($F = 5.187$, $p = 0.027$). None of the differences between the two classes in the rest of the attitudinal components were significant (Table 4).

Table 3. Comparison of Student Scores Between Classes (mean ± SD)

Attitude Towards Biology	Pre-test Score	
	Consensus Class (*n = 30*)	Conventional Class (*n = 30*)
Importance of Biology (IMPT1)	3.17 ± 0.39	3.29 ± 0.20
Interest in Biology Lessons (INT1)	3.01 ± 0.57	3.02 ± 0.43
Perceptions of the Biology Teacher (TEACH1)	3.00 ± 0.27	2.86 ± 0.28
Keenness to Learn Biology (KEEN1)	2.78 ± 0.33	2.71 ± 0.28
Enjoyment of Biology (ENJOY1)	2.94 ± 0.35	3.06 ± 0.39
Anxiety Towards Biology (ANXIETY1)	2.97 ± 0.58	2.86 ± 0.46
Effort in Learning Biology (EFFORT1)	3.31 ± 0.43	3.30 ± 0.39
Overall Pre-test Mean Score (PREATB)	2.91 ± 0.27	2.87 ± 0.18
	Post-test Score	
Importance of Biology (IMPT2)	3.35 ± 0.32	3.19 ± 0.42
Interest in Biology Lessons (INT2)	3.21 ± 0.40	3.10 ± 0.54
Perceptions of the Biology Teacher (TEACH2)*	3.08 ± 0.31	2.79 ± 0.31
Keenness to Learn Biology (KEEN2)*	2.81 ± 0.28	2.64 ± 0.28
Enjoyment of Biology (ENJOY2)*	3.07 ± 0.28	2.88 ± 0.41
Anxiety Towards Biology (ANXIETY2)	3.02 ± 0.41	2.88 ± 0.41
Effort in Learning Biology (EFFORT2)	3.23 ± 0.36	3.13 ± 0.57
Overall Post-test Mean Score (POSTATB)*	2.98 ± 0.19	2.83 ± 0.29

** ANCOVA analysis shows significant difference between the two classes.*

Table 4. ANCOVA Test of Between Subject Effects

Dependent Variable	Source	Type III Sum of Squares	df	Mean Squares	F	Sig.
IMPT2[a]	Corrected Model	.416[a]	2	.208	1.483	.235
	Intercept	4.509	1	4.509	32.18	.000
	CV: IMPT1	.066	1	.066	.472	.495
	TREATMENT	.395	1	.395	2.821	.099
	Error	7.988	57	.140		
	Total	650.108	60			
	Corrected Total	8.404	59			
INT2[b]	Corrected Model	2.516[a]	2	1.258	6.741	.002
	Intercept	6.202	1	6.202	33.23	.000
	CV:INT1	2.327	1	2.327	12.47	.001
	TREATMENT	.206	1	.206	1.101	.298
	Error	10.640	57	.187		
	Total	610.082	60			
	Corrected Total	13.156	59			
TEACH2[c]	Corrected Model	1.637[a]	2	.819	8.821	.000
	Intercept	2.079	1	2.079	22.40	.000
	CV: TEACH1	.402	1	.402	4.328	.042
	TREATMENT	.850	1	.850	9.164	.004
	Error	5.290	57	.093		
	Total	522.548	60			
	Corrected Total	6.927	59			
KEEN2[d]	Corrected Model	.782[a]	2	.391	5.415	.007
	Intercept	2.924	1	2.924	40.49	.000
	CV: KEEN1	.371	1	.371	5.130	.027
	TREATMENT	.322	1	.322	4.455	.039
	Error	4.117	57	.072		
	Total	449.837	60			
	Corrected Total	4.899	59			
ENJOY2[e]	Corrected Model	.831[a]	2	.415	3.541	.036
	Intercept	4.910	1	4.910	41.86	.000
	CV: ENJOY1	.304	1	.304	2.595	.113
	TREATMENT	.650	1	.650	5.538	.022
	Error	6.686	57	.117		
	Total	537.365	60			

Dependent Variable	Source	Type III Sum of Squares	df	Mean Squares	F	Sig.
	Corrected Total	7.517	59			
ANXIETY2[f]	Corrected Model	2.377[a]	2	1.188	6.474	.003
	Intercept	6.573	1	6.573	35.81	.000
	CV: ANXIETY1	1.960	1	1.960	10.68	.002
	TREATMENT	.252	1	.252	1.370	.247
	Error	10.463	57	.184		
	Total	530.280	60			
	Corrected Total	12.839	59			
EFFORT2[g]	Corrected Model	.278[a]	2	.139	.609	.548
	Intercept	7.010	1	7.010	30.72	.000
	CV: EFFORT1	.128	1	.128	.560	.457
	TREATMENT	.145	1	.145	.637	.428
	Error	13.010	57	.228		
	Total	618.125	60			
	Corrected Total	13.288	59			
POSTATB[h]	Corrected Model	.529[a]	2	.264	4.613	.014
	Intercept	1.762	1	1.762	30.75	.000
	CV: PREATB	.185	1	.185	3.233	.077
	TREATMENT	.297	1	.297	5.187	.027
	Error	3.267	57	.057		
	Total	510.370	60			
	Corrected Total	3.796	59			

a. R Squared = .049 (Adjusted R Squared = .016)
b. R Squared = .191 (Adjusted R Squared = .163)
c. R Squared = .236 (Adjusted R Squared = .210)
d. R Squared = .160 (Adjusted R Squared = .130)
e. R Squared = .111 (Adjusted R Squared = .079)
f. R Squared = .185 (Adjusted R Squared = .157)
g. R Squared = .021 (Adjusted R Squared = -.013)
h. R Squared = .139 (Adjusted R Squared = .109)

Non-Significance of Differences in Four Attitudinal Components

The two classes did not significantly differ in the four components of attitude towards Biology: importance of Biology, interest in biology lessons, anxiety towards Biology, and effort in learning biology lessons. For the component 'importance of biology', the non-significant difference is probably brought about by a 0.10 point decline in post-test mean in the conventional class (from 3.29 to 3.19) and a 0.18 point increase in post-test mean in the consensus class (from 3.17 to 3.35).

This opposing trend could have counterbalanced the mean difference between the two groups but was not sufficient enough at attributing such variation to the instructional approach used in Biology. The teacher also made it a point to integrate the relevance and usefulness of learning the topics in their daily lives in both groups whenever applicable. Likewise, both groups could have an inherent appreciation of the importance of Biology, regardless of the instructional approaches used because many problems and challenges the world faces today are biology-related such as medical advancements, environmental degradation, climate change, GMOs and the like. These are usually featured in mass media to which both groups could have been exposed. Moreover, today's age is also named by scientists as the century of Biology. This supports the argument that generally students tend to develop positive attitude towards science in the context of the society [22],[37],[38].

While the use of consensus process has been reported to create engaged students [39] to a higher level [28], this engagement was not translated in this investigation into a higher interest in biology lessons than those taught in a conventional way. Probably, interest was triggered by factors other than using consensus. For example, one of the students in the consensus class reflected upon the important role of the teacher in making the topic less boring:

> Bioenergetics is not a boring topic because our teacher makes some activities that make us happy. Example of this is the experiment time, trivia, games and participation/recitation with corresponding points. In that way, I consider that bioenergetics is a very interesting lesson.

In the above student's reflection, it can be deduced that what makes bioenergetics an interesting lesson is because of the activities that were done by the teacher. These activities, however, were the results of the whole-class consensus decision about the negotiated learning plan. But from the perspective of this student, interest in biology lesson was mediated by the teacher. Moreover, both groups were exposed to slide presentation using a LED TV and used similar module on bioenergetics, thus arousing students' interest and probably offsetting the effect of the instructional approach.

It has been reported in literature that the consensus process can mitigate the effect of threats, stress, and anxiety among learners [28]. In this investigation, this suggested effect, however, was not evident. Nevertheless, the researcher observed that in the conventional class, there were occasional blank stares and yawns probably brought about by the strict use of English as a medium of instruction. A loss of interest in attending classes was also observed evidenced by several unexcused absences incurred by students in the conventional class (47 times) than in the consensus class (7 times). In the conventional class, the frequency of absences ranged from one to four times. These were committed by 21 students, 8 males, and 13 females. In the consensus class, on the other hand, frequency of absences ranged from one to three times which was recorded only to be incurred by five female students.

One of the probable reasons why the two groups did not differ in this aspect of comparison is that those students who were frequently absent in the class taught the conventional way were removed from the qualified sampling frame. Their data were excluded in the analysis and thus were not reflected in the findings. When this concern was validated with the subject teacher, she mentioned that such degree of truancy was not apparent in the conventional class prior to the experiment. While attributing truancy to instructional approach is less conclusive, the researcher suspected that it was probably brought about by the teacher-centered policies and many autocratic decisions implemented in the conventional class. Interestingly, it has been claimed that behavior problems like the one presented erstwhile are minimized when students engage in productive dialogue with guidance and structure provided by the teacher [33].

The decline in effort in learning Biology from pre-test to post-test both in the consensus (from 3.31 to 3.23) and conventional classes (from 3.30 to 3.13), with the latter decreasing more (0.17) only shows that improving students' efforts in learning Biology is not a function of instructional approach but possibly of other factors such as motivation, self-drive, and the like. Bioenergetics is a challenging topic and given the same set of modules, assignments and slide presentation materials, students from both classes might have exerted comparable efforts in doing their best in learning Biology.

On Improving Students' Attitude towards Biology through Consensus

Significant differences favoring the use of consensus in instructional decision-making in a biology classroom were seen in three attitudinal components as well as the students' overall attitude towards Biology. For the component 'perception of the biology teacher', the positive perception after implementing the intervention is consistent with the claims of the pioneering proponents of using consensus in the classroom, that consensus requires and creates a paradigm shift in a teacher's relationship with his or her students and in students' relationship with each other [28]. They believe that through consensus, teachers can gain a broader understanding of their students' needs, abilities, and concerns which they can consider in teaching. The result also strengthens the position that one of the most common reasons given by students for liking or disliking the subject were teacher-related comments [23]. Perhaps, the democratic and consensual manner of identifying learning needs and difficulties and addressing them based on the agreed process in the consensus class created a feeling of trust, thereby developing a better perception of the teacher. The issue on student's trust on the teacher was emphasized as an essential requisite for consensus in the classroom to work [28]. Students in the consensus class point to the positive perception of their teacher's competence, pedagogical skills, and motivating skills.

Students' keenness or eagerness to learn Biology is significantly higher in the consensus class than in the conventional class. When students know that what has been agreed is implemented and when they feel comfortable at speaking up on different issues that may affect their learning, it was observed that they show eagerness in learning more about the topic by having regular study schedule, doing home works and reviewing lessons. Consistent with this finding were the researchers' observations that involving students in the consensus process allows them the creativity to work together to fulfill their own learning goals within a group dynamics [29],[31]. This finding also corroborated the accounts that students in the consensus classroom were developing personal authority and responsibility of their own learning [28] and the consensus process improves their ability to apply learning to new contexts [31].

Based on the reports made in literature, the use of consensus is expected to heighten students' engagement and full-participation thus fostering a lively learning community [28]. This claim is supported by the findings of the current study because students in the consensus class enjoy more in learning Biology as compared to those in the conventional class. This also confirms the observation that students get excited if course content is reflective of their interests and is connected to their daily lives [29]. Likewise, the result is a proof that achieving optimal engagement is not difficult when learners have something to say in the most basic structure of a course. This also supports the observation that students experience apparent satisfaction when their individual needs and interests are incorporated in their learning [31]. It also confirms the proposition that the learning environment provided by the consensus class gives students opportunities to take control of their learning and enhance their role for personal autonomy [4],[26].

From the reflective comments of the students in the consensus class, they pointed out that the consensus group activities, decision-making activities that everyone can support, teacher's adherence to the negotiated elements of the learning plan, the democratizing process of consensus, the opportunity for self-expression, and student-teacher interactions were among those that gave them sense of enjoyment.

That the overall attitude towards Biology is significantly higher in the consensus class is of interest because the current study is one of the few attempts that empirically tested the effect of the consensus process, since most reports about its benefits originated only from the investigators' self-contained classrooms.

In the literature, the importance of developing positive attitude towards science is an uncontested goal of science education. These positive attitudes could result in the public engagement with science which is argued as the *sine qua non* of the public appreciation of science [4]. In the context of this investigation, the use of consensus in instructional decision-making is a strategic response to reports in literature [4],[24]-[26] about the kind of classroom environment that can develop positive attitude in science in general, and in Biology in particular such as high level of involvement, very high level of personal support, strong positive relationship with classmates, the use of variety of teaching strategies, and unusual learning activities. These ideals of a learning environment are actually the major features of the consensus classroom. In addition, the variety of teaching strategies and learning activities in the consensus class are products of the consensual decisions of the students and teachers – decisions that everyone in the class can support and work with. On top of the cognitive demands required to learn science content, the use of consensus provides students an opportunity for a productive student-to-student dialogue. With the findings of this experiment, the use of consensus in instructional decision-making can be proposed as a workable and sustainable solution to remediate the international trend on students' declining attitude towards science. The reflection of a student below is a compelling proof of the adoption of this approach.

> Based on what we experienced in our bioenergetics class using consensus, I can easily say that this is very effective. It tightened our relationship as classmates and it strengthened our unity. Using consensus can improve and help everyone express their thoughts and ideas freely and learn how to negotiate and interact with others.

This account concretizes the value of using consensus as an instructional decision-making that embodies inclusiveness, cooperation, collaboration, maximizing agreement, relationship building and respect for all viewpoints [40].

Study Limitations

Since the investigation is a quasi-experiment conducted only in one learning unit, the results must be interpreted in the light of this constraint. Although careful measures were done to equate the two classes in several factors such that they only differed in the use of consensus, the possibility that the inadequate dosage of intervention resulting in the non-significance of difference or the novelty effect resulting in the positive results cannot be discounted.

CONCLUSION AND RECOMMENDATION

This study empirically established the use of consensus process in instructional decision-making as an effective approach to improving the general attitude of undergraduate students towards Biology. The open environment in a consensus classroom, whether in the context of whole class or within groups, where students can freely express their ideas, raise issues, propose alternatives, negotiate, engage in grand conversations, participate in consensus decision-making and adhere to the agreed process is reflective of a constructivist, context-based, democratic and postmodern pedagogy. Likewise, consensus can effectively develop attitudinal components which are crucial precursors towards public appreciation and engagement with science such as a positive perception of the biology teacher, keenness to learn Biology, and enjoyment of the subject. Since this investigation covers only one unit, the sufficiency of the dosage of intervention cannot be ascertained. Thus, a similar semester-long or year-long experiment is recommended.

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