AJOTE
African Journal of Teacher Education
ISSN 1916-7822. A Journal of Spread Corporation

Volume 10. No. 2 2021 Pages 144-163

Enhancing Students' Attitude towards Biology through the Integration of Traditional Medicine and 5E's Learning Cycle

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Abstract

The study investigated the effect of integrating traditional medicine (TM) concepts with grade 9th microorganism and disease topics on students' attitude towards biology. The study used a quasi-experimental pretest, posttest non-equivalent group design. two intact classes were selected in Chiro district of Oromia Regional State, Ethiopia. The first class belonged to the treatment group where TM contents are integrated through 5E's learning cycle with the topic Microorganism and Disease and the second was assigned as comparison group learning the same biology unit on Microorganisms and Disease using the usual approach. Biological Attitude Questionnaires (BAQ) was administered for both groups as pre- and post-tests. The findings showed that the integration of TM with the school biology enhanced students' attitude towards biology as compared with teaching the topics without integration.

Keywords: traditional medicine, microorganism and disease, 5E's learning cycle, attitude towards biology.

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Introduction

The Ethiopian Government has given great emphasis to Science, Technology, Engineering, and Mathematics (STEM) education. Accordingly, a ratio of 70:30 has been advocated, i.e., to enrol 70% of students in science and technology fields (MoE, 2012). This emphasis on science and technology was designed to help fill the gap for the scarcity of professionals in the construction, industry, and health care sectors. However, these objectives have not been fulfilled due to lack of competency on the part of the graduates in creating jobs and most Ethiopian graduates of STEM remain unemployed. This has caused the development of negative attitudes towards science and technology fields in students thus further aggravating the problem of lack of interest in science education (Mulatie, 2018). Students' attitudes towards science influence their interest to study science. This affects the amount of time and effort they exert on learning/studying science, a factor which ultimately determines their academic successes (Mulatie, 2018).

Research in science education has indicated that positive students' attitude towards science is one of the factors that contributes to meaningful learning of science because students bring significant expectations into classrooms (Alzahrani, 2016). Attitude towards science can be favorable or unfavorable feelings about science as a school subject (Sitotaw & Tadele, 2016). The study of Attitude as a construct has gained much popularity in science education research as students' attitude towards science can affect their academic performance (Osborne, Simon, & Collins, 2003).

Studies show that students are not excited by the manner that science is taught in Ethiopian high school classrooms; it does not consider worldview differences nor connect their indigenous knowledge with the school science (Mekuria, et al, 2018,). This disconnect and lack of context negate the development of student's positive attitude towards science subjects. Since science is presented within a Western cultural context without being related to students' everyday life, students' interest, motivation, and enjoyment are often reduced (Hussaini, Foong & Kamar, 2015). Thus, this study investigated the role of the integration of TM with school biology in enhancing the attitudes of students by applying cultural border crossing (CBC) approach.

There are no extant empirical studies on how the integration of IK TM influenced students' attitude towards biology in Ethiopia and elsewhere. Thus, this is a pioneering study that focused

on investigating how students' positive attitude towards biology can be enhanced by integrating IK with the school biology using CBC approach. It starts off with the assumption that the integration of TM with school biology can foster students' participation, interaction, discussion, cooperative learning, and practical activities so that their attitude towards the subject may improve. Applying various teaching-learning methods and relating students to their everyday life is important to enhance positive attitude towards science (Alemu, 2013). The interaction of students with TM concepts as cognitive tool, and with their peers, teachers, and the regular study material may bring a positive change in their attitudes towards biology (Alemu, 2013).

Ethiopia's Education and Training Policy (ETP) encourages teachers to employ a constructivist and learner centered approach to teach science (ETP, 1994). This approach aimed to increase students' motivation and engagement. It helps them participate actively in constructing meaning out of their learning experience by connecting what they are learning with what they already know. TM serving as prior knowledge when integrated with school biology should thus enhance students' understanding of the subject and improve their attitude towards it.

How students perceive the learning environment can affect their attitudes towards biology. If the classroom environment addresses worldview differences through bridging school biology with indigenous knowledge, students may develop a positive attitude towards it. The study undertaken by Cimer indicated that teaching biology in a manner that connects the topics with students' everyday lifeworld helps them develop a positive attitude (Cimer, 2012). Research in South Africa also confirmed that motivation and participation of students increases when IK practices are integrated into school science (Cameron, 2007; Manzini, 2006).

This study investigated whether the integration of IK with school biology plays any role in enhancing students' positive attitude towards the subject. The study employed cultural border crossing (CBC) as a framework for and bridge to biology education: students' IK was the bridge, prior knowledge of TM and the worldview it embedded, which was linked with school biology. The approach aimed at facilitating a smooth border crossing between IK and school biology to facilitate students developing a positive attitude towards the subject.

Methodology

To achieve the goal of the study, a quasi-experimental pre-test, post-test non-equivalent control group design was employed. This design helps to control various extraneous variables. A total of 177 students (88 in the treatment and 89 in the comparison group) participated as intact classes from two high schools in Chiro district, Oromia Regional State, Ethiopia. The two groups had been taught the same topics (microorganism and disease) as presented in a grade 9th biology textbook. The teacher who taught the experimental group took a three-day training on how to integrate the indigenous knowledge on TM with the biology topics using the 5E's instructional model. The comparison group were taught the same biology topics without integrating the IK but using the usual approach. The intervention lasted for six weeks after which the questionnaires were administered to both groups as post-test.

The Biology Attitude Questionnaire (BAQ) consisting of seven components was used as instruments of data collection. The reliability of the BAQ using Cronbach's Alpha was 0.91. The tool was also reviewed by a panel of experts in the area to ensure face and content validity. Our use of theoretical background and literature review serves to address construct validity. To ensure that the treatment group received all the aspects stipulated in the design, the procedures followed within the 5E learning cycle were as follow:

- During the Engagement stage students were given scenarios depicting a particular disease together with how TM healers diagnose the same ailment by prescribing a certain type of TM with a specified dosage to take apply at specific time interval. This was to get the students engaged.
- During the second, explore stage, students were given points of discussion to discuss in groups and to debate. Here they manipulated specific medicinal plants and discussed which part is used as medicine, how drugs are extracted, and how dosage is regulated including how the drug is administered into the body. This helped students to identify the strong and weak sides of the TM practices compared with modern medicines. This helped them to discuss the drawbacks of TMs and how to improvements might be made. The teacher acts as cultural brokers and facilitates discussion as he went round each group.
- In the explain stage, the students explained what was discussed in the explore stage. The teacher presented the science topic about a specific microorganism, its modes of

transmission, and measures to control the disease and tried to make a link with the traditional perception about diseases and their traditional treatment options.

- In the elaborate stage the teacher allowed students to reflect on their understanding of how medicinal plants are important in curing particular diseases and compared the mechanism of control with the biomedicine.
- Finally, students' understanding of the biological concepts was evaluated.

Results

Descriptive Data Analysis and Interpretations

A preliminary analysis and interpretation were made to understand the nature of data set obtained from both the pre-tests- and post-tests to check assumptions and make ready for the appropriate inferential statistical tools. Descriptive statistics were generated to examine the extent to which the assumptions of the statistics were satisfied. The statistical assumptions explain when it is not justifiable to perform a specific inferential statistical test. The type of inferential statistical tool planned to compare the treatment and comparison groups based on their mean score on the BAQ test scores was independent samples t-test. However, this statistical tool is used based on some basic statistical assumptions which include: (1) independent measurement, (2) the dependent variables should be normally distributed in each group and (3) there are equal variance (homogeneity of variance) of the dependent variable across the groups (Pallant, 2005).

Independent measurement was assured in the research design by selecting intact classes of the respective schools and each set of participants is tested under only one treatment condition. In addition, each group was subjected to same questionnaire at same time. The normal distribution was checked using skewness. Levene test was also used for further analysis of the homogeneity of variances of the data sets.

Table 1. Descriptive statistics summary related to the scores on BAQPRE and BAQPOST for the treatment and comparison groups

Group	Variable	N	Mean	SD	Min.	Max.	Skewness	Kurtosis
Treatment	BAQPRE	88	157.56	16.49	117	185	-.382	-.512
	BAQPOST	88	185.50	16.72	153.00	227.00	.306	-.400
	BAQPRE	89	153.56	14.02	126	187	.027	-.678
Comparison	BAQPOST	89	170.40	12.97	143	212	.237	.162

BAQPRE: Biology Attitude Questionnaire Pre-test

BAQPOST: Biology Attitude Questionnaire Post-test

Descriptive statistics were generated using exploratory data analysis technique to get the basic information on mean score, variation (the range of scores) and normality of the data sets obtained from pre-test and post-test. The mean score of the treatment group on the BAQPRE (M=157.56, SD =16.72) was almost equal to the mean score of the comparison group (M = 153.56, SD =14.02). These results revealed that the two groups were having almost equal level of attitude towards biology before the intervention. Thus, any difference which would occur in the post-test results between the treatment and the comparison groups would be accounted for by the effect of the intervention. After the intervention had been carried out, a BAQ post-test covering the planned topics was given for the two groups immediately after. As it can be noticed in table 1, mean score of the treatment group on BAQPOST (M=185.50, SD = 16.72) was greater than the mean score of the comparison group (M=170.40, SD=12.97). However, it is too early to give a conclusive idea based on these results without undergoing inferential statistics.

In addition, results obtained from the exploratory data analysis outputs provided in Table-1 were used to check some of the statistical assumptions for the independent samples t-test. The main statistical assumption that was used to check from these outputs was normality of the dependent variables in each group. The skewness of the variables was used for checking normality. From the outputs provided in Table 1, it can be seen that all of these variables have skewness values between -1 and 1. These results show that the variables in each group were at least normally distributed; the BAQPRE and BAQPOST at least approximately normally distributed in each

group and were more like scale variables. Hence, it was justifiable to use the independent samples t-test to compare means of the two groups on these variables.

Inferential statistics and Interpretations

Table 2. Independent Samples t-test analysis to compare the Treatment and Comparison Groups on BAQPRE

Variable	Group	N	M	*SD*	*T*	*df*	*d*	*P*
BAQPRE	Treatment	88	157.56	16.49	1.74	175	.26	.084
	Comparison	89	153.56	14.02				

The above table shows a pretest on attitude scale to determine base line equivalence of the two groups. An independent samples t-test was computed to determine if a difference existed in the attitude towards biology between the treatment and comparison groups. The result shows that there was non-significant mean difference in BAQPRE scores between the treatment and comparison groups (t (175) = 1.74, P > .05, d = .26). This indicates that the two groups were in the same status with regard to their attitude towards biology before the intervention. Therefore, any difference after the intervention can be attributed to the presence of the intervention provided that other confounding variables are controlled.

Attitudes of Students towards Biology

Ho-2: There is no significant difference in the mean scores of students' attitude towards biology taught by integrating traditional medicine contents with school biology using the 5E's learning cycle model compared with those taught the biology topic using the usual approach.

Table 3. Independent Samples t-test analysis to compare the Treatment and Comparison Groups on the BAQPOST.

Group	N	*M*	*SD*	*t*	*df*	*d*	*P*
Treatment	88	185.5	16.72	6.71	163.94	1.02	.000
Comparison	89	170.40	12.97				

An independent t-test was conducted to compare students' attitude towards biology post-test scores for the treatment and comparison groups. The value of Levene's test of equality of variance was significant ($P < .05$) and hence the statistics for equal variance not assumed was considered. The result displayed in table 3, revealed that the mean score of the treatment group (M=185.5, SD=16.72) is significantly greater than the mean score of the comparison group ($t (163.94) = 6.71$, $P < .05$, $d = 1.02$). This was manifested in the effect size of $d = 1.02$, which was larger than typical (Cohen, 1988). This shows the treatment group possess better attitude towards biology than the comparison group after the intervention. The integration of TM with school biology was therefore effective in learning biology topics than otherwise. Since the treatment group was not different significantly from the comparison group on the BAQPRE, the implication is that the two groups were in the same status regarding their BAQPRE before the intervention. Therefore, the difference can be ascribed to the integration of IK with school biology. Hence, we can conclude that the null hypothesis of non-significance difference in the mean scores of the two groups regarding attitude variable was rejected and the alternative hypothesis that there is significant difference in the mean scores between the treatment and the comparison groups on attitude towards biology was accepted. This indicates the integration of IK with biology topics improves students' attitudes towards biology. The components of BAQ is presented in table 4 to see variability withing the construct.

Table 4. Descriptive Statistic Summary of the components of Biology Attitude pre-test scores for the Treatment and Comparison Groups

Group	Variable	N	Mean	SD	Min	Max	Skewness	Kurtosis
Treatment	UPRE	88	25.27	4.98	15	39	.192	-.061
	MPPRE	88	24.91	4.42	14	39	.242	.328
	IPRE	88	37.15	6.18	22	49	-.343	-.622
	DPRE	88	19.14	3.71	11	28	-.196	.099
	TSPRE	88	19.28	3.46	10	27	.075	-.051
	LAPRE	88	11.95	2.55	5	20	.188	-.802
	FCPRE	88	12.57	2.95	6	20	-.026	-.352

	UPRE	89	23.74	3.95	13	34	-.335	-.114
Comparison	MPRE	89	26.33	4.05	15	38	.141	.353
	IPRE	89	37.45	5.58	26	51	-.154	-.559
	DPRE	89	18.35	2.87	11	24	.033	-.583
	TSPRE	89	17.69	3.12	11	25	.132	-.411
	LAPRE	89	12.60	2.76	6	19	-.196	-.452
	FCPRE	89	11.02	2.36	5	17	.063	.141

UPRE: Usefulness Pretest
MPRE: Motivation Pretest
IPRE; Interest Pretest
DPRE: Difficulty Pretest
TSPRE: Teacher Support Pretest
LAPRE: Laboratory Activity Pretest
FCPRE: Future Career Pretest

Descriptive statistics were generated using exploratory data analysis technique to get the basic information on mean scores, variation (the range of scores between the maximum and minimum) and normality of data sets obtained from attitude component pretest scores. Table 4 provides the descriptive statistic summary related to the UPRE, MPRE, IPRE, DPRE, TSPRE, LAPRE and FCPRE for the treatment and comparison groups. As can be observed from the table, the means scores on the attitude components between the treatment and comparison groups showed very slight variations on these variables before the intervention. Students in the treatment group had more positive attitude towards the usefulness of biology (M=25.27, SD=4.98) than the comparison group (M= 23.74, SD = 3.95). The comparison group demonstrated somewhat greater motivation (M = 26.33, SD = 4.05) than the treatment group (M = 24.91, SD = 4.42) before intervention. The treatment group had the same interest (M = 37.15, SD = 6.18) with the comparison group (M = 37.45, SD = 5.58) before the intervention. The treatment group (M = 19.14, SD = 3.71) feel difficulty in biology learning equivalent to the comparison group (M = 18.35, SD = 2.87). The consideration of teacher's support for biology learning was slightly greater

for the treatment group (M = 19.28, SD = 3.46) than the comparison group (M = 17.69, SD = 3.12). The attitude of students towards learning biology supported with laboratory activity was almost at the same status (M = 11.95, SD = 2.55) with the comparison group (M = 12.60, SD = 2.76). The perceptions of the students in the treatment group on the contribution of biology for future career was slightly greater (M = 12.57, SD = 2.95) than the comparison group (M = 11.02, SD = 2.36).

Based on these results, there were viable variations on some of the attitude components before the intervention. But these pre-existing variations can be treated as natural since there was no random assignment of students in the two groups. However, we have statistical mechanisms that can be used to control the pre-existing variation between the groups on these variables. In addition to these values, results obtained from the descriptive data analysis outputs provided in Table 4 were used to check for some of the statistical assumptions for the independent samples t-test. The skewness of the variables was used for checking normality. The result shows that all the attitude components had skewness values between -1 and 1. These results tell us that the variables in each group were at least normally distributed. Thus, it can be assured that attitude components were at least approximately normally distributed in each of the groups, and they were more like scale variables. Hence, it was justifiable to use the independent samples t-test to compare the means of the two groups on all of the data obtained from the pretest scores of the attitude components.

Table 5. Independent Samples t-test analysis summary to compare the Treatment and Comparison Groups on the pretest.

Variable	Group	N	Mean	*SD*	*t*	*df*	*P*	*d*
UPRE	Treatment	88	25.27	4.98	2.268	175	.025	.34
	Comparison	89	23.74	3.95				
MPRE	Treatment	88	24.91	4.42	-2.224	175	.027	.34
	Comparison	89	26.33	4.05				
IPRE	Treatment	88	37.15	6.18	-.341	175	.733	.05
	Comparison	89	37.45	5.58				

DPRE	Treatment	88	19.14	3.71	1.581	175	.116	.24
	Comparison	89	18.35	2.87				
TSPRE	Treatment	88	19.28	3.46	3.230	175	.001	.48
	Comparison	89	17.69	3.12				
LAPRE	Treatment	88	11.95	2.55	-1.60	175	.111	.24
	Comparison	89	12.60	2.76				
FCPRE	Treatment	88	12.57	2.95	3.846	166.130	.000	.25
	Comparison	89	11.02	2.36				

An independent sample t-test presented in table 5 shows the difference obtained on each of the attitude component before the intervention. The result shows that there were non-significant mean differences on the IPRE between the treatment group ($t(175) = -0.341$, $P > 0.05$). Similarly, there was no statistically significant mean difference on the DPRE between the treatment group ($n = 88$, $M = 19.14$, $SD = 3.71$) and the comparison group ($n = 89$, $M = 18.35$, $SD = 2.87$, $t(175) = 1.581$, $P > 0.05$). These results revealed that the treatment and comparison groups were in the same status with respect to the IPRE and DPRE.

The result also shows that there was non-significant difference on the LAPRE between the treatment group and the comparison group ($t(175) = -1.60$, $p > 0.05$, $d = 0.24$). But there was a significant mean difference in the UPRE favoring the treatment group ($t(175) = 2.268$, $P < 0.05$, $d = 0.34$). The mean difference of MPRE ($t(175) = -2.224$, $P < 0.05$, $d = 0.34$), was significant favoring the comparison group but the mean difference of TSPRE ($t(175) = 3.230$, $P < .05$, $d = .48$), FCPRE ($t(166.130) = 3.846$, $P < .001$, $d = .25$) is found to be statistically significant the reason the treatment group showed a better result. Thus, the treatment group demonstrated favorable attitude than the comparison group on these three attitude components, namely, Usefulness, Teacher Support, and Future Career and the comparison group is better in motivation component. Students' variations on these variables before the intervention is no cause for panic since such variation on the pretest can be managed by undergoing further statistical analysis (ANOVA), while comparing the groups on post test scores for the variables. Thus, ANCOVA was

used to compare the mean difference of the two groups on the UPOST, MPOST, TSPOST, and FCPOST using the UPRE, MPRE, TSPRE, and FCPRE as covariates.

Table 6. Descriptive Statistic Summary of the Components of Biology Attitude Post-Test Scores for the Treatment and Comparison Groups.

Group	Variables	N	Mean	SD	Min	Max	Skewness	Kurtosis
Treatment	UPOST	88	31.14	3.49	23	38	-.239	-.446
	MPOST	88	28.78	4.45	17	38	.025	-.248
	IPOST	88	42.03	6.03	31	55	.356	-.66
	DPOST	88	24.72	3.55	17	30	-.292	-.851
	TSPOST	88	21.88	2.86	16	30	.135	-.171
	LAPOST	88	15.94	2.49	7	20	-.612	-.651
	FCPOST	88	14.76	2.91	6	20	-.612	.253
Comparison	UPOST	89	28.63	3.17	22	36	.204	-.519
	MPOST	89	25.93	4.36	17	38	.177	-.04
	IPOST	89	38.55	5.30	29	51	.334	-.316
	DPOST	89	21.38	3.85	13	30	.106	-.663
	TSPOST	89	21.07	3.36	14	28	-.110	.424
	LAPOST	89	15.10	2.51	9	20	-.192	-.103
	FCPOST	89	14.06	2.98	6	18	-.639	-.293

Table-6 provides the descriptive statistic summary related to the UPOST, MPOST, IPOST, DPOST, TSPOST, LAPOST, and FCPOST for the treatment and comparison groups. As it can be observed from the mean scores on attitude components between the treatment and comparison groups, we can see big variation on most of the variables in favor of the treatment group and the variation was nearly equal on some of the other variables. The treatment group demonstrated a positive attitude towards the usefulness of biology (M=31.14, SD=3.49) than the comparison

group (M=28.63, SD=3.17). Students in the treatment group are highly motivated in learning biology (M=28.78, SD=4.45) than the students in the comparison group (M=25.93, SD=4.36). The treatment group was more interested (M= 42.03, SD=6.03) than the comparison group (M = 38.55, SD=5.30). Likewise, the comparison group showed some difficulty in learning biology (M=21.38, SD=3.85) than the treatment group (M=24.72, SD=3.55). The attitude of the students in the treatment group towards teacher's support for effective learning of biology (M=21.88, SD =2.86) is nearly equal to the comparison group (M=21.07, SD=3.36).

The attitude of the treatment group in learning biology in the laboratory activity (M=15.94, SD=2.49) was nearly equal to the comparison group (M=15.10, SD=2.51). Similarly, the attitude of students in the treatment group towards the importance of learning biology for future career (M=14.76, SD=2.91) was nearly equal to the comparison group (M=14.06, SD=2.98). These result shows that the comparison and treatment groups are situated at different positions regarding most of the attitude components towards biology after the intervention. The mean scores of the two groups on the IPOST showed variation in favor of the treatment group.

In addition to these, the results obtained from the exploratory data analysis provided in Table 6 were used to check for some of the statistical assumptions for the independent samples t-test. The main statistical assumption that was used to check from these outputs was normality of the dependent variables in each group. All of the variables in the attitude components had skewness values between -1 and 1. Thus, it is clear that the attitude components were at least approximately normally distributed for both groups and they were more like scale variables. Hence, it was justifiable to use the independent samples t-test to compare statistically the mean difference of the two groups on all of the data obtained from the post-test scores of the attitude components.

Table 7. Independent Samples t-test Analysis Summary to compare the Treatment and Comparison Groups on the Attitude Components of IPOST, DPOST and LAPOST

Variable	Group	N	*M*	*SD*	*t*	*df*	*P*	*d*
IPOST	Treatment	88	42.03	6.03	4.082	175	.000	.61
	Comparison	89	38.55	5.30				
DPOST	Treatment	88	24.72	3.55	5.987	175	.000	.90
	Comparison	89	21.38	3.85				

LAPOST	Treatment	88	15.94	2.49	.026	175	.026	.34
	Comparison	89	15.10	2.51				

Table 7 provides the summary of independent samples t-test on IPOST, DPOST, and LAPOST for the treatment and comparison groups. The result of the study shows that there was statistically significant mean differences on the IPOST between the treatment group ($t(175) = 4.082$, $P < 0.05$). In addition to the information on the statistical significance outcome, the effect size can also provide information on the magnitude of the difference between levels of the independent variable with respect to the dependent variable. The effect size for the IPOST was found to be $d = .61$, which was larger than typical. This result revealed the treatment group performed better than the comparison group. This shows that the integration of TM with school biology was more effective than learning biology topics without integrating TM in fostering the interest of the students in biology. Similarly, there was statistically significant mean difference on the DPOST ($t(175) = 5.987$, $P < 0.05$). This result was manifested in the associated effect size of $d = .90$, which is larger than typical according to Cohen (1988). This result revealed that the integration of IK with school biology highly minimized the students' perception towards the difficulty of biology. Likewise, students in the treatment group preferred to learn biology supported by the laboratory activity ($t(175) = 2.242$, $P < 0.05$, $d=.34$).

To compare the two groups on the remaining attitude components (UPOST, MPOST, TSPOST and FCPOST); analysis of covariance (ANCOVA) was used considering the UPRE, MPRE, TSPRE and FCPRE as covariates. ANCOVA typically provides a means of statistically controlling for the effect of continuous or scale covariate on the independent variable in predicting the dependent variable. To eliminate the bias of the treatment effect that results from the measurement error inherent in the pre-test when studying non-equivalent groups, using a reliability corrected ANCOVA model to adjust the pretest for measurement error is essential. The ANCOVA has statistical assumptions that increase the validity of the results obtained from it. These are Independent measurements, normal distribution, homogeneity of variances and homogeneity of regression slopes. The assumption of independent measurements was addressed during the research design and data collection stage. As it is displayed in Table 6, the normality and

homogeneity of variances of UPOST, MPOST, TSPOST and FCPOST were checked using skewness value, Kurtosis and Levene test. The assumption of homogeneity of regression slopes is one of the most important assumptions and it can be checked with an F test on the interaction of the independent variables with the covariate. If the F test is significant, then this assumption has been violated. In the interaction of the pre-tests and the post-tests of the four cases, the F test obtained was non-significant. Hence, the assumption of homogeneity of regression slopes was not violated for Group*UPRE (P=.463), Group*MPRE (P = .246), Group*TSPRE (P = .751) and Group*FCPRE (P=.925). Thus, these data sets were qualified for using the ANCOVA.

Table 8. Analysis of Covariance for UPOST, MPOST, TSPOST, and FCPRE as a Function of the Groups, using the UPRE, MPRE, TSPRE, and FCPRE taken as a Covariate

Source	SS	D*f*	*MS*	*F*	*P*	*Eta*^{2}
UPRE	12.996	1	12.996	1.170	.281	.007
Group	250.546	1	250.546	22.563	.000	.115
Error	1932.132	174	11.104			
MPRE	90.470	1	90.470	4.770	.030	.027
Group	411.379	1	411.379	21.691	.000	.111
Error	3300.023	174	18.966			
TSPRE	251.452	1	251.452	8.121	.005	.045
Group	555.698	1	555.698	17.947	.000	.094
Error	5387.468	174	30.962			
FCPRE	189.19	1	189.19	24.80	.000	.125
Group	.435	1	.435	.057	.812	-
Error	1327.52	174				

The results displayed in Table 8 indicates that after controlling for the UPRE, MPRE, TSPRE and FCPRE, there were significant differences between the treatment and comparison groups on the UPOST ($F(1, 174) = 22.563$, $P < 0.05$), MPOST ($F(1, 174) = 21.691$, $P < 0.05$) and on the TSPOST ($F(1, 174) = 17.947$, $P < 0.05$). To the contrary, there was non-significant difference on the FCPOST between the treatment and comparison groups ($F(1,174) = .057$, $P > 0.05$). As is evident from Table 8, 11.5% of the variances on the UPOST, 11.1% of the variances in the MPOST, and 9.4% of the variances in TSPOST between the treatment and comparison groups were explained by the independent variable being considered. Therefore, the integration of TM with school biology was effective than learning biology without integrating TM in influencing these attitude components towards biology in favor of the treatment group except FCPOST. This shows that the integration of TM with school biology significantly improved attitudes of students towards biology.

The integration of TM with school biology improved the general attitudes of students towards biology. Therefore, the null hypothesis of no significance difference was rejected and the alternative hypothesis of there is significance difference between the two groups in terms of the six attitude components except FC is accepted in favor of the treatment group. Hence, in terms of influencing attitudes of students towards biology, the integration of TM with the school biology played a very important role.

Discussions of the Findings

Evaluation of the overall attitudes of students between the treatment and comparison groups showed that both groups have positive attitudes towards biology before and after the intervention. However, comparison of the two groups based on post-test mean scores indicated that students in the treatment group showed a more positive attitude towards biology than the comparison group.

The analysis of data showed significant mean difference between the two groups when post-BAQ responses were compared. When the group that received instructions based on the integration of TM with school biology was compared with the group that received instructions without integration of TM, the result was in favor of the treatment group. This indicated that integration of TM with school biology was better in enhancing a positive attitude towards biology. If students understand the link between what they learn at school and their everyday life

experiences, they can understand its relevance. The result of the study shows that understanding the relevance of what students learn helped them develop a positive interest in learning biology which is consistent with the findings of (Zinyeka, 2014; Erinosho, 2013). Moreover, integrating IK with school biology helped students to understand the usefulness of biology to their life, result that is in line with that of (Alemu, 2013). research by Erinosho also confirmed that through integration of indigenous knowledge into the subject, students can understand the usefulness of biology which in turn triggers their interest and motivation to enhance their attitude (Erinosho, 2013).

Krogh and Thomsen (2005) applied the concept of cultural border crossing in research and found it as key predictor of attitudes towards science. Research showed that students in non-Western countries faced difficulties in crossing cultural borders while learning science (Webb, 2014). These difficulties in crossing cultural borders are barriers to positive attitude of students towards science. To alleviate such problems the IK of the community has to be integrated with school biology to facilitate border crossing. When students crossed cultural borders smoothly, they can understand biological concepts which in turn can improve students' attitude towards biology. The assumption is that the integration of IK with the school biology can foster students' participation, interaction, discussion, cooperative learning, and practical activities which altogether contribute to improve their attitude towards the subject. Using a diversity of teaching-learning methods and involving students in student-centered learning by drawing on and validating their relevant prior knowledge is important to improve their attitude towards science (Alemu, 2013). Manganye (1994) referenced a study conducted in United Kingdom that showed that students' experience and prior knowledge influence their attitude towards science. This supports the position that integrating students' IK with school biology as their everyday life experience and prior knowledge would play an important role in increasing the usefulness of biology and in improving attitude. On the other hand, low interest in learning biology could be due to lack of relevance of biology to student's everyday life, the alienation of biology from the society, and the prevalence of isolated scientific facts in the teaching process (Alemu, 2013).

According to several studies, students' attitudes towards science can also hinder their career choices (Alemu, 2013; Manganye, 1994; Nasr & Soltani, 2011). The above ideas indicated

that attitude of students towards science/biology can determine their job preferences. This means that when students develop positive attitude towards science/biology, they are likely to choose science/biology related careers. Thus, among the factors which need to be considered in determining job preferences, students' attitude toward science is worth mentioning. Furthermore, it was found that the way science is taught by relating the topics to students' everyday life contributed to enhancing attitudes towards biology.

Conclusions and Recommendation.

Integration of IK with school biology facilitated smooth border crossing for the students by creating a favorable classroom environment. Smooth border crossing could be a factor that affects students' attitude towards the subject. This was because favorable learning environment and students' involvement to cross cultural borders between the two forms of knowledge has an important influence upon student attitudes toward biology. This approach has the potential to motivate students to engage in meaningful learning. The integration of indigenous knowledge into science curriculum is effective in improving students' attitude towards biology. Additionally, as indigenous knowledge has science embedded in it, it provides solutions to many real-life problems.

Although there are several qualitative studies concerning the integration of IK into science curriculum, there is scarcity of quantitative data regarding the role of indigenous knowledge in improving the attitude of students towards biology/science. Hence, we hope that this article can provide useful insights concerning integration of indigenous knowledge with school biology to improve students' positive attitude towards biology. Finally, it is recommended to integrate IK with science subjects as it enhances students' attitude towards the subject and can play a role for understanding the concepts under study. We also like to recommend that future research might focus on assessing the challenges of integrating IK with science subjects in different cultural settings.

Author Contribution

- Shager Ali was responsible for writing the draft background and literature review. He was also involved with field data collection and data analysis.
- Aweke Shishigu was responsible for writing the research report and for reviewing the entire section for completeness and consistency.

- Solomon Belay Faris was responsible for writing the research report and for reviewing the entire section for completeness and consistency
- Sutuma Edessa was responsible for writing the research report and for reviewing the entire section for completeness and consistency

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