Worldview Assimilation Method (WAM): Effects on Student Behavior and Conceptual Understanding in Science

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Abstract

Worldview Assimilation Method is a researcher designed teaching approach that investigates the effect of students' acquired knowledge, experiences, and personal beliefs on their behavior and conceptual understanding. Two sections of Grade 6 in Jubilee Christian Academy were randomly assigned as to WAM or conventional group and were exposed to the respective teaching approaches. Student behavior for both groups was observed using the same checklist. Both groups were also administered with the same pre and post test for conceptual understanding test.

Two-samples-test Kolmogorov-Smirnov Test revealed that the students under WAM have a higher behavioral mean score than the students under the conventional method. The t-test for the conventional group and the WAM group showed that there is a significant difference between the pretest and the posttest scores.

Keywords: Worldview, Science Education, Student Behavior, Conceptual Understanding

Introduction

A world view is a set of presuppositions and beliefs that someone uses to interpret and form opinions about his humanity, purpose in life, duties in the world, responsibilities to family, interpretation of truth, social issues, *etc.* (Slick, 2010). It shapes how one thinks and acts in everyday situations. It also tells a person what is real, what is important, what is right, and what is wrong (Roberts, 2004).

A person's worldview develops overtime and is influenced by different factors. One's worldview is shaped by one's experience of people, places and events. Moreover, these experiences take place in a dynamic world where individuals, societies and nations engage in an endless dance of cooperation, competition and conflict (Mendelson & Baker, 2002). Awareness of worldviews can help analyze and solve conflicts.

Student perception of education is anchored on their worldviews. In a study conducted by Owolabi and Olatunde in 2008, they found out that student perception of science is predominantly based on their cultural belief rather on seeing the concepts in a school context. Thus, Owolabi and Olatunde suggest that worldview and school concepts should be taught side by side.

In this regard schools should tailor the curriculum to let students assess their worldview. A worldview will let students live better. Students will tend to have better choices (Roberts, 2004). If students will see the world in a positive point of view, they will tend to be more responsible with their resources, show concern to the people around them, and be good citizens of the country.

In education, a process in which students view certain learning concepts or ideas and how these concepts or ideas apply to their existing cognitive structure is referred to as assimilation. Such process was discovered by the popular psychologist Jean Piaget. Assimilation happens when a student applies the schemas learned to other situations. For example, an infant knows how to grab objects and thrust it to his/her mouth.

Students have existing schemas of how they view certain truths about God, morals and values. This study considers the different worldviews of students and assess if they have an effect on their behaviour and conceptual understanding. The process to be used in this study is named *Worldview Assimilation Method (WAM).*

Statement of the Problem

This study aims to determine the effect of *Worldview Assimilation Method (WAM)* on student behavior and conceptual understanding in Science. Specifically, the research seeks to answer the following questions:

1. Do students taught using the *Worldview Assimilation Method* have higher mean score than students taught using the conventional method in terms of student behavior?
2. Do students taught using the *Worldview Assimilation Method* have higher mean score than students taught using the conventional method in terms of conceptual understanding?

Conceptual Framework

The figure below shows the conceptual framework of this research.

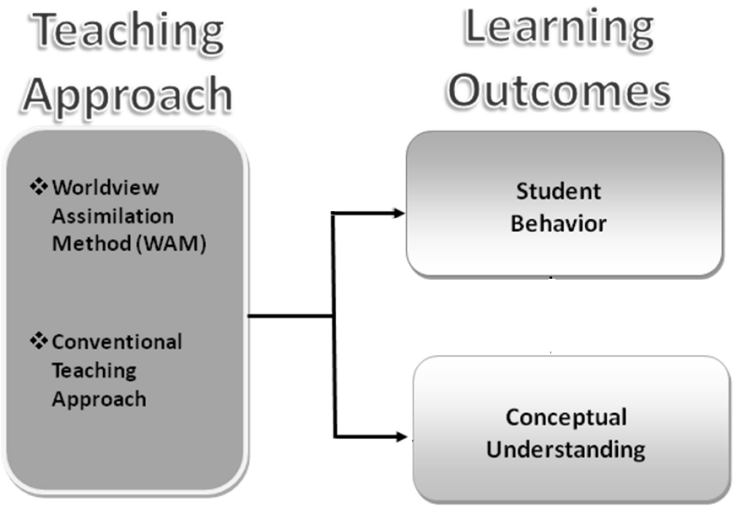

Figure 1. Conceptual Framework

As seen on the diagram above, this research utilized two teaching approaches, the *Worldview Assimilation Method (WAM)* and the conventional teaching approach. Such teaching approaches comprise the independent variable of this study.

Two sections of Grade 6 students were randomly assigned to either of the approaches. The length of exposure to the two teaching approaches was about six weeks and its effect will was measured and analyzed.

The effect of *Worldview Assimilation Method (WAM)* and the conventional teaching approach were measured on the dependent variables of this research which were student behaviour and conceptual understanding. The arrows from the teaching approaches to the learning outcomes signify cause-and-effect relationship.

Worldview refers to the existing beliefs of students about every aspect of their life, brought about by their experiences, acquired knowledge and their religious belief. This research acknowledges that each student has his or her own worldview, and that it influences him or her to behave in a certain manner. Such behavior may include the ability to participate and react to situations in the classroom and that may lead to the students' ability to comprehend a certain science concept.

The diagram below shows the underlying assumption of this research on the three most important factors that influence a student's worldview.

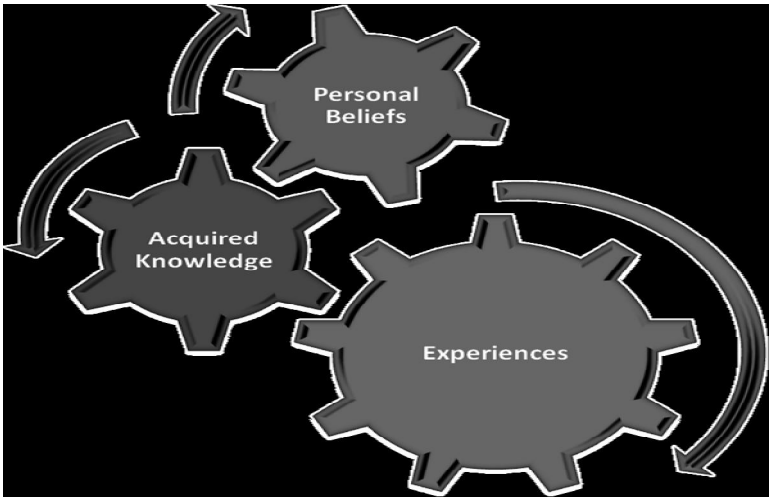

Figure 2. Factors Affecting Worldview

Figure 2 shows the different factors that affect a student's worldview. Each factor is represented by a certain gear, which means that as one factor moves; the other factors can be influenced. The biggest gear represents students' experiences, since theoretically, they determine their ability to gain knowledge and may affirm or revoke their personal beliefs. These three factors that comprise students' worldview were taken into consideration in designing the assimilation process integrated in each lesson plan.

Research Design

This study includes a comparison of students who had been exposed to Worldview *Assimilation Method (WAM)* approach to those exposed to the conventional teaching methods. Therefore, its research design is best described as pretest-posttest quasi-experimental design (Fraenkel & Wallen, 2007).

The Samples

This study was conducted at Jubilee Christian Academy, a Chinese-Filipino school in Quezon City. Eighty four Grade six students, 42 in each class, comprise the sample of this research. There were 21 boys and 21 girls for each class and their ages vary from 11 to 12 years old. About 95% of all the students are Chinese-Filipino.

A coin was tossed to assign which class would serve as the WAM group or the conventional group. As a result of such toss, Grade 6 Milton was assigned to be the WAM group while the conventional group was the Grade 6 Hemingway.

Both classes were taught by the teacher-researcher during the fourth quarter of School Year 2010 -2011 for about six weeks.

The Instruments

Conceptual Understanding Test

The researcher prepared a 50-item conceptual understanding test for both groups. The questions were taken from the conceptual understanding test released by the National Achievement of Educational Progress (NAEP), TIMMS test items, Glencoe online science quiz, TIMMS tests, California Standards tests, and My Pals Are Here Tests.

After the content validation and pilot testing, 30 items were chosen based on their discriminating indices to be part of the Conceptual Understanding Test. The reliability of the Conceptual Understanding Test was determined using the formula KR20 and it was found out to be 0.71.

Table 1, shows the scheme that was followed in scoring the explanation of students.

Table 1: Criteria for Scoring CU Response

Response	Features of Response	Score
No Understanding (NU)	• Blank • I do not understand • Repeat question • Irrelevant or unclear response	1 pt.
Alternative Conception (AC)	• Reponses that attempt the phenomena but do not necessarily match the scientific concept	2 pts.
Partial Understanding (PU)	• Responses that clears at least one of the scientific concept but not all of the components	3 pts.
Sound Understanding (SU)	• Responses that includes all the components of the scientific concept	4 pts.

Each item in the Conceptual Understanding Test is equivalent for 5 points, thus the perfect score that each student can get is 150 pts.

Student Behavior Checklist

The researcher prepared a checklist for assessing student behavior in the classroom. The contents of the checklist were derived from the science classroom observation protocol by the North Cascades and Olympic Science Partnership (2010) and were modified to fit this study.

The checklist was validated by one of the education specialists in UP NISMED and the research adviser. Their comments and suggestions were integrated in the revision of the checklist.

The checklist was divided into three groups which are classroom behaviour, class interaction, and group tasks. The checklist was accomplished by the science coordinator for both WAM and conventional group.

Worldview Assimilation Method

Worldview Assimilation Method (WAM) is a researcher-designed teaching approach using assimilation method as theorized by Piaget.

The researcher prepared lesson plans for both WAM and conventional groups. The lessons covered in this study were:

- Work
- Forms of Energy
- Earth Structure and Processes
- Plate Tectonics
- Solar System
- Evolution

Both the WAM and the conventional groups were taught the same science concepts using the inquiry approach because it is the teaching approach which is required in the curriculum of the school.

The inquiry approach has five basic steps known as the five E's which are Engage, Explore, Explain, Elaborate, and Evaluate. Lesson plans for WAM and the conventional groups were designed using the inquiry approach. However, the assimilation process was integrated in certain E's of the WAM.

WAM questions are designed to let students fit in their preconceived ideas for the researcher to identify sources of misconceptions so they can be corrected.

Data Collection Procedure

Before this study was conducted, the researcher obtained permission from the executive directress, through the principal of the elementary department of Jubilee Christian Academy. The researcher was allowed to conduct the study on two sections of Grade 6 on condition that the concepts to be used in the research must be aligned with those of the competencies of the school.

The researcher prepared lesson plans on the different topics covered for the duration of the study. The lesson plans were presented to the science coordinator for checking and approval.

Before the treatment, both WAM and conventional groups were administered the pretest on conceptual understanding. The scores of both groups for the pretest were recorded.

The science coordinator served as the observer for the whole six weeks of the study. During her observations, she accomplished the student behavior checklist as well as the classroom observation checklist.

After the treatment, both WAM and conventional groups were administered the posttest and the scores of both groups were also recorded.

Data Analysis Procedure

The data collected were subjected to the appropriate MS Excel and Windows SPSS to determine statistical significance and relationships.

A Shapiro-Wilk test was utilized to check if the data in both the student behavior and conceptual understanding are normally distributed.

To test whether students taught the WAM and the conventional way significantly differed in their mean scores for student behavior, a Kolmogorov-Smirnov Test for Two Samples was used.

A paired-sample t-test was run to investigate if there was a significant difference in the mean scores of both WAM and the conventional groups in the Conceptual Understanding Test.

To analyze the result on the conceptual understanding test better, the researcher looked into the scores per item of both the WAM and the conventional group. Mean scores for the pretest and the posttest of the WAM and the conventional groups are determined for every item and the differences between the posttest and pretest were compared. Also, the items on which both the WAM and the conventional groups had a significant difference were analyzed by comparing their means.

Presentation and Analysis of Data

Student Behavior

To check the characteristic of the data in student behavior, a Shapiro-Wilk test for normality was used. Table 2 shows the result of such test.

Table 2. Shapiro-Wilk W test for Normality

Variable	Observations	z	p-value
Behave of WAM	19	2.720	0.00327

The p-value of the set (0.00327) is less than the set level of significance which is 0.1. Thus, the null hypothesis is rejected and the data are deemed not normally distributed.

Due to the failure of the data to satisfy the normality assumption, t-test cannot be used. Instead, the Two-samples-test Kolmogorov-Smirnov Test, a nonparametric test, which makes no assumption on the distribution of the sample was employed. Table 3 shows the result of this test on student behavior.

Table 3. Two-Sample Kolmogorov-Smirnov Test for Student Behavior

Group	D	P-value
Conventional Group	0.6316	0.001
WAM Group	0.0000	1.000
Combined K-S	0.6316	0.001

Using Two-sample Kolmogorov-Smirnov Test, the test statistic is (m*n*D = 19*19*0.6316) 228. This is greater than the critical value $D_{0.1,\,19,\,19} = 152$.

This means that the null hypothesis (Ho) is rejected and that there is no significant difference between the two treatments. Thus, the alternative hypothesis is accepted and that the difference between the conventional and WAM groups is negative. A negative difference means that the mean score of the WAM group is greater than that of the conventional group. Thus, it can be concluded that the students under WAM have a higher behavioral mean score than the students under the conventional method.

The more positive observation on the behavior of students in the WAM group compared to students with the conventional group agrees with the argument of Rusbult (2000) that an education process that allows students to input, discuss, and even evaluate their ideas enables

them to participate in the process better. Because in these process students are able to integrate their own ideas and even defend them.

Students exposed to WAM were more participative because they have realized the connections between the subject matter being taught and their experiences or their worldviews, such method coincides with the idea of Cobern and Lythcott (1991).

Comparison of Scores in Student Behavior for Each Group of Criteria

Table 4 presents the results of the observations on the WAM and conventional groups for six weeks for each of the criteria in the checklist.

Table 4. Mode of Student Behavior Observation Scores

Criteria	Mode of Scores	
	Conventional Group	WAM Group
Classroom Behavior	21.00	23.00
Class Interaction	22.00	23.00
Group Tasks	20.00	24.00

For each criterion, the perfect score is 24 points. Data show that both the WAM and conventional groups have scores which are way above the passing mark. The WAM group had scores consistently higher than those of the conventional group in each criterion. It is in the group tasks category that the WAM group differed most from the conventional group. Such result indicates that WAM allowed students to be more interested in tasks which they can relate to.

The observer cited that students exposed to WAM participated more in the class compared to those in the conventional group, *"students are more active in Milton (WAM group)"*, she said.

Also, the teacher-researcher observed that the students under WAM have been more active than they were during the previous three quarters. Passive students have become more cooperative than before.

Researcher Observation for Student Behavior

The researcher observed that the WAM group participated in class discussions in a more personal way. Students answered questions on how they have perceived a certain concept. As an example, when asked, "*Based on your own point of view, what do you mean when you say energy?"* Students in the WAM group answered, "*it gives you power, has something to do with strength, makes you do work*". In the discussion, it can be said that though students were not able to definitely describe the concept of energy, they still managed to associate their personal views and gave certain responses on the question.

On the other hand, students in the conventional group when asked, "What is energy?" gave varied answers from "*potential, kinetic, and gravitational*".

The most interesting topic discussed in this research is evolution because it revealed most worldview incoherency between science and students' personal belief. When the teacher discussed the concept of evolution, students in the WAM group were made to take note which part or concept discussed they found hard to understand or even believe.

For the engagement part of the lesson, students were given a puzzle of an evolution to be formed. Both the WAM and the conventional groups have been observed to have participated in the activity. Students of WAM group were asked with different questions for assimilation. When asked, "*What does the picture show?"* they answered in chorus "*Evolution!".* One of the students said, "*it shows different changes in humans"*. Students were made to identify similar processes they could relate with the picture and they gave varied answers such as metamorphosis of butterflies, chick development and development of humans.

For assimilation, students of WAM group were allowed to formulate questions about evolution. Some of their questions are presented below.

- How many times have we evolved?
- If we really have evolved, why are there still monkeys around?
- Will we still evolve in the future?
- In all the animals, why would Darwin pick monkeys?

The researcher tried to answer all the queries of the students in the most scientific way. However, there were responses that were not necessarily questions but more of a feedback.

- Did that (Darwin's Theory) really happen? I believe that God created us and not from monkeys!
- Do humans really come from monkeys? That's a bit impossible….
- God created us!

Based on the questions and feedbacks gathered from students on evolution, it can be deduced that students' personal belief has a great impact on their ability to apprehend. Though evolution was discussed by the researcher as thoroughly as he could, and explained the mechanics on how it operates, it was inevitable that some students' would reject its truthfulness.

In Jubilee Christian Academy, biblical truths are integrated in each subject area. Maybe because of the strong foundation on such biblical truths, students reject the ideas on evolution and the big bang theory.

Conceptual Understanding

In determining whether WAM is more effective than the conventional method, the difference in the pre-CUT and post CUT mean scores for the conventional and WAM groups were calculated. In order to determine the test to be used, the distribution of the differences (diff_conv and diff_wam) was determined.

Using Shapiro-Wilk Test for Normality, it was determined that the scores are normally distributed at 0.1 level of significance. Also, the variances of the two differences are found to be equal. Therefore, in comparing the means of the two variances, t-test for paired samples assuming equal variances was used. The result of the analysis is shown in Table 5.

Table5. Paired Samples t-test for Conceptual Understanding

Group	Pre/Posttest	Mean	Mean Diff.	N	Std. Deviation	Std. Error Mean	T	df	Sig. (2-tailed)
Conventional	Pretest	64.26	26.31	42	13.594	2.098	-10.995	41	.000
	Posttest	90.57		42	20.145	3.108			
WAM	Pretest	61.74	47.07	42	15.839	2.444	-17.438	41	.000
	Posttest	102.81		42	16.919	2.611			

The pretest of the conventional group had a mean score of 64.26 (SD=13.59) which is about 42.84 %. The score of students in the conventional group ranged from 30% to 65.33%. The number of students in the conventional group who passed the pretest is about 24% .

The WAM group obtained a mean score of 61.74 (SD=15.84) or a mean percentage of 41.16%. Scores of students under WAM group ranged from 24.83% to 74%. There were only 20% of the students who passed the pretest. In general, both the conventional group (M= 64.26;42.84%) and the WAM group (M= 61.74;41.16%) did not pass the pretest (below 50%).

For the posttest, the conventional group had a mean score of 90.57 (SD=20.15). The scores varied from 32.67% to 95.17%. About 73% of students in the conventional group passed the posttest. The WAM group obtained a mean score of 102.81 (SD=16.919). Students' scores are within 33.10% to 89.66%. About 91% of the students passed the post test. Both the WAM and the conventional group passed the posttest.

The correlation between the pre test and the posttest of the WAM is 0.567 and while that for the conventional group is 0.639. Both correlations are significant ($p<.001$). In this regard, it can be said that students who performed well in the pretest also performed well in the posttest.

When the mean score difference in the pretest and posttest of the WAM and the conventional groups are compared, WAM had a greater mean difference of 41.071 (SD=15.264) compared to that of the conventional group (M=26.310; SD=0.639). In mean percentage differences, WAM group had a 28.32% while the conventional group had a mean percentage difference of 18.14 %. With these data at hand, it can be inferred that the WAM group had increased their mean scores in their CUT better than the conventional group.

The t-test for the conventional group (t=-11.00, df = 41, sig = .000) and the WAM group (t=-17.44, df = 41, sig =.000) showed that there is a significant difference between the pretest and the posttest scores.

The result of the of the conceptual understanding test agrees with the theory of Cobern(1993) that it is not enough to teach students with just mere concepts, but making them understand the need to know so they can be literate in the real sense of the word. Making students understand the concept to enable them to make connections with the world in a more meaningful way promotes responsible decision making, which is a significant skill in life.

Moreover, the significant difference between the conceptual understanding test of the WAM and the conventional group, supports the idea of Lythcott(1991) that if students find their voices in the class and are able to connect with what they are supposed to learn, they will achieve the main of goal of science, which is to find meaning of the world around them and make sense of it.

Also, the result of the conceptual understanding test answers the suggestion of Olatunde and Owolabi (2008) that a classroom instruction that aims to dig deeper on the beliefs of students can allow the misconception of students to resurface. Thus, such misconceptions can be addressed accordingly.

Both the WAM and the conventional groups significantly improved difference in the result of their pretest because they were both exposed to varied teaching strategies that allowed them to think critically such as inquiry technique and hands-on activities like those Gabel (2003) suggested.

Conceptual Understanding Items

Table 6 summarizes the result of the CUT based on topic distribution.

Table 6. Mean Difference per Topic in CUT

Topic	Location in CUT	Mean Difference in Pretest and Posttest	
		Conventional Group	WAM Group
Evolution	9, 10, 11, 12, 29, 30	28.60	35.60
Work	21	14.00	50.00
Energy	1, 2, 5, 15, 18, 19	41.17	41.67
Earth Structure	3, 6, 13, 14, 17, 23	30.33	47.00
Plate Tectonics	24, 26, 27, 29	12.50	31.00
Solar System	4, 22, 7, 8, 16, 20, 25	35.43	41.57

**Mean Difference = posttest-pretest-*

Both the WAM (M_{diff}=41.67) and the conventional groups (M_{diff} =41.17) scored fairly in topics about energy. Also, as seen in the table, the WAM and the conventional groups improved in their conceptual understanding test for all the topics. However, it is also observed that the WAM group consistently had a higher mean difference in all the topics compared to the conventional group.

An interesting fact on the data gathered is in the topic about evolution because it showed how students' unbelief affected their conceptual understanding. In the observation of the researcher on student behaviour, he noticed that during the assimilation part, students refused to believe in evolution. Though the WAM group improved their scores in questions on evolution, still it can be observed that among the different topics, it was the least that the WAM group has improved on. One of the questions on evolution asked students to infer how some birds survived while others died out. Most of them answered, *"because they interbreed with other species",* which is not correct because organisms of different species could not naturally breed with each other. Students failed to comprehend that developing better body structures for survival enabled the said birds to survive. Such misconceptions may have been brought about by their conflicting worldviews on faith and science theories.

Though most of the students under the WAM group had better mean scores in almost all of the questions, there were two items where the conventional group obtained a higher mean score than the WAM group. The conventional group had gained 18% and 10% mean difference in Item numbers 6 and 20, respectively.

For Item number 6 most of the students under the WAM group failed to choose the letter of the correct answer and their explanations revealed that they also have failed to analyze that

earth processes like orogeny or mountain building processes can also push rocks beneath the earth upward. Such concept was well analyzed by one of the students in the conventional group. He answered that "*Because older rock layers that are 200, 000 years old maybe due but due to geologic processes, it came up or pushed closer to the earth's surface.*"

In Item number 20, the 10 % difference was due to a low comprehension of the respondent. One of the students under WAM answered that *"Based on my belief, Mercury has a lighter color so it reflects light(heat) but Venus is darker so it absorb more heat."* Such answer was given 2 points since her tried to explain his answer in a scientific way, still such notion is incorrect. The student failed to comprehend that Venus has a high content of carbon dioxide that it causes greenhouse effect. However, in the conventional group one of the students answered that *"Carbon dioxide is the gas that causes global warming on earth"*. Her answer was given 4 points because it is conceptually correct.

Students of WAM and conventional groups have performed well in items number 3, 4, 9, 12, 21, and 25. Both students of WAM and the conventional groups also shared the average ability of students in items number 14, 15, 20, and 24. Lastly, students found difficulty answering numbers 1, 5, 8, 10, 11, 13, 17, and 18.

The rest of the scores for both the WAM and conventional groups are distributed randomly. However, among such randomly assigned scores it has been observed that while the conventional group had performed averagely in items 19, 23, 27, and 30, the WAM group performed high in these items.

Implication to Science Teaching

Science aims to explain the natural world. It allows humans to ask questions about the world they live in, and also motivates them to seek answers to certain questions. Such question-and-answer routine attempts to give meaning on the different phenomena that happen in a person's life.

As a curricular subject, science presents the ideas, perceived true by the investigations and experiments of experts. When discussed to students, truthfulness of such science ideas is weighed using student worldviews.

The *Worldview Assimilation Method* allowed students to participate, relate and even assess certain science concepts and allowed them to rationalize whether they perceive such idea to be true or not. Upon exposing students to such method, it was found out that when they are able to grasp the concept on their own level, they tend to have a better conceptual understanding.

It is the goal of education to have learners with sound understanding. Thus, it is a must to see all things that hinder a student to understand or find any other way to help them develop understanding. This study suggests the following to help science educators, in one way or another, achieve their goals:

1. Allow students to find meaning on their quest for knowledge because according to Cobern (1993), teaching students with just mere concepts is not enough. The method of instruction must also be considered. WAM considers the different worldviews of students and allows them t o justify if such views are correct or not.

2. This research reveals that the students' conceptual understanding is influenced by their belief system. Students find it hard to understand a concept because they do not believe it. Such unbelief can easily lead to misconceptions.
3. Also, this research can help improve the teacher-student relationship in a classroom. WAM allows students to find the connection between their experiences and the concepts being discussed. When a teacher takes note of these experiences and explains concepts related to them, the students will behave properly, participate more in the discussion, and even take more responsibilities in group tasks.

Conclusion

After analyzing the data gathered, the following conclusions are made.

1. *Worldview Assimilation Method* is an effective teaching approach to make students behave better in a classroom, interact well in the discussion, and effectively perform in group tasks.
2. The *Worldview Assimilation Method* enables students to understand concepts better than the conventional teaching approach.

Recommendations

Based on the findings of this research, the following recommendations are suggested.

1. *For School Administration.* The school administration should carefully review the competencies discussed in a certain subject matter and the design or approach with which they will be taught. They should send teachers to training programs for them to be equipped with skills and techniques on WAM.
2. *For Curriculum Planners.* Experts on curriculum should develop programs that will improve the WAM. Materials such as books, activity sheets, and visual aids that can help students assimilate their worldview on the concepts, will truly help.
3. *For Teachers*. Worldview Assimilation Method supports the idea that students learn better if their experiences, previous knowledge, and beliefs are used as part of the education process. Discussions anchored on what they have experienced, learned, and believed can help students reveal their misconceptions, thus a teacher can have the opportunity to correct them. Worldview consideration, directly or indirectly, enables students to realize the importance of the concepts learned in relation to their daily lives.
4. *For Future Research*. A research on how students accommodate new worldviews, once their existing ones are proven erroneous, can be conducted. With regards to controversial topics such as big bang theory and evolution, it will be helpful to know why and how students accommodate or fail to accommodate new worldviews.

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