

Effect of Advance Organizers Teaching Approach on Student's Achievement in Biology in Public County Secondary Schools in Kitui Central Sub- County, Kitui County Kenya

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Abstract: - The purpose of the study therefore was to establish in biology in secondary school. The study adopted a Quasi Experimental research design and in particular the effect of the use of Advance Organizers on the students' achievement Solomon's Four Non Equivalent Control Group Research Design. The accessible population was 252 form three students in single county schools in Kitui central sub county participated in the study. Simple random sampling technique was used to select and to assign participating schools in experimental and control groups. Descriptive statistic and inferential statistics, ANOVA and t-test were used to analyse the data. Results of this study reveals that the use of Advance Organizers significantly improves achievements of students to learn biology. The researcher recommends extensive utilization of Advance Organizers be communicated to administrators, teachers and students teachers of all grades and disciplines through on going supportive professional development activities.

Key words: Achievements, Advance Organizers, Ecology

I. THE IMPORTANCE OF TEACHING AND LEARNING BIOLOGY

Biological knowledge plays a fundamental role in most aspects of human life. Its applications in genetic engineering have resulted in the production of high yielding plant and animal species. This has made a tremendous contribution towards meeting the demand of food requirements for the ever growing human population (Burns & Bottino, 1989). Biological knowledge has also been applied in branches of medicine such as organ transplant and control of a wide range of diseases.

Biological knowledge is also applied in industry such as the use of microorganisms in food processing. Other areas where biological knowledge has been applied include population control and environmental conservation (UNESCO, 1986). In conflicting research especially in challenges posed by diseases such as Ebola and HIV AND AIDS biology remains a very important component (Minish et al, 2004)

There is a rapid change taking place in industrial, communication, agriculture and medicine and biology plays an important role in advancing these changes through

technological development promoting national wealth and industrialization (Njue, 2016). If Kenya government is to meet her goal of industrial development by 2030 it should expand science and technology education in order to produce the required human resource (Changeiywo, 2001). It is therefore important for teachers to use approaches that would enhance learners' motivation towards science and hence motivation to learning biology. Without the development of positive motivations towards the learning of science, learners will not be well prepared to acquire scientific knowledge and skills necessary for meaningful contribution to debates and decisions on societal issues that have a scientific orientation. Biology involves the pursuit of truth; hence it inculcates intellectual honesty, diligence and perseverance (Das, 2001).

(Sakiyo, 2015) Conducted a research on Implementation for the attainment of Millennium Development in Nigeria. Where they discovered that Students academic performance in sciences is crucial for national development and attainment of the millennium development goal. Education is crucial in liberating man from ignorance and the attainment of any vision or goal. Science and technology is the engine that drives technological development and national development. The dismal performance of students in science portends the danger for national development.

Most of the instructional methods used in Kenyan classrooms are usually teacher centred thereby giving students with few opportunities for active participation in the classroom discourse (Kiboss 2000, Tanui, 2003). Kiboss (2002) argued that expository approach is the dominant teaching method commonly used for science instruction in Kenyan schools. It is therefore necessary to use methods which utilize instructional activities in which students are involved in doing and thinking of application of what they are learning.

According to (Mamalanga and Madau, 2014) who sought to find out factors affecting Biology performance uncovered that the quality of teachers is one of the factors affecting performance in Lesotho. They discovered that the way biology is taught and assessed could be regarded as one factor

of the factors affecting Biology performance. The teaching style plays a very important role in the academic success of the learners. (Malongo, 2015) in his study found out that high mean score for the experimental group was attributed to teaching methodology used by teachers through hands on, learner centred approach and through experimental design. He further discovered that inquiry approach provides means to increased interest in science by students

Low achievement in science implies that fewer students will pursue higher education in science and science related disciplines and career. The below average performance of students in Biology, Chemistry, Physics, Mathematics and English from 2008 to 2012 in Nigeria suggests that the attainment of the Millennium development goal by 2015 may be difficult and impossible. Nigeria needed scientists and technologists to grease its wheel of development in science and technology which is the index of development of nations in the world (Badau, 2015)

Auwalu(2014) examined the academic achievement in biology in Kano state Nigeria showed that the level of students' academic achievement in Biology subject was very low. The declining performance in secondary school in Kano district was disappointing. Poor performance in the science is caused by the poor quality of science teachers. From the analysis he realized that the level of students' achievements in Biology was low, about 73% of the students 11939 who sat for SSCE examination from 2007-2011 had below 40 percentage mean.

Academic achievements refer to a performance in school in a standardized series of educational test (Good 1974). According to (Nimmi, 2015) comparison of boys and girls in academic achievements showed that there was no significant difference between boys and girls with regard to academic achievement

Objectives of the study

To determine the effect of use of advance organizes teaching approach on student's achievements in Biology in secondary schools in Kitui County.

Hypothesis

H₀₁ There is no statistical significant difference in achievement scores between students taught using Advance Organizers and those taught using conventional methods.

Statement of the problem

The government of Kenya is geared towards provision of qualified educational training and innovation in schools and other institutions of learning. This is important in making Kenya an industrialized middle income economy providing high quality life for its citizens as envisaged in vision 2030. The government of Kenya has allocated massive resources to education sector which is still faced with challenges which are likely to undermine the envisioned development. One of the challenges is dismal performance in science subjects among

high school students particularly in biology. This has probably negatively affected the learners' motivation to learn biology. Research indicates that students are unable to interpret questions, do not possess scientific language and fail to relate biological knowledge to real life. Several interventions have been put in place to improve the achievement in this subject. The government of Kenya has corroborated with Japanese Government to cascade SMASSE programme in secondary schools. The purpose of SMASSE was to entrench effective classroom practices in biology to ensure a strong foundation was laid for the subject. However, with such an effort the achievement of students in biology has continued to decline. This study utilizes strategies that lay the structure for thinking and conceptual bridge between the known and unknown hence making information to embed in the memory for a very long time. The main objective for this study was to bridge this gap. This study investigated the effect of Advance Organizers on student's achievement in biology.

The Effect of Advance Organizers on Student's Achievement

Advance Organizers (Advance Organizers) enhance learners' motivation. Advance Organizers enable students to be active cognitively. He discovered that teachers are most important agents that can influence change in the student's motivation towards science through stimulating and motivating instructional strategies like Advance Organizers (Hudson, 2009).

Raj Rani Agarwal (2004) in study found that the Advance Organizers model and the concept attainment were found more effective than conventional methods in fostering concept learning. Mayer (2004) Abstract Forty-four published research studies in which Advance Organizers were reviewed. Twenty-seven studies included an advance organizer vs. a control group (standard advance organizer study) and 17 studies included an advance organizer vs. a post organizer group (modified advance organizer study). Results of the studies were compared to the predictions of several theories. In addition, four specific predictions of assimilation theory were evaluated: that Advance Organizers should have a stronger effect for poorly organized text than for well-organized text, that Advance Organizers should have a stronger positive effect for learners lacking prerequisite knowledge, that Advance Organizers should have a stronger effect for learners lacking prerequisite abilities, and that Advance Organizers should have strong effect on measures of transfer rather than retention

Raj Rani Agarwal (2004) in a study found that the Advance Organizer Model and the Concept Attainment were found more effective than the Conventional Method in fostering concept learning. Keppell (2001) conducted a study which explored the development, trial, and implementation of the Content Production Process (CPP) which was designed to assist instructional designers in eliciting and conceptualizing unfamiliar content from subject matter experts. Highlights include Advance Organizers, schema theory, consultation

practices, knowledge acquisition in constructing expert systems. A study by (Githua & Nyabwa, 2005) has demonstrated the effectiveness of using Advance Organizers in teaching mathematics in secondary schools.

Bastick (2001) in a study tested the common assumption that lists of instructional objectives (LIOs) presented at the start of a lesson are used as Advance Organizers (Advance Organizers). Because traditional research designs have yielded conflicting results, an alternative design was used that sought to falsify the necessary association between the objectives and their use that results when Advance Organizers are used.

Callison (2000) focuses on "organizers," tools or techniques that provide identification and classification along with possible relationships or connections among ideas, concepts, and issues. The findings discuss David Ausubel's research and ideas concerning Advance Organizers; the implications of Ausubel's theory to curriculum and teaching and "webbing," a specific organizational technique; and graphic organizers.

Wachanga and Mwangi (2009) found out that cooperative class experiment as advance organizer facilitated chemistry learning more than regular teaching methods in 2010. (NjueA, 2010) found out that students taught using constructivist method teaching strategy [CTS] achieve relatively higher scores in chemistry. (Mugira, Arimba, Zachariah, Mbugua and Samuel Wachanga (2013) found out that there is merit in using advance organizer approach to enhance students' achievements. They found out that when students are given Advance Organizers prior to actual learning the learners' attention is actually directed to the most important aspect of the lesson in term of understanding the main concept than the ability to recall facts, definitions and formulae.

Adebola (2011) recommends that behavioural objectives and other forms of Advance Organizers should be used in teaching mathematics at secondary level. Adebola found out that use of Advance Organizers is an effective strategy for teaching and learning mathematic in senior school. (Wachanga & Mwangi, 2004) explained that successful teaching and learning depends partly on the correct use of teaching methods whose activities target most learners senses. Advance Organizers is statement of inclusive concept to introduce and sum up materials that follow (Woolfolk, 2001)

Bransford and Anderson (2004) agree with Ausubel that Advance Organizers are an excellent way to achieve and build schema prior to actual learning of new materials by students based on the initial response of the material present in the organizer. Teachers can modify the lesson plan and material to better fit the prior knowledge of their students, in addition they efficiently structure their time and critical points that need to be covered while simplifying complicated texts (Bransford, 2004). This enhances the development of higher order thinking in their students by helping them to quickly organize their thoughts, if no knowledge is available Advance

Organizers are used to give knowledge to the student in order for this framework to be followed.

(Wachanga, Orimba and Mbugua 2013) in their research concluded that students' achievement is higher when they are taught through Advance Organizers teaching approach (Advance Organizers TA). In (Mohammad, 2010) investigated the role of Advance Organizers in English language learning and in found out that research findings have provided evidence of the superior effects when various types of Advance Organizers are used to facilitate reading comprehensions. Evans 2003 investigated the effect of graphic organizers for Japanese readers on expository texts in English and found out that students generated graphic organizers help accommodate different learners' styles lead to meaningful learning and enhance reading comprehension.

(Mayer, 2003) believed that Advance Organizers helped to organize new materials by outlining, arranging and sequencing the main ideas of the new materials based on what already the learner knows. Advance Organizers use familiar terms and concepts to link what already the student knows to new information that will be presented in the lesson, which aid in the process of transforming knowledge and creatively applying it. In new situations. This process helps to embed the new information in to long term memory. Advance Organizers don't have to be length or complex just clearly understood and related to the material (Mohammad, 2010). Advance Organizers can include pictures, verbal description, requisitioning techniques, graphic, visual Advance Organizers. (Ausubel And Robinson, 1969) contend that the material presented to the learner must possess relevant ideas to which the new idea can be related or anchored to.

Bastick (1999) in this study investigated the assumption that students use instructional objectives as Advance Organizers. This assumption, developed by (Ausubel, Novak and Hanesion, , 1978) is appealing to instructors, but has been difficult to test experimentally. Tyler and Reynolds (1998) used a model for incorporating feature films into a course for training group facilitators is presented. Using cognitive learning theories, the authors describe how films may be used as an advanced organizer, as the basis for student learning assessment, or as examples of specific theory in action. Specific examples are provided.

(Shihusa & Keraro, 2009) investigated on the effect of Advance Organizers on students' Achievements in biology of Bureti District Kenya. The data collected by use a biology Achievement alpha level of 0.05. The findings indicated that students taught using Advance Organizers significantly higher than those taught using conventional teaching methods.

Samwel (2010) Et.al did a study on advance organizer teaching approach on secondary school students Achievements in Chemistry in Maara District, Kenya. Based on the study, it was observed that students who are taught through Advance Organizers achieved a higher mean score than those taught R.T.M. Gender achievements when they are

taught through Advance Organizers. In this study, students who were taught using AO posted a significant improvement in BAT post test mean scores.

II. RESEARCH DESIGN

The study involved Quasi-experimental research in which the researcher used Solomon’s four-group, non-equivalent control group design. The design give the researcher confidence in the significance of the study results since it guards against both threat of internal and external validity (Coolican, 1994). Solomon’s four-group enabled the researcher to make a more complex assessment of the cause of the change in the dependent variable and even tell whether changes in the dependent variables are due to the interactions effect between the pre-test and treatment.

		pre-test	treatment	post-test
Group I Experimental	E1	O ₁	X	O ₂
Group II Control	C1	O ₃	-	O ₄
Group III Experimental	E2		X	O ₅
Group IV Control	C2		-	O ₆

In Solomon’s Four Non Equivalent Control Group Design the dotted lines signify that the four groups are non-equivalent. X is the treatment where students were taught through Advance Organizers Approach. O₁ and O₃ are pre-tests while O₂, O₄, O₅, O₆ are post-tests. Group I is the experimental group E1, received the pre-test, the treatment and the post test. Group II is the control group C1, which received a pre-test followed by the control condition and finally post-test. Experimental group E2 Group III is the group that will receive X-treatment and a post test, it was not pretested. Group IV is a control group C2 that received post-test only.

The students were taught by their respective teachers and were not aware of the experimentation. The experimental and control group formed different schools to avoid interaction of subjects.

1. Biology Achievement Test (BAT)

A Biology Achievement Test (BAT) was developed and used in this study. The BAT contained 15 Short answer questions with total score of 30 marks on the topic; The items tested knowledge, comprehension and application of material learnt.

2. Reliability

Reliability coefficient of BAT was computed using K under-Richardson method, particularly Formula K.R 21. Reliability of SMQ was estimated using the Cronbach’s coefficient alpha which is considered appropriate because it determines the reliability of instruments using a single administration. A reliability coefficient of 0.82 was obtained, this shows that the reliability of the instrument was suitable as recommended by Tavakol & Denick(2011).

Data Analysis

The data collected was quantitative and was analysed using both descriptive and inferential statistics. Descriptive statistics of means, standard deviation and percentages were used to analyse raw data. The inferential statistics of Analysis of Variance (ANOVA) and t-test was used to list statistical significant difference within and among means in the post-test scores for the groups exposed to scientific problem solving instruction and those exposed to conventional teaching methods. t- test was used to compare means of two groups. ANOVA will be used to compare means of four groups. Hypothesis were tested at alpha value $\alpha = 0.05$ level of significance. A computer package, Statistical Package for Social Sciences (SPSS) Version 21 for Windows will be used to do analysis.

III. RESULTS AND DISCUSSION

Demographic characteristics of respondents

A total 252 students sampled from Kitui central sub county participated in the study. 130 boys and 122 girls participated in the study as indicated in table 1

GENDER OF THE STUDENT					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	FEMALE	122	48.4	48.4	48.4
	MALE	130	51.6	51.6	100.0
	Total	252	100.0	100.0	

All the participants were randomly assigned to the four groups of study as indicated in table 2. Groups 1 and 3 were experimental groups and were given treatment using AOTA whereas groups 2 and 4 were control groups, they were taught using conventional method of teaching .table.2. shows the composition of groups

Table.2. The composition of group

Group	Nature	Frequency
1	EXPERIMENTAL1	98
2	CONTROL1	30
3	EXPERIMENTAL2	62
4	CONTROL2	62
	Total	252

Results of the Pre-test

The researcher administered a BAT pre-test to two groups involved in the study. The aim of the pre-test was to ascertain whether or not the students selected to participate in this study had comparable characteristics before intervention. The results are presented in Table 3

Table 3: Independent sample t-test of pre-test scores on BAT

Variable	Group	Mean	Std. Dev.	t-value	p-value
BAT	1N = 98	18	9.4	1.83	0.075*
	2N = 30	13.8	4.08		

As shown in Table 3, the pre-test mean score in groups 1 was 18 and that of group 2 was 13.8. Students in Group one had a high mean score than group two. Further analysis of these results was carried out in order to establish whether the mean scores were statistically different at $\alpha = 0.05$ significance level. The t-test results analysis reveals that the pre-test mean scores for group 1 and 2 were not statistically significant ($t(1,83) = 1.83$, $p > 0.05$), this implies that the groups of study had homogeneous characteristics before administration of treatment. Table 5 presents the pre-test mean scores.

Results of the post-test

The four groups involved in the study were exposed to a post test at the end of the 5 week instructional period. The data collected was analysed separately for each objective.

Effects of Advance Organizers on Students Achievements in Biology

To determine the effect of Advance Organizers on students' achievement in biology the analysis of BAT post test scores was carried out. Hypotheses one, H_{01} of the study sought to find out whether there was statistically significant difference between students exposed to Advance Organizers and those exposed to CTA. Table 4 presents the descriptives of post test scores from the four groups of study on BAT.

Table 4: Descriptives of post test scores

GROUP OF THE STUDENT	Mean	Std. Deviation
EXPERIMENTAL1	52.47	12.672
CONTROL1	28.97	5.928
EXPERIMENTAL2	59.48	7.548
CONTROL2	27.62	10.236
Total	45.40	16.839

The results in table 4 reveals that experimental groups performed better than control groups, however, to establish whether the mean difference was significant, a one way ANOVA was conducted. Table 5 shows the results of the ANOVA of Post test mean scores

Table 5 results of the ANOVA of Post-test mean scores

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10477.654	3	3492.551	56.979	.000
Within Groups	8090.986	132	61.295		
Total	18568.640	135			

Results in Table5 reveals that the differences in achievement in the four groups were significant ($F(3,162) = 69.92$, $P < 0.05$). Hypotheses one, H_{01} of the study sought to find out whether there was statistically significant difference between students exposed to Advance Organizers and those exposed to CTA. To determine where the differences existed a Least Significant Difference (LSD) *post hoc* comparisons was used. LSD *post hoc* is preferred over other means separation statistics because of its ability to establish whether there was statistically significant difference in achievement between students taught through Advance Organizers and those taught through Conventional Teaching Approaches.

Table 6 the post hoc analysis of post test scores

(I) Group of the student	(J) Group of the student	Mean Difference (I-J)	Std. Error	Sig.
Experimental 1	Control 1	15.86323*	1.87458	.000
	Experimental 2	-4.25801*	1.89967	.027
	Control 2	14.09775*	1.95824	.000
Control 1	Experimental 1	-15.86323*	1.87458	.000
	Experimental 2	-20.12124*	1.84606	.000
	Control 2	-1.76548	1.90628	.356
Experimental 2	Experimental 1	4.25801*	1.89967	.027
	Control 1	20.12124*	1.84606	.000
	Control 2	18.35576*	1.93095	.000
Control 2	Experimental 1	-14.09775*	1.95824	.000
	Control 1	1.76548	1.90628	.356
	Experimental 2	-18.35576*	1.93095	.000

The results in Table 7 show that the pairs of BAT mean scores of group 1 and 2, 1 and 4, 2 and 3 and 3 and 4 were statistically different at $\alpha=0.05$ level. However, the mean scores for experimental group 1 and 3 and control group 1 and 4 were not statistically significant. In the view of these findings the null hypothesis, H_{01} which suggested that there is no statistically significant difference between achievements scores of students who are exposed to Advance Organizers and those who are not exposed to rejected.

IV. DISCUSSION OF THE RESULTS

In the view of these findings the null hypothesis, H_{01} which suggested that there is no statistically significant difference between achievement scores of students who are exposed to Advance Organizers and those who are not exposed to it is rejected. The finding of this study indicates that the use of Advance Organizers brought positive and constructive change in the learning achievements of students. Students taught through Advance Organizers performed significantly better than those taught through regular methods. This implies that Advance Organizers method enhanced students' achievements than regular teaching methods.

The Advance Organizers highly emphasized the application of science process skills on major concepts of topics taught. Extensive use of the skills is attributed to higher achievements amongst students in experimental groups. In a related study to investigate the effects of science process skills training on students achievements found out those students who had Science Process Skills SPS training succeeded more than students with traditional training (Aktamis, 2008). Similarly studies show that there was increase in achievement levels of students at the end of SPS training done on science courses by Ardac & Mugaloghu (2002), laboratory and computer aided training done based on SPS training in chemistry course (Turpin, 2000). In another comprehensive study, Roehrig et al. (2001) presented the Advance Organizers as an alternative evaluation tool compared to the traditional laboratory reports. The Advance Organizers was examined and discussed under 6 different dimensions: Focus question, Word list, Concept map, Events, Data and analysis and Conclusions. The study focused on how and why to use Advance Organizers.

Luft *et al.*, (2001) reported that students using the Advance Organizers were more successful in such processes as organizing the experiment, analyzing and generalizing the data, stating the results clearly, and thinking and learning. In a related study, Tsai *et al.*, (2001), examined how students did their homework based on the Advance Organizers as the primary activity and then how they evaluated their homework together in class. At the end of their study, the researchers stated that an evaluation tool based on the Advance Organizers was a method beneficial for pre-service teachers to prepare scientific activities.

Cömlekoglu and Gür (2002), in their study, reported that there should be all the elements of the Advance Organizers within a well-prepared structure of information. The findings of this study concurs with Meric, (2003) who emphasized that Advance Organizers could become the only tool for instruction and evaluation which could also prevent boring hours of lessons and which could lead to meaningful learning.

Ahlberg *et al.*, (2005), in their 4-year action research on the development of the curriculum for the course of home economics in pre-service teacher training program, used concept maps and Advance Organizers for the planning, execution and evaluation of the research process. Consequently, the researchers observed that these were all influential on teacher candidates' professional development and on their thinking. Calais (2009) investigated the use of Advance Organizers in other fields besides mathematics and science. As a result of the applications, the researcher pointed out that Advance Organizers not only helped students to understand and transfer the information but also provide teachers with practical benefits.

In line with qualitative data obtained in a study conducted by Afamasaga-Fuat'i (2011), the researcher found out that students' use of such techniques as Advance Organizers in learning mathematics, in establishing reason-result

relationships and in solving problems led to significant cognitive development. These findings demonstrated that Advance Organizers could be applied in secondary and elementary school mathematic courses.

Further, Osguthorpe & Graham (2010) found that blended instruction methods improve pedagogy, increase access knowledge, foster social interaction, increased the amount of teacher presence during learning, improved cost effectiveness and enhanced ease of revision. In conclusion, the findings of this study show that more opportunities should be given to discussion, problem solving, creating solutions and working the peers.

V. IMPLICATIONS OF THE FINDINGS

Research suggests that advance organizers teaching is an effective way to teach. It encourages active and meaningful learning and promotes responsibility and autonomy. Because extensive use of advance organizers teaching is beneficial in achieving desirable educational goals for students, it is important for teachers to grow professionally towards AO practice.

These findings have implications for the way AO and regular curricula are implemented. The confirm that the responsibility for the professional development of teachers fall largely on the teachers themselves. This concept is generally recognized by teachers; however, the incentive to pursue personal professional development over the course of one's career is frequently lacking in teachers. For example, the importance of collegial sharing and support is widely accepted yet infrequently practiced except informally. Similarly, teachers who are familiar with reflective practice resist it even though they recognize its importance in encouraging an awareness of how our students learn and, therefore, in how we need to reach. To encourage incentive, this research suggests that teachers need to be provided with opportunities, resources, support, encouragement and recognition in their professional development pursuits. They need to know that their efforts are being supported by their colleagues, administrators and school boards.

Considering the constructivist nature of many new curricula, it is important that the theory and concepts of regular and advance organizer teaching be communicated to administrators as well as teachers and student teachers of all grades and disciplines through on going, supportive professional development activities. The importance of administrative support for teachers attempting regular and constructivist strategies which entails the AO needs to be communicated to school administrators through professional literature and professional in-service.

University instructors in colleges of education need to model constructivist practices and provide supportive assistance to reserves and in-service teachers as they grapple with these practices in their practicum and internships.

Regular and constructivist practices may be modelled, and advance organizers activities and strategies may be presented to teachers in teacher in-services and workshops. A discussion of the implications of such practices for teachers and students needs to be included in these in-services. Issues and concerns of teachers as they begin to make their transition to constructivist teaching need to be acknowledged and addressed through discussion, explanations of what is to expect, practical suggestions, reassurance and supportive understanding of teachers' concerns.

Resource information about constructivist philosophy and practices written in a non-threatening style that respect current personal and practical knowledge where AO belongs would perhaps make personal and professional development towards a constructivist practice appealing. Information presented in a friendly and creative style may encourage teachers to embark on their own professional development journeys and may encourage teachers to be less reticent about risking innovative practices, thus beginning a development process of change. Indeed, an outcome of my study is that change is a developmental process in which practice often precedes theory, and teachers, encouraged to attempt constructivist practices and to be self-reflective, and inspired by the success of those practices, may, in time, acquire the philosophy that underpins that practice.

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