

ENVIRONMENTAL BELIEFS AND ATTITUDES: An Analysis of Ecological Affinity in Secondary Science Students in Indonesia

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Paper presented at the AARE Annual International Education Research Conference, Adelaide,
27th – 30th November, 2006

Abstract: A person constructs an interface with the environment and this environment accounts for many of their life experiences as they engage in community discourses. Their life experience contributes to the growth of the interface between the person and the environment and in turn justifies the beliefs constructed between community and the person. This paper assumes that a set of beliefs regarding the relationship between people and the environment promotes certain attitudes through which the degree of the interface can be measured. In a context in which the development of science and technology impacts environmental policies, a people's interface with the environment is challenged by their ecological affinity, which encompasses the extent to which they value science and technology, accept limits of growth, and recognize human domination of the environment. This paper describes an investigation of the extent to which a set of student beliefs and attitudes drives their intentions regarding the environment. Data for this study was collected from 236 secondary school science students in Indonesia and related directly to environmental topics in the Indonesian secondary science curriculum. Analysis of surveys and interviews revealed a complex relationship between student beliefs, attitudes, and intentions on one hand and location on the other. More active learning approaches seemed to promote integration, with participation in community issues having a greater impact on student ecological affinity than field research projects.

Introduction

This paper rests on some of the results of a study focusing on environmental education and citizenship values. The aim of the wider study is to reveal the impact of various approaches to science education on the relationships between student environmental beliefs and attitudes and their intention to maintain the quality of the environment. This paper explores the relationship between student beliefs and attitudes concerning environmental issues.

The importance of environmental issues in Indonesia has been increased by a number of recent developments. There has been a Memorandum of Understanding between the Ministry of National Education and the state ministry of the environment amending the need for improving the environmental education values of democratic and responsible citizens (Sirait, 2005; Balitbang, 2004). Sirait indicated that this memorandum intends

to refocus current curriculum orientations in Indonesian schools emphasizing understanding of environmental awareness to promote more positive attitudes toward the environment by young Indonesian generations (Sirait, 2005). This new emphasis is situated within the Indonesian educational Act with the ultimate national goal for education being that school has to educate children to be a democratic and responsible citizens (Balitbang, 2004). Both these initiatives become more compelling when understanding that the Indonesian Department of National Education has indicated that the 2004 standard curriculum of competence has to be implemented in 2007.

Students involved in this study dealt with compulsory parts of the Indonesian senior chemistry course in one of three ways. One group of students dealt with environmental issues through ordinary classroom teaching. A second group was involved in more active forms of science learning that led them to work independently and in group activities on environmental problems that they found in their local social situations. Students from this second group were involved in either community-based science participation or field research science activities through which students cooperatively worked on environmental issues found affecting their society.

The wider study found that positive changes in students' beliefs and attitudes were somewhat greater in the group taking a more active approach to environmental learning than they were in the group taught more ordinarily. The main issue being discussed in this paper is the extent to which the greater impacts of more active science learning in the society may be expected to flow into student environmental citizenship, that is, in the students intention to nurture their natural environment. The main concern underlying this issue has roots in the fact that human lifestyle is a function of human interaction in the society (Miller, 2005; Harris, 2004). This rests on the recognition that greater relationship between beliefs, attitudes and intentions is more likely to lead to more effective environmental citizenship, and that this in turn may have a more direct impact on creating good citizens (Jenkins, 2006; Davies, 2004; Jelin, 2000).

The underlying assumption of this study is that some citizenship values arise naturally in environmental issues and associated social problems. Therefore, engaging students in society-based science actions to deal with the issues and problems may influence students to develop values conducive to the environmental citizenship. This being so, involving students actively in environmental issues should increase their ecological affinity, predisposing them towards positive environmental citizenship attitudes and behaviors. Fishbein & Ajzen (1975, p.8) indicated this when they suggested that “.... a person holding a favorable attitude towards the object would be expected to perform any favorable behaviors and not to perform unfavorable behaviors....”

Methods

This paper is based on a series of surveys of student opinion, illuminated by observation and follow up interviews. The surveys were based on an instrument adapted from Fien, Yencken, & Sykes, (2002). The methodology was quasi-experimental, with ‘treatment’ consisting of variation between ordinary classroom teaching, group research into environmental issues and direct involvement in exploration of a socially significant local environmental issue. The aspect of the study discussed here investigated the impact of these treatments on the integration of student environmental beliefs, attitudes and intentions. The majority of study participants were students enrolled in the second grade of public school (year 11). The results described in this paper are limited to those from respondents in three of the seven schools participating in the wider study. These three schools included the student participants who undertook more active forms of science learning. One of the schools was from an urban area (n = 61 students), one was from the outskirts of the city (n = 86 students) and the third school (n = 89 students) was in a rural area. Based on the data from these schools, the paper presents comparative integrations of student beliefs, attitudes and intentions before and after ordinary environmental teaching and after more active science learning.

The researcher sought to increase the validity and reliability of this study by triangulating a number of approaches. Three different approaches to measurement were adopted, namely attitude scales to measure student ecological affinity and observations

and interviews to advance analyses regarding the contribution of more active science learning. Johnson and Christensen suggest that triangulation represents a strategy to, “seek convergence, corroboration, correspondence of results from different methods” (2004, p.423). In terms of the function of the triangulation method, Wiersma has stated that this method constituted “a qualitative cross-validation. It assesses the sufficiency of the data according to the convergence of multiple data sources or multiple data-collection procedures” (1995, p.263-264). Bourke (2003), has discussed the role of survey questionnaires, suggesting that, “Responses to questionnaire items are what respondents say they believe and say they would do...” (2003, p.2). This supports the use of other methods to support the data from surveys in this study to expose integration between student beliefs, attitudes and intentions.

This study deals with three variables, namely student environmental beliefs, attitudes and intentions. The environmental belief variable includes student environmental awareness, concept familiarity, priority placed on national development and confidence to act. Environmental attitudes involve the extent to which the advancement of science and technology is valued, limits of growth are accepted and peoples’ domination of the environment is recognized. Finally, this study measures student intentions to maintain the quality of the environment.

The following discussion deals with the relationship between student group beliefs and attitudes and the intention of those student groups to participate in maintaining the quality of the environment. The multi-dimensional charts that follow were built on the assumption that environmental intention represents a tangible outcome towards which change in student beliefs and attitudes are to be directed and so intention appears at the centre of the web with the other variables radiating from it. The data on which they rest was drawn from recoding of survey responses from the 236 students participating in the portion of the wider study reported here.

The charts illustrate the distance between student beliefs and attitudes and their environmental intentions. The belief component consists of awareness of environmental

issues ('*Awareness*' on the charts which follow), knowledge of environmental issues ('*Knowledge*'), priority placed on environmental concerns ('*Environmental priority*'), priority placed on economic concerns ('*Economic priority*'), priority placed on social concerns ('*Social priority*') and confidence to undertake action concerning the environment ('*Action confidence*'). The attitude component consists of reliance on the advancement of science and technology ('*SAT*'), recognition of limits to growth ('*LOG*'), and acceptance of people dominating the environment ('*PDN*' on Figures 1, 2 and 3). The centre of the chart surrounded by these radiating variables represents stated student intention regarding the environment.

The distance between the central intention point and an indicated point on a radiating variable axis was determined by subtracting the mean score for intention for the particular group from the mean scores for that group on that variable. This process yielded a number which was graphed as a point on the particular variable axis, indicating distance between a component of belief or attitude from mean intention. The charts can thus be understood as indicating relationships between group intentions regarding environmental issues and components of group belief and attitude: *The closer a variable is mapped to the centre, the stronger the relationship of that variable with positive group intention.* Joining the points on various axes produces a polygon whose changing shape reflects the impact of various teaching approaches on interactions between group beliefs and attitudes and environmental intentions. The charts which follow indicate such changes for three groups of students, those from a city school, those from a school on the outskirts of an urban area and those from a rural school.

This first phase of the study leaves open the possibility that observed differences are due to the novelty of the more active learning methods. The second phase of the study reported here challenges this by comparing the results from groups of students who were involved in community-based science participation with those involved in field research science activities through which they cooperatively worked on environmental issues found affecting their society.

Results and Discussions

Phase 1: Ordinary learning versus more active learning and the connection between beliefs, attitudes and intentions

Figure 1 shows the relationship of belief and attitude variables of a group of senior secondary science students in schools in an Indonesian city with that group's intention to maintain the quality of the environment. Attitudes and beliefs become more positive towards the environment as the centre of the web is approached. The centre of the web represents a very high level of group intention to protect the environment.

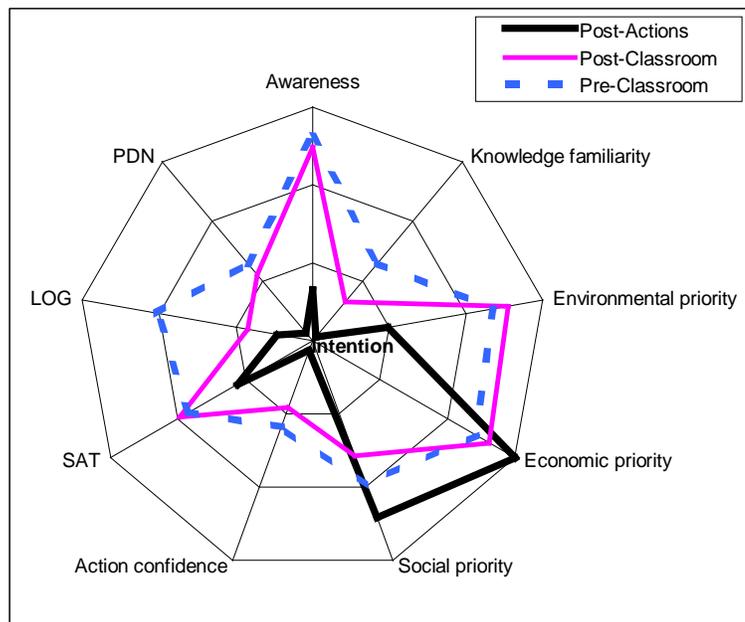


Figure 1 City participant performances of relationship of beliefs and attitudes with intention

It is apparent from the figure that active science learning (either research or community work) in the city had a stronger impact on every aspect of the relationships of group beliefs and attitudes with their intentions to maintain the quality of the environment than did ordinary classroom teaching. A more active approach appeared to reverse some defects occurring after ordinary teaching (such as an increasing distance between student beliefs regarding the priority of environmental issues and their intention to act),

and to reinforce the impacts of other environmental learning resulting from ordinary environmental teaching. For example, ordinary teaching increased the environmental knowledge of the students, decreasing the distance between knowledge and intention. More active science learning further improved the environmental knowledge of this group of senior students, decreasing the distance between their knowledge and intention and drawing them to the center of the web. This suggests that active science learning reinforced students knowledge regarding the environment and that encouraged them to reduce the distance between belief, attitude and intention. It is of interest that the shapes of the polygons emerging from the pre-teaching, post-classroom and post-action survey administrations appear to have few parallel portions. This may imply that the impact of science learning differs for various aspects of city students' beliefs and attitudes concerning the environment.

Figure 2 shows the respective distances between belief and intention for senior students from a school on the outskirts of an Indonesian city. The impact of active science learning appears to have a greater impact in this context. The changes in polygon shape are more marked.

Classroom teaching had an ambivalent impact on integration between beliefs, attitudes and intentions for this group of senior science students. Distance from intention has not noticeably changed for environmental awareness and the priority placed on social concerns and the distance between knowledge and intention has noticeably decreased. However, classroom teaching appears to have further distanced intention from prioritizing environmental and economic concerns, student confidence to act, their view of the utility of science and technology, their recognition of limits to growth and their acceptance of human domination of the environment.

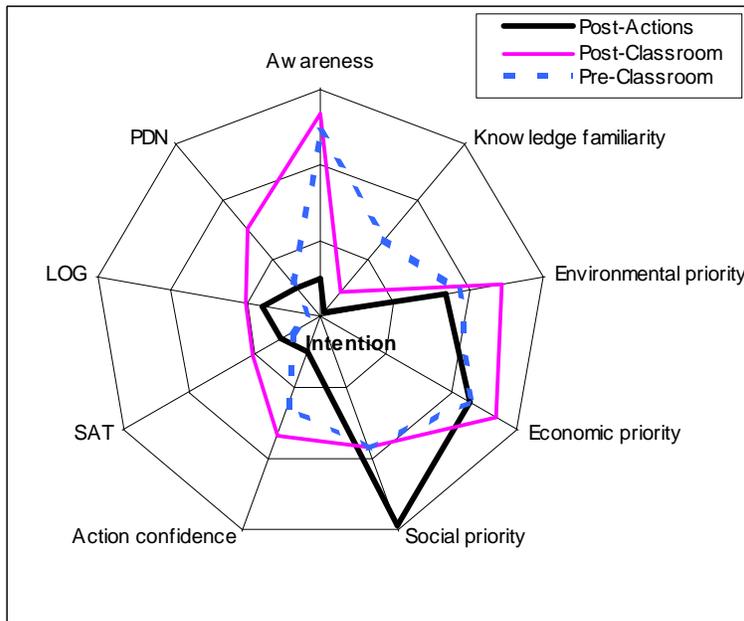


Figure 2 Outskirts participant performances of relationship of beliefs and attitudes with intention

Active science learning, on the other hand, had noticeably positive impacts on integrating intention to maintain the quality of the environment with awareness, knowledge, confidence to act, students' view of the utility of science and technology, their recognition of limits to growth and their acceptance of human domination of the environment. The relative priority placed on environment, economics and society have also been modified by a more active approach to science learning. This group of students appears to recognize the importance of environmental concerns, to have returned to their earlier view of economic importance and to be quite unsure as to the impact that social issues should have upon on their environmental intentions.

Figure 3 shows the respective distances between belief and intention for senior students from a rural school in the Indonesian countryside. The changes in polygon shape are more consistently ordinary in the data emerging from this context.

It appears from Figure 3 that ordinary environmental teaching does not seem to have greatly changed student environmental awareness, their priority on environmental protection and economic development, their confidence to act and their attitudes to science and technology. On the other hand, student environmental knowledge has moved closer to positive intentions, as has the priority this group of students place on social development, and their attitudes to limits of growth and human environmental domination.

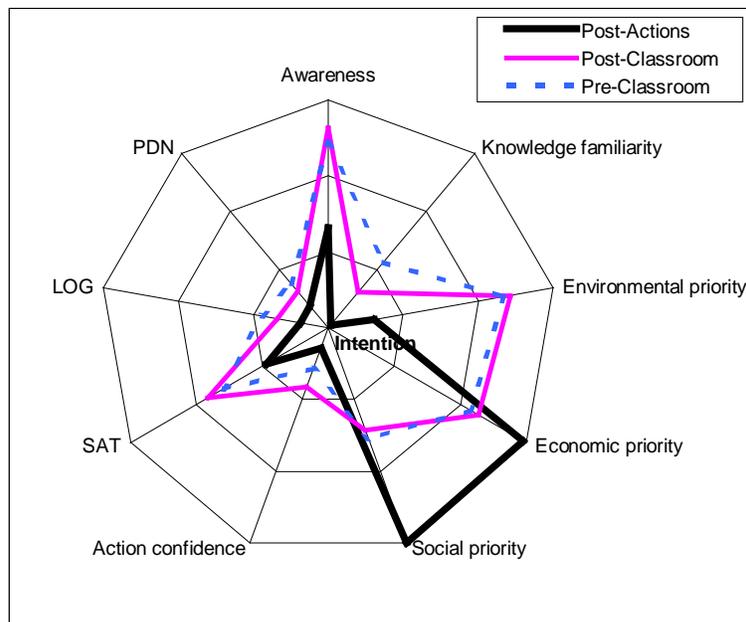


Figure 3 Country participant performances of relationship of beliefs and attitudes with intention

Involving the students in science action activities appears to strengthen the impact of ordinary teaching with respect to further integrating participants' intention with their knowledge and their attitudes to growth limits and environmental domination, and changed the priority for this student group for environmental protection, and their confidence to participate in environmental actions.

Over all, this study found that science actions contributed to student learning in two ways. Firstly, it strengthened the impact that previously resulted from ordinary teaching.

Secondly, it reversed negative tendencies that emerged from ordinary teaching. As a result, this study argues that active science teaching, beyond the ordinary classroom, contributes to the integration of student beliefs and attitudes concerning the environment with their intentions to act positively towards environment sustainability.

Phase 2: Discriminating within active learning – Field research and community action and the connection between beliefs, attitudes and intentions

The preceding discussion has treated both active forms of science learning together. However, as pointed out earlier in the paper, two forms of more active science learning were used in the study on which this paper partially reports. Separate groups of students were involved in either community-based science participation or in field research science activities through which students cooperatively worked on environmental issues found affecting their society.

The following discussion deals with the impacts of different types of science activity in three schools, one each from city, urban outskirts and country locations. Table 1, 2 and 3 present the results of independent sample T-Tests on survey data coded to show the differing impacts of community action and field research activities on students' beliefs, attitudes and intentions. The survey data is based on student responses to Likert scale items, recoded from Disagree = 1 to Agree = 3. Thus, low mean 'scores' reflect lower ecological affinity and means of 2 and beyond represent higher ecological affinity. Higher ecological affinity indicates a more positive attitude to ecological sustainability. The tables provide statistical significance figures for nine dimensions of ecological affinity across two groups of senior science students from three Indonesian secondary schools.

There are statistically significant differences ($p < 0.05$) between the means of the two groups on four of the nine dimensions in Table 1. Such statistically significant differences are indicated by the use of ***bold italic*** text. It appears that city student awareness of environmental issues, the priority they place on environmental and social

concerns in the short term and the priority they place on environmental concerns in the long term are all influenced by the particular active learning approach they experienced.

Table 1 Independent sample T-Test for community actions and field research activities -- **City**

Variables	Mean scores	<i>t</i>	<i>P</i>
Awareness	2.818 – 2.333	2.589	0.017
Concept familiarity	3.000 – 2.917	0.958	0.339
Short-term-Environmental priority	2.727 – 2.000	2.156	0.044
Short-term-Economic priority	1.000 – 1.000	--	--
Short-term-Social priority	1.583 – 1.182	2.088	0.049
Long-term priority *	2.000 – 1.667	2.345	0.036
Action confidence	2.818 – 3.000	- 1.560	0.133
Science and Technology	2.455 – 2.083	1.336	0.204
Limits of Growth	2.818 – 2.583	1.221	0.236
People Dominating Nature	2.818 – 3.000	- 1.560	0.134
Intentions	3.000 – 3.000	--	--
Note: df= 21 The first mean score is community action The second mean score is field research * Scores of this priority range from 1 (priority on economic development) and 2 (environmental protections)			

The group of city students who participated in community action, visiting community members and exploring the problems they faced, had a higher level of environmental awareness and placed a greater emphasis on environmental sustainability (in both the long and short term) than they did on other issues.

Table 2 presents similar information for the school on the urban outskirts. There are more statistically significant differences between the two groups in the results from this school than there were from the city school and they fall into the attitude, rather than belief, area. Students who worked in the community again show a higher degree of awareness of environmental issues. They seem more confident to act or, at least, those who undertook field research are less confident. However, these student groups from the outskirts of an Indonesian urban area seem to place a higher long term priority on economic development than they do on environmental sustainability. Differences in the attitude area are noteworthy. Field research seems associated with lower levels of

ecological affinity regarding the impact of science and technology, recognition of limits to growth and human domination of the natural environment.

Table 2 Independent sample T-Test for community actions and field research activities -- **Outskirts**

Variables	Mean scores	<i>T</i>	<i>P</i>
Awareness	2.889 – 2.444	2.138	0.048
Concept familiarity	3.000 – 2.889	1.000	0.332
Short-term-Environmental priority	2.222 – 1.555	2.353	0.032
Short-term-Economic priority	1.000 – 1.000	--	--
Short-term-Social priority	1.111 – 1.000	1.000	0.332
Long-term priority*	1.556 – 2.000	- 2.530	0.022
Action confidence	3.000 – 2.333	2.309	0.035
Science and Technology	3.000 – 2.222	5.297	0.000
Limits of Growth	2.778 – 2.222	2.673	0.017
People Dominating Nature	2.889 – 2.444	2.138	0.048
Intentions	3.000 – 3.000	--	--
<i>Note: df= 16</i> The first mean score is community action The second mean score is field research * Scores of this priority range from 1 (priority on economic development) and 2 (environmental protections)			

Table 3 provides information from the rural school that participated in the portion of the wider study being discussed here.

Table 3 Independent sample T-Test for community actions and field research activities -- **Country**

Variables	Mean scores	<i>t</i>	<i>P</i>
Awareness	2.368 – 1.769	3.515	0.001
Concept familiarity	3.000 – 2.923	1.218	0.233
Short-term-Environmental priority	2.843 – 2.231	2.826	0.008
Short-term-Economic priority	1.006 – 1.077	- 1.218	0.233
Short-term-Social priority	1.000 – 1.000	--	--
Long-term priority*	1.789 – 2.000	- 2.191	0.042
Action confidence	2.947 – 2.615	2.518	0.017
Science and Technology	2.158 – 2.692	- 3.534	0.001
Limits of Growth	2.632 – 2.923	- 2.123	0.042
People Dominating Nature	2.632 – 2.923	- 2.123	0.042
Intentions	3.000 – 3.000	--	--
<i>Note: df= 30</i> The first mean score is community action The second mean score is field research * Scores of this priority range from 1 (priority on economic development) and 2 (environmental protections)			

The differences, regarding ecological affinity, between the group undertaking community action and that carrying out field research are most marked at this school. The two groups differ on all but two of the nine dimensions of ecological affinity. However, the directions of the differences are noteworthy. The group carrying out community action had a higher degree of environmental awareness, placed emphasis on sustainability in the short term and were more confident to take environmental action. However, they placed a lower priority on sustainability in the long term and were more optimistic about the potential of science and technology, more accepting of human domination of the environment and less accepting of limits to growth. Community action appeared to have more impact on improving students' beliefs, while field research activities appeared to improve student attitudes towards the environment.

However, a closer examination of student mean scores indicates that the scores of both student participant groups had similarly moved away from moderate towards more positive levels of attitude. This may imply that both kinds of activities had similarly led student to positive attitudes towards the environment.

Over all, this study found that community action participants had a somewhat better improvement in aspects of environmental awareness, knowledge familiarity, development priorities, and confidence to act. Teacher interview data reinforced the tendencies apparent in the survey data.

Phase 3 Illuminating survey data through interview data

Interviews with teachers and focus groups made up of participating students were both features of the wider study. The following extracts from transcripts provide further insight into the differences between the experiences of students involved in the two forms of more active student learning.

**Interview 1: Community action versus Field research
Teacher participants' responses**

City: ... so far I am concerned, they (community action participants) appeared more active in asking questions, both inside and outside classrooms. I think it is because their confidence started to grow or because of their improvement in knowledge and familiarity ...

Country: ... Community action group knowledge and understanding, and their self-confidence appeared clearer compared with field research groups...

Outskirts: " ...I am not sure from the school evaluation... because the test was usually in the form of objective test... but from the ways they answered the formative essay tests (regarding environmental problems), the students from this group (community actions) gave answers in a more detail. Their knowledge and understanding regarding the environment might already been improved...

These comments illuminate the results of the surveys regarding a greater contribution of community action participations to change in student beliefs. They also imply that community action students had interacted more frequently with their teachers. This suggests that students learned, as well as experienced, more from participating in community action.

This study found that these community activities challenged students not only to practice defining environmental problems and then suggesting solutions to them, but also practiced communicating actively with the wider society. Such communication is rare in the study locations, due to the local culture which tends to keep students calm and quiet. Extended questioning, especially of older people, is frequently considered to be impolite.

Interview 1 suggested that the more active science learning situation invited teachers to be more open in providing students with extra access to them. Consequently, students learned more. Furthermore, it should be noted that the traditional respectful and compliant culture is changing. This situation was frequently admitted by teachers, as exemplified in the interview 2 with the participating teacher from the city school, and clearly seen in changing patterns of student behavior.

Interview 2: Local uncooperative culture to participative learning
Teacher responses

... one of the most significant problems with respect to the community action students was the uncooperative culture from local society... students felt embarrassed in declaring their environmental findings to society... felt shy and worried if the people would not believe in their findings...

This study clearly indicates the positive impact of more active science learning on student beliefs. Such activities, in particular community action participation, contribute to improvement in student environmental knowledge, leading to consequent improvements in student prioritization of environmental preservation and improvement as short-term or long-term national development priorities for Indonesia.

However, the survey results produce a picture that is somewhat different from the information given by teachers, particularly the information from the city and country schools. Interviews with teacher participants suggested that students who participated in community action activities had stronger positive attitudes towards the environment. This situation was apparent in all locations. The followings are the interviews with all teacher participants.

Interview 3: Community action versus Field research
Teacher responses

City: ... in term of their attitudes, I think, even though both groups appeared to have similarity in their sensitivity towards environmental issues and problems, compared with field research participants, community action students were more critical in giving their responses to the issues arisen in the environment ...

Country: ... but as far as I am concerned, community action groups were more intense in dealing with their tasks, searching data, meeting resource persons, developing presentation media etc.

Outskirts: ... In my experiences, I had difficulty to observe the differences between them directly and visually. However, according to their written reports, it appeared that community action groups had specialty, which was not apparent in the field research groups. Community action reports were written in more detailed and more critically in discussing about environmental issues and problems appeared in the locations where they conducted activities...

The teachers apparently recognized that science actions, in general, had considerable potential for improving student attitudes towards the environment. Further, with some enthusiasm, they suggested that community action activities had greater potential for leading students to critically engage with environmental sciences as well as for allowing them to independently practice environmental values. Interviews with participating students from the country school who worked on community action participations painted a somewhat different picture than either the teacher interviews or survey data.

**Interview 4: Community action versus Field research
Community action students' responses**

“ ...We do research too beforehand, just like what they (Field research students) do, but we have also to continue on sharing... Longer procedure and more complicated... Honestly, we have never learned how to conduct dialogue with people much older than us, we are not sure if we can do this or not... We are not sure if they will believe in us...”

It appeared from the interview that students considered the community action activity to be more complicated and to require more time, capacity and skills. This could cause the community action participants to become more restrained in expressing positive attitudes on the questionnaire surveys. It is apparent from Table 3 that the averages of the mean values moved towards a positive level of attitude. This means that the levels of attitudes of both the community action and field research group participants were beyond neutral. It may be that the teachers' comments, which implied that community action activities had a more positive impact on ecological affinity should be given considerable weight when the different forms of data comprising this study are triangulated. Community action had more opportunities for students to learn and practice values ascribed in the environment and may have had a greater impact on student ecological affinity than indicated by their survey responses.

Conclusion

This report on one portion of a wider study explored the impact of ordinary classroom teaching and more active science learning on the extent of ecological affinity indicated by groups of students from schools in three different locations in Indonesia. It reported on the influence of the differing teaching strategies on the integration of student beliefs and attitudes with their environmental intentions. The results reported may have been confounded by novelty effects and so the differing impact of two approaches to more active learning was investigated. There were differences in the impact of various teaching approaches in the three study sites and differences in the impact of community action and field research approaches indicate that the results reported are not so confounded.

In general, this study indicated that, although there were some inconsistencies, students' environmental knowledge and their confidence to act appeared to have consistently strong relationships with their intention across the locations and throughout the surveys. This suggests that science actions have potential to enhance students' personal capacity to think critically and systematically in order to act appropriately to maintain the quality of the environment, beyond the level that may be achieved through ordinary teaching.

Involving students in active science learning, in particular by participating in community action, led participants across the study locations to critically value advances in science and technology. This may influence student understanding about the relationships between the quality of life, state development, and the environment, and lead them to more greatly appreciate the values of interdependency.

In addition, community participation helped students to become more sensitive to the limits of growth and appreciate the rights of future generations. This action strengthened participants' recognition of the need for sustainable environmental change, built on the values of responsibility and action for a better environment. More active science learning facilitated participant opportunities to practice environmental citizenship in their society.

Participation in community-involved environmental actions may help students to more constructively interface with the environment. The student-environment interface allows students to realize their beliefs and control their attitudes, which in turn permits them to decide to what extent their action should be directed towards the environment. Their life experiences in dealing with environmental issues and engaging in discussing them with the community fertilize their understandings regarding their environmental rights and responsibilities.

This exploration of values may contribute to the extent to which environmental citizenship can be negotiated between students and staff in a school environment. More active environmental learning will encourage student integration of beliefs attitudes and intentions. Participation in community environmental issues will have a positive impact on the development of student ecological affinity than field research with community contact. Ecological affinity integrated with positive environmental intentions forms a solid basis for the development of environmental citizenship. However, the values context may be as complex as the environmental!

This paper has opened up a number of areas which have not been explored in detail. The largest of these hitherto unexplored areas is the impact of locality. The shape of the result polygons for the three schools indicate a substantial difference between them, and differing impacts for various approaches to science education on dimensions of the student groups' beliefs and attitudes. This could have serious implications for more active approaches to environmental citizenship education in differing locations. The findings of this portion of a wider study indicate that there is unlikely to be a simple formula which can be applied to ensure positive environmental education outcomes.

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