A World of Good: A Humane Education Program's Effects on Lower-Elementary Students' Environmental Behaviors

William Ellery Samuels, Ph.D.

The City University of New York

This is an accepted for publication, scheduled for publication in

the *International Journal of Humane Education.*

Accepted for publication on February 22, 2020

Abstract

Most research on humane education has focused its effects on concern for animals or other people. We instead investigated the effect of a humane education program on self-reported behaviors addressing environmental issues. The program was conducted with urban first graders in four cities in eastern China across an entire academic year; a randomly-chosen subset of children from participating ($n = 338$) and closely-matched, non-participating schools ($n = 293$) completed the Children's Environmental Attitude and Knowledge Scale's (CHEAKS) Actual Commitment Subscale at both the beginning and end of the academic year. Students who participated in the humane education program showed significantly stronger increases in their total behaviors addressing environmental issues. In addition, program participants also showed significantly more frequent behaviors addressing four of the six specific environmental issues: water, energy, animals, and recycling; behaviors towards pollution and "general" issues did not change significantly. These results support the role that humane education can play in helping a global audience change their behaviors about several global issues.

Keywords: humane education, caring-for-life education, urban, elementary, environment, behaviors, first graders, intervention, People's Republic of China

Introduction

Environmental issues—such as climate change, animal exploitation, extinction, inter-specific disease transfer, resource depletion, and waste production—are among the most urgent and potentially catastrophic challenges humans (and the world) face. The United Nation's Intergovernmental Panel on Climate Change (2018) states that societies across the world must take "rapid and far-reaching changes" and would be "unprecedented in terms of scale, but not necessarily in terms of speed" (p. 17) to reduce current levels of greenhouse gas emissions to avoid a suit of calamitous changes that would persist centuries if not millennia.

And yet as accurate, frequent, and important as warnings like this are, they have not led to the changes widely seen as needed to avert global catastrophes. Current strategies simply have not sufficed (Pew Research Center, 2016). Although governmental action will likely be needed (Chan, 1999; Babie, 2011), change will surely need to start most in public attitudes and behaviors. Among the public, children are not only often more amenable to both evidence-based changes in attitudes than many adults (McCright, Dunlap, & Xiao, 2013), but changes made among children can sometimes transfer to adults (Rakotomamonjy et al., 2015). In addition, Eagles and Muffitt (1990) argue that children are predisposed to be concerned about natural, animal, and environmental (what they call "ecologistic") issues. Therefore, education will play an increasingly important role in addressing these urgent issues (Teixeira, 2013).

To meet this need, there is no lack of environmental education (EE) programming. From the federally-mandated requirements of the US Environmental Protection Agency to increase environmental literacy to the myriad school- and community-based programs, many see the potential of EE to move people and societies toward a sustainable and humane future.

There is also a growing effort to evaluate the effectiveness of these numerous programs. Ardoin, Bowers, Roth, and Holthuis (2018) conducted a review of 119 evaluations completed on grades K – 12 EE programs published between 1994 and 2013. They found strong evidence that EE programs can produce a range of positive outcomes, with most (93%) studies employing quasi-experimental methods to find gains in knowledge (68%) and/or dispositions (61%). However, few (2%) of these studies investigated EE conducted with first-grade students, and none reportedly used true experimental designs. Twenty percent of the studies did investigate changes in behavior, but behavioral outcomes were also the most often (46%) reported to have a null effect. Despite the promising, growing body of evidence, there remains a conspicuous lack of experimental studies conducted on the behaviors of lower-elementary students. These are among the goals addressed in the current study.

Encouragingly, studies on EEs have not only been conducted among “WEIRD” (Western, educated, industrialized, rich, and democratic; Henrich, Heine, & Norenzayan, 2010) populations. Borchers et al. (2014), for example, conducted a large evaluation of an EE program in the Côte d’Ivoire. They found that the program improved knowledge and attitudes about environmental issues, and that effects were affected by prior knowledge (along with age and gender). Grúnová, Brandlová, Svitálek, and Hejcmanová (2017) found similar results among Senegalese children that persisted for at least a year. In addition, Zhang, Goodale, and Chen (2014) found that increased self-initiated contact with nature among Chinese students was related to stronger attitudes about conservation and wild animal protection. Environmental issues are, of course, global, and developing countries are having an increasingly large impact (Liu, Guo, & Xiao, 2019; Scherer, de Koning, & Tukker, 2019); it is important that environmental education programs can effectively reach “non-WEIRD” populations. We therefore investigated the effectiveness of a program among Chinese students.

Environmental issues are also diverse and interconnected. EE programs regularly seek to make connections between issues and hope to have their effect generalize to uncovered topics. Environmental education, like other types of humane education, also promotes kindness to and respect for living things (Unti & DeRosa, 2003; Samuels, 2007). Humane education also often seeks to make connections across issues, sometimes even explicitly addressing the link between violence toward animals and violence toward people to address both issues (Taylor & Signal, 2005; Thompson & Gullone, 2006; Faver, 2010). Given the overlap in content and their proclivities for attempting to generalize their effects to related areas, it seems natural to connect the terms humane education and EE. The final goal of the current study is this; we employ an experimental design to test the effect of a humane education program on urban Chinese lower-elementary students' self-reported environmental behaviors.

Methods

Program

The Caring for Life (CFL) education program addresses humane education issues related to wild and domesticated animals, other people (especially one's peers), and environmental issues. The program employs both teacher- and student-centered activities and attempts to make connections to students' lives outside of school through developmentally-appropriate activities. It also promotes empathetic self-efficacy through ways that students themselves can use to address the issues addressed in the program. The program was developed from the United Nationals Educational, Scientific and Cultural Organisation (UNESCO) Four Pillars of Education by Nick Leney, University of South Wales, in collaboration with ACTAsia, an international non-profit organization with presence in the United Kingdom, USA, the Netherlands, Australia, and China as well as other countries in south and eastern Asia.

The CFL program addresses environmental issues most directly through the Web of Life unit of the Caring for Life curriculum. The goals of this Web of Life unit are "to enable students to understand the difference between the natural environment and the man-made environment, to recognise the interrelationship between humans, animals and the environment, to accept that humans are responsible for keeping the environment safe and clean, and to understand some of the ways in which we can all be actively involved in helping to protect the environment" (ACTAsia, 2014, p. 2). The unit addresses recycling, pollution, and—as the name of the unit implies—the interconnectedness of living beings.

The program's other units are Sentient Beings, Care and Respect, Interacting with Others, and Empathetic Choices. Three strands are also woven throughout all of the units; these are the interdependence of natural environments and life, recognizing and managing emotions, and civic responsibility. It is in relationship to the first two strands that environmental issues are addressed through these other units; nonetheless, the most direct environmental instruction is through the Web of Life unit.

Although the program's full curriculum spans grades K – 5, logistical constraints necessitated that we only evaluate the first-grade curriculum. Each year's curriculum—

including the first-year curriculum—is comprised of a sequence of 12 sessions that are conducted throughout an academic year. The program was conducted at the same day and time throughout the year.

The CFL program is conducted by teachers or volunteers who are first trained through a brief set of workshops that familiarize them with the pedagogical strategies, target outcomes, and content knowledge. In the current study, the program was conducted by the given class's teacher of record.

Participants

With IRB approval, 631 students participated in this study. As summarized in Table 1, these students were in 23 classes in 6 schools in 4 cities in the People's Republic of China. The cities were medium to large cities located across China's populous east; all are within 250 km of the coast. Even though it was made clear that they were not obliged to participate in the study, no students or students' parents/guardians declined to do so.

Schools were invited to serve as non-participating control-group schools because they closely matched the demographics of program-participating schools. Schools participated in the CFL program voluntarily, after they were approached by ACTAsia and were given permission to do so by the local authorities.

Instrument

Many of the published evaluations of environmental education programs used only *ad hoc* instruments or instruments with only support for their face validity (e.g., Dettmann-Easler & Pease, 1999; Drissner, Haase, Wittig, & Hille, 2014; Simsekli, 2015; Cho & Lee, 2018; Smith et al., 2018; White, Eberstein, & Scott, 2018). We therefore used a rather well-established instrument to more objectively, precisely, and perhaps validly measure the effect of the program. The Children's Environmental Attitude and Knowledge Scale (CHEAKS) was created by Leeming, Dwyer, and Bracken (1995) to measure children's knowledge, attitudes, and self-reported behaviors about environmental issues, such as pollution and energy/resource conservation. Children complete the CHEAKS by answering "yes" or "no" to prompts asking them if they have engaged in various environment-related behaviors such as whether they "leave the refrigerator door open while I decide what to get out," or "do not let a water faucet run when it is not necessary." The reliability and validity of the Chinese version of the CHEAKS is reported on by Samuels, Normando, Ferrante and Meers (2019).

We used the 12-item Actual Commitment scale of the CHEAKS, which measures environmentally-conscious behaviors that children can engage in themselves such as turning off lights when they are not being used and putting out a bird feeder. The Actual Commitment scale is itself comprised of sub-scales measure "general" environmental behaviors, pollution, water, energy, animals, and recycling. Responses to all of these sub-scales are also combined to create a total CHEAKS score that measures overall understanding of and thus concerned action about environmental issues that are accessible to children. Note that since the CHEAKS sub-scales are only comprised of two, yes-no items each, we believe some caution is warranted when interpreting these sub-scales.

Procedure

Students in both the CFL-participating experimental group and the non-participating control group completed the CHEAKS at the same time: exactly one week before and exactly one week after the CFL program was conducted at all of the experimental schools. Students who were absent during the class period during with the CHEAKS was administered were excluded from the study.

The following week, students in the experimental group began participating in CFL as it is designed to be conducted, roughly once every other week during one class period, a period when a civics and citizenship course is typically conducted. Students in the control group participated in the civics and citizenship course as it is normally conducted. Students in the experimental group therefore followed a modified version of this course in which 12 sessions expressly addressed humane education content through more student-centered lessons and activities, supplemented with home-based activities intended to “tie in” the children’s extracurricular lives.

Analyses

Jeon, Lee, Hwang, and Kang (2009) argue that conceptualizing longitudinal data—like pre-post scores—as being nested within the participant produces the most reliable parameter estimates for those longitudinal factors. Similarly, since classrooms, schools, and even the city of residence can affect students’ educational experiences, not accounting for the nested nature of the data may bias the factor estimates (Chen, Kwok, Luo, & Willson, 2010). Fully nesting data is not always feasible, but we were able to do so here, helping ensure that our models represent well the actual phenomena we investigated (Singer & Willet, 2003). The resultant multilevel models we used here accounted for the complex relationships between the data to allow us to more clearly test the effect of interest: whether participating in the program affected first-graders’ behaviors about environmental issues. Analyses were conducted with R, version 3.4.4 (R Core Team, 2013) interfaced through RStudio version 1.0.456. R packages used included car (Fox & Weisberg, 2011), lme4 (Bates, Mächler, Bolker, & Walker, 2015), lmerTest (Kuznetsova, Brockhoff, & Christensen, 2019), and psych (Revelle, 2014).

Results

Table 1 presents the number of participating students in each class, school, city, and group (experimental & control). Although attendance during the assessments was quite high (98.6%), not all students responded to all items, and we only used data from complete instruments. Therefore, total CHEAKS scores were calculable for 244 (83.8%) of the control-group participants at pretest and for 254 (87.3%) at posttest; for the experimental-group participants, total CHEAKS scores were calculable for 314 (93.2%) at pretest and 304 (90.2%) at posttest.

CHEAKS Total Score

The primary outcome of interest here is the total CHEAKS score, which is calculated from all of the items and therefore generates an overall score about one's views and actions on a range of environmentally-relevant issues. Table 1 presents these total scores for each class in each school and city for the control and experimental groups. This table displays the variability among these levels for pre- and posttest scores within both of the control and experimental groups; this variability supports our initial analytic strategy to carefully model this variability and thereby focus on what matters here: whether and where the program was effective. At the bottom of the control- and experimental-group sections of Table 1, we can also see that students in the experimental group appeared to demonstrate stronger pre-post gains in the total environmental behaviors than did students in the control group. This is perhaps more easily viewed in Figure 1, which also presents the pre- and posttest total CHEAKS scores for the control and experimental groups along with the approximate 95% confidence intervals for these measures. It is worth noting that these confidence intervals do not account for the nested nature of the variance and should therefore be regarded as even more approximate than these scores (computed as 95% C.I. = 1.96 x (standard deviation / √sample size)).

A more rigorous test of the effect of the CFL program on students' total environmental behaviors is achieved through a multilevel model of change in which pre- and posttest scores are nested within student, student is nested within class, class in school, and school in city. The model parameters for these random effects (class, school, and city) are not presented here since they were included solely to properly control for their effects and since computing significance tests for these random, nested terms is both contended (Snijders, 2005; Raykov & Marcoulides, 2006; Jeon, Lee, Hwang, & Kang, 2009; Aguinis, Gottfredson, & Culpepper, 2013) and not always recommended (Bates, 2006; Chen, Kwok, Luo, & Willson, 2010) .

It does seem advisable, however, to report and consider further the model's fixed effects: group membership (experimental vs. control), time (pre- vs. posttest), and—most importantly here—the group x time interaction. The main group effect tests whether there is a differences between the experimental and control group collapsed across the pre- and posttest waves; this can be interpreted as primarily testing the equality of group assignment, i.e., whether students assigned to the experimental group differed overall in their environmental behaviors from those assigned to the control group. The main time effect tests whether there is a pre-post difference across both groups. Including the main group and main time effect into the model serves to isolate those theoretically uninteresting effects and put into perspective the effect that *is* of interest here: whether students who participated in the CFL program showed changes in their environmental behaviors compared with similar students (that were also controlled for measurably, random differences via the main group effect) who did not participate in the program.

Table 2 presents those results. The total CHEAKS scores converted to z-scores before being added to the model (all other terms were nominal), so the β-weights measure the standardized changes in environmental behaviors attributable to the fixed effects. These β-weights are given with approximate 95% confidence intervals, which provide robust estimates of these effects: effects where the confidence interval does not overlap zero can be rather safely interpreted as significant.

Although these β-weights with confidence intervals may be sufficient to evaluate the effect of the CFL program (Bates, 2006), we also report the results of significance tests using t-tests that employed Satterthwaite (1946) estimation of the denominator degrees of freedom, which provides robust estimates for multilevel models that only assume normality. The *p*-values generated by these *t*-tests are more familiar measures that test the significance of these effects.

Finally, Table 2 presents Cohen's *d* for each term. This measure of effect size is computed from the *t*-value and the degrees of freedom ($d = 2t / \sqrt{df}$). Since the degrees of freedom in these models are computed using the Satterthwaite estimation, the resultant Cohen's *d* scores should be interpreted with some caution. With this in mind, these values measure the size of each effect, with Cohen (1988, p. 40), suggesting that values around 0.2 can be considered as "small" effects, those around 0.5 as "medium," and those around 0.8 as "strong."

In Table 2, the β-weight for the group x time interaction (0.374 ± 0.177) does not overlap zero, the *t*-test found a significant effect ($t_{133.8} = 4.17$, $p < .001$), and Cohen's *d* (0.72) is greater than a "medium" effect, all of which support the effectiveness of the CFL program. We therefore found good evidence that students' overall environmentally-relevant behaviors improved considerably after participating in the CFL program compared to students who did not participate. (The significant main group effect reflects the variability shown in Table 1 and that we were justified in isolating this variability in our models.)

Figure 1 depicts the effect of the CFL program on (non-standardized) total CHEAKS scores. Although students who did not participate in the program showed a real decline in their behaviors about the environment as they progressed through first grade, those who participated in the CFL program not only resisted this decline, but in fact realized strong improvements in their overall behaviors.

CHEAKS Sub-Scores

The CHEAKS total score provides a well-rounded and reliable measure of children's behaviors about environmental issues. It can also be divided into six sub-scores. These subs-scores cannot measure as wide a range of behaviors—or topics—as the total score can, however; they can therefore not detect differences as sensitively and only detect differences among a narrower range of topics. Despite these limitations, they do provide some insights into the effectiveness of the programs like the CFL program on a range of environmental issues.

Table 3 presents the pre- and posttest mean CHEAKS sub-scores for the experimental and control groups, along with their 95% confidence intervals. The environmental issues most directly addressed by the CFL are asterisked in this table; the daggered sub-score (animals) is addressed frequently but mostly indirectly by the program. These group and time effects are further explored through a series of multilevel models that are summarized in Table 4. Each sub-score was included as the outcome variable in one of six models that otherwise replicated the model that contained the total CHEAKS score and is explained in detail in the section immediately above. Finally, the pre-post sub-score differences in the groups are depicted in the panels in Figure 2. With these summaries in hand, we will now explore the effects of the CFL on each of these environmental issues.

General Issues

The perhaps confusingly-named "general" sub-score measures whether children have often read about environmental issues or whether they have discussed with their parents ways in which they could help prevent environmental problems. Although the first panel of Figure 2 suggests that further research may be able to detect an effect; we could not: The β-weight for the group x time interaction term (0.147 ± 0.177) could not be reliably distinguished from zero, nor was the *t*-score for this effect significant ($t_{146.4} = 1.64$, $p = .103$). Cohen's *d* was also more indicative of a "small" effect ($d = 0.27$).

Pollution

The pollution sub-score measures whether children have asked what they can do to address pollution issues and whether they have "written to someone" about a pollution problem. We did not find evidence that these children do either much nor that the program affected whether they did ($\beta = 0.115 \pm 0.282$, $d = .23$, $t_{60.9} = 0.90$, $p = .388$).

Water

As panel 2 in Figure 2 shows, students in both the experimental and control groups were already highly concerned about water issues. Nonetheless, the CFL program had a significant effect on these behaviors, giving them a stronger rate of increase than was found among the control-group students ($\beta = 0.269 \pm 0.223$, $d = .44$, $t_{197.7} = 3.05$, $p = .003$).

Energy

These children did not engage in energy-related behaviors or have as strong attitudes about energy issues as they did about water issues: Both groups began with lower energy sub-scores than water sub-scores. While the energy sub-scores of students in the control group continued to worsen throughout the academic year, those of the students participating in the CFL program improved ($\beta = 0.295 \pm 0.227$, $d = .66$, $t_{71.5} = 2.80$, $p = .007$).

Animals

Children in both groups began with the least-frequent self-reported behaviors helping wild animals (companion and domesticated animals are not measured by the CHEAKS). And yet those in the control group still showed some decline. Those children who participated in the CFL program, however, showed strong improvements—perhaps the strongest of all areas ($\beta = 0.378 \pm 0.159$, $d = .58$, $t_{260.9} = 4.70$, $p < .001$).

Recycling

Recycling sub-scores resembled the levels and general pattern of the energy sub-score; children here began with middling scores. Children who did not participate in the CFL program presented modest declines while those who did participate showed modest but reliable improvements ($\beta = 0.218 \pm 0.176$, $d = .37$, $t_{171.7} = 2.44$, $p = .016$).

Discussion

The Caring for Life (CFL) education program significantly improved Chinese first graders' self-reported environmental behaviors—at times reversing what would otherwise appear to be worsening behaviors. We found this among a large number of students who were not only in many different classes and schools, but in different cities across eastern China. We also used good experimental design in the field and with best, current analytic practices.

The size of the program's effect on total environmental behaviors was quite strong. The CFL program does address some environmental issues directly—as do an increasing number of other humane education programs. Nonetheless, environmental issues per se are not the central focus of the program. It is therefore especially interesting that the CFL program had a good effect on most of the environmental behaviors we measured.

The size of the effect of the CFL on a given environmental issue was not well-predicted by how directly the program addressed a given issue. The program appeared to have the greatest effect on the issue addressed most frequently but indirectly: wild animals. It also had a significant effect on recycling behaviors, which is directly addressed by the program, but it did not have a significant effect on pollution behaviors, which is also directly addressed. Instead, the program had larger effects on water- and energy-related behaviors. The study was not designed to measure *why* this may be, but perhaps an important factor is how accessible a given behavior is to a given child. The pollution sub-area, for example, includes an item asking whether the child has written to an official about pollution, a behavior that is certainly less frequent and perhaps easily changed than, e.g., turning off a faucet or turning off a light. Similarly, Fransson and Gärling (1999) found that knowledge, belief that one's actions matter, and a sense of responsibility were among the factors that most affected one's environmentally-relevant behaviors. It may therefore be that it is not so much what issues are addressed in an environmental or humane education program, but how they seek to change participants' beliefs and behaviors.

The effect sizes for the sub-scores ranged from what Cohen (1988) suggested be considered "small" (0.23 for recycling) to at least "medium" (0.66 for energy). In their evaluation of an environmental education program over several years, Brandl, Alvarado, and Peltomaa (2019) found that the program had a "medium" effect on environmental attitudes directly addressed and a "small" effect on issues less directly addressed by the program. Humane education may therefore be as effective as environmental education in addressing at least some environmental issues among children.

The CFL program employs several of the strategies that Jacobson and McDuff (1997) found effective among conservation education programs, including student-centered, activity-based programs that take into consideration and build upon participants' prior knowledge, attitudes, and behaviors. It may also be that children in early elementary grades are especially responsive to aspects environmental issues addressed by the CFL and similar humane education programs. Kellert (1985) found that children aged six to nine were not only responsive to environmental issues, but were especially responsive to affective and emotional perspectives of these issues. (Older children were more respons-ive to factual—and later to ethical—facets of these issues.) Environmental programs in general may benefit from focusing on attitudes and emotions (Pooley & O'Connor, 2000) as many humane educations do.

Although there was non-ignorable variations between the classes, schools, and cities (that were addressed in the models), in general students in both the experimental and control groups began their first grade with similar behaviors for each of the environmental issues addressed by the CHEAKS. However, the level of their concern about the various environmental issues varied greatly. Their actions addressing water and energy issues rather high while their actions for pollution and especially animal issues were quite low. To the best of our knowledge, other reported uses of the CHEAKS do not report sub-scores' levels, so we cannot compare these pretest levels against other children or cultures.

Children's pretest levels did not well predict the gains made in either the experimental or control group. Although one of the scores with the lowest pretest values—animals—showed the strongest gains in the experimental group, the other low pretest sub-score—pollution—was not significantly affected by the CFL program. Although there may have been a slight ceiling effect for water sub-scores, energy sub-scores—which also started the study with high values—showed no sign of a ceiling effect. Therefore, the program seems to affect environmental behaviors largely independent of the students' initial levels of engagement or concern. We do not mean to imply that the

CFL—or any—program should not address students' prior knowledge or beliefs, simply that the results here suggest that humane education programs like this can work with students with a range prior concern.

Most of the issues addressed by the CHEAKS involved behaviors that can be done by the student without the help of others (e.g., turning off lights). The general sub-score asks students if they have talked with their parents about environmental issues or if they have read books about the environment. Both of these actions involve the child's parents who are not directly affected by the program, and which books a first grader reads and what topics they discuss are surely influenced by their parents as much as the CFL program. It is worth repeating, though, that although parents' attitudes and behaviors may well be affecting those of these children, working to change children's attitudes and behaviors can be an effective vehicle for reaching parents (Rakotomamonjy et al., 2015). Indeed, Grodzińska-Jurczak, Bartosiewicz, Twardowska, and Ballantyne (2003) found that about 70% of Polish elementary students who participated in a semester-long environment-related program talked with their parents about the program, and that about a third of the students discussed improvements that the family could do.

Children's behaviors were only measured immediately before and after the CFL program, so we cannot infer how well these effects will persist. As much as early elementary-aged children may be amenable to behavior modification about environmental issues, they are probably susceptible to those behaviors degrading if they are no longer reinforced. We also did not measure their behaviors during the program. We therefore cannot know if most of the change occurred, e.g., during the first or second half of the academic year or in relation to the unit most directly focused on environmental issues (the Web of Life unit). Both of these are important factors to investigate; most humane education programs are "push-in" programs with only limited time granted to them to affect a change, so it is especially important to know how their goals can be reached efficiently.

We *can* say that these results support a small but growing body of research that finds that including animals and nature in educational programs promote prosociality, empathy, and general concern for others. Like the programs that both Piek et al. (2015) and Samuels, Meers, and Normando (2016) found effective, the currently-evaluated program included themes and activities that involved animals and nature. Both programs included activities that were intended to help animals (and people) with whom the children interacted or witnessed in their own lives—such as planting flowers that attract butterflies—but none of these programs included direct interactions with animals. Therefore, addressing animal- and nature-related content per se appears effective to promote prosociality. Including animals directly may be additionally effective

(Sprinkle, 2008), but doing so comes with additional safety and class management concerns.

Together, these results indicate that a supplemental, school-based program that includes animal- and nature-related content and activities can increase lower elementary students' prosociality. These results were found in many schools across eastern China. In addition, those results cannot be attributed to possibly confounding factors unrelated to the program like the student's school or city.

Conclusions

The current study adds to the body of research supporting the effects of these programs on children's prosocial behaviors and extends their efficacy to students in cities across eastern China. At its most basic, this acknowledges the importance of considering a global audience when addressing global issues. More directly germane to considerations of promoting prosocial development, the study addresses whether similar results are possible among non-Western, more collectivist cultures since pedagogical styles can differ between the two areas (Li, Rao, & Tse, 2012; Shih, 1999). It was not a given that we would find similar results; Ma et al. (2003) found that the classroom's social environment—which can also differ (e.g., Shih, 1999; Sorrentino, Szeto, Chen, & Wang, 2013)—affected the development of prosociality in elementary school children.

Limitations

The content measured by the CHEAKS has clear face validity, so students who responded to it could well infer what was being measured. We therefore cannot distinguish how much social desirability affecting the responses of students who participated in the CFL program at posttest. Not all post-test sub-scores increased, however, so it is unlikely that it had a profound effect—even though we cannot know for sure.

Relatedly, children were asked to self-report their behaviors. Even those unaffected by social desirability may not always recall their actions well. Most of the actions measured by the CHEAKS would have happened recently, which should help reduce recall errors. This is a common issue in field-based research involving children, and we can no more eliminate its effects than can others.

Acknowledgements

I thank the participating students, their families, and their participating teachers for agreeing to take part in this study. I would also like to thank the schools' administrators; the Dalian Committee on Caring for the Next Generation; Nick Leney, University of South Wales, for his development of the Caring for Life Education curriculum framework and guidelines; and ACTAsia for their permissions to conduct this study. I would also like to thank the anonymous re-viewers for their useful feedback.

References

ACTAsia (2014). *Web of Life Teacher's Manual*. Publisher: Author. Retrieved from: https://actasia.org

Aguinis, H., Gottfredson, R., & Culpepper, S. (2013). Best-practice recommendations for estimating cross-level interaction effects using multilevel modeling. *Journal of Management*, *39*(6), 1490 - 1528. doi: 10.1177/0149206313478188

Bamberg, S. (2003). How does environmental concern influence specific environmentally related behaviors? A new answer to an old question. *Journal of Environmental Psychology*, *23*(1), 21 - 32. doi: http://dx.doi.org/10.1016/S0272-4944(02)00078-6

Bates, D. (2006). lmer, p-values and all that, Retrieved from: https://stat.ethz.ch/pipermail/r-help/2006-May/094765.

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, *67*(1), 1-48. doi: 10.18637/jss.v067.i01

Borchers, C., Boesch, C., Riedel, J., Guilahoux, H., Ouattara, D., & Randler, C. (2014). Environmental education in Côte d'Ivoire/West Africa: Extra-curricular primary school teaching shows positive impact on environmental knowledge and attitudes. *International Journal of Science Education, Part B: Communication and Public Engagement*, *4*(3), 240 - 259.

Brandl, R., Alvarado, A., & Peltomaa, A. (2019). Evaluating efficacy of environmental education programming. *School Science and Mathematics*, *119*(2), 83 - 93.

Chen, Q., Kwok, O.-M., Luo, W., & Willson, V. L. (2010). The impact of ignoring a level of nesting structure in multilevel growth mixture models: A Monte Carlo study. *Structural Equation Modeling: A Multidisciplinary Journal*, *17*(4), 570-589. doi: 10.1080/10705511.2010.510046

Cho, Y. & Lee, D. (2018). 'Love honey, hate honey bees': Reviving biophilia of elementary school students through environmental education program. *Environmental Education Research*, *24*(3), 445 - 460.

Cohen, J., (1988). *Statistical power analysis for the behavioral sciences (2nd ed.)*. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Dettmann-Easler, D. & Pease, J. L. (1999). Evaluating the effectiveness of residential environmental education programs in fostering positive attitudes toward wildlife. *The Journal of Environmental Education*, *31*(1), 33 - 39.

DiMatteo, J., Radnitz, C., Zibulsky, J., Brown, J., Deleasa, C., & Jacobs, S. (2014). Is energy conservation education effective? An evaluation of the PowerSave Schools Program. *Applied Environmental Education and Communication*, *13*(2), 99 - 108.

Drissner, J. R., Haase, H.-M., Wittig, S., & Hille, K. (2014). Short-term environmental education: long-term effectiveness? *Journal of Biological Education*, *48*(1), 9 - 15.

Eagles, P. F. J. & Muffitt, S. (1990). An analysis of children's attitudes toward animals. *Journal of Environmental Education*, *21*(3), 41 - 44.

Erdogan, M. (2011). The effects of ecology-based summer nature education program on primary school students´environmental knowledge, environmental affect and responsible environmental behavior. *Educational Sciences: Theory and Practice*, *11*(4), 2233 - 2237.

Erdogan, M. (2015). The effect of Summer Environmental Education Program (SEEP) on elementary school students´environmental literacy. *International Journal of Environmental and Science Education*, *10*(2), 165 - 181.

Fox, J. & Weisberg, S., (2011). *An R Companion to Applied Regression.* Thousand Oaks {CA}: Sage.

Fransson, N. & Gärling, T. (1999). Environmental concern: Conceptual definitions, measurement methods, and research findings. *Journal of Environmental Psychology, 19*(4), 369 - 382. doi: http://dx.doi.org/10.1006/jevp.1999.0141

Grodzińska-Jurczak, M., Bartosiewicz, A., Twardowska, A., & Ballantyne, R. (2003). Evaluating the impact of a school waste education programme upon students', parents', and teachers' environmental knowledge, attitudes and behaviour. *International Research in Geographical & Environmental Education*, *12*(2), 106 - 122.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, *33*(2-3), 61 - 83. doi: 10.1017/S0140525X0999152X

Jacobson, S. K. & McDuff, M. D. (1997). Success factors and evaluation in conservation education programmes. *International Research in Geographical and Environmental Education*, *6*(3), 204 - 221. doi: 10.1080/10382046.1997.9965048

Jeon, M.-J., Lee, G., Hwang, J.-W., & Kang, S.-J. (2009). Estimating reliability of school-level scores using multilevel and generalizability theory models. *Asia Pacific Education Review*, *10*(2), 149-158. doi: 10.1007/s12564-009-9014-3

Kellert, S. R. (1985). Attitudes toward animals: Age-related development among children. *Journal of Environmental Education*, *16*(3), 29 - 39.

Knapp, D., & Poff, R. (2001). A qualitative analysis of the immediate and short-term impact of Environmental Interpretive Program. *Environmental Education Research*, *7*(1), 55.

Korpela, K., Borodulin, K., Neuvonen, M., Paronen, O., & Tyrväinen, L. (2014). Analyzing the mediators between nature-based outdoor recreation and emotional well-being. *Journal of Environmental Psychology*, *37*(Supplement C), 1 - 7. doi: https://doi.org/10.1016/j.jenvp.2013.11.003

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2019). lmerTest: Tests in linear mixed effects models. https://cran.r-project.org/package=lmerTest.

Leeming, F. C., Dwyer, W. O., & Bracken, B. A. (1995). Children's Environmental Attitude and Knowledge Scale: Construction and validation. *The Journal of Environmental Education*, *26*(3), 22 - 31. doi: 10.1080/00958964.1995.9941442

Olli, E., Grendstad, G., & Wollebaek, D. (2001). Correlates of environmental behaviors: Bringing back social context. *Environment and Behavior*, *33*(2), 181 - 208. doi: 10.1177/00139160121972945

Pew Research Center (2016). *The Politics of Climate*. Publisher: Author.

Pooley, J. A. & O'Connor, M. (2000). Environmental education and attitudes: Emotions and beliefs are what is needed. *Environment and Behavior*, *32*(5), 711 - 723. doi: 10.1177/0013916500325007

Rakotomamonjy, S. N., Jones, J. P. G., Razafimanahaka, J. H., Ramamonjisoa, B., & Williams, S. J. (2015). The effects of environmental education on children's and parents´knowledge and attitudes towards lemurs in rural Madagascar. *Animal Conservation*, *18*(2), 157 - 166. doi: 10.1111/acv.12153

Raykov, T. & Marcoulides, G. A. (2006). On multilevel model reliability estimation from the perspective of structural equation modeling. *Structural Equation Modeling*, *13*(1), 130 - 141.

Revelle, W., (2014). *psych: Procedures for Personality and Psychological Research.* Evanston, Il: Northwestern University. Retrieved from http://cran.r-project.org/web/packages/psych/.

Samuels, W. E., Normando, S., Ferrante, L., & Meers, L. (2019). Support for the reliability and valid use of the Chinese version of the Children's Environmental Attitude and Knowledge Scale among first and second grade students. Manuscript in preparation.

Satterthwaite, F. E. (1946). An approximate distribution of estimates of variance components. *Biometrics*, *2*(6), 110 - 114. doi: 10.2307/3002019

Simsekli, Y. (2015). An implementation to raise environmental awareness of elementary education students. *Procedia - Social and Behavioral Sciences*, *191*(C), 222 - 226.

Singer, J. D. & Willet, J. B., (2003). *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence.* New York: Oxford University Press.

Snijders, T. A. (2005). Power and sample size in multilevel modeling. *Encyclopedia of Statistics in Behavioral Science*, *3*, 1570 - 1573.

Soga, M., Gaston, K. J., Yamaura, Y., Kurisu, K., & Hanaki, K. (2016). Both direct and vicarious experiences of nature affect children's willingness to conserve biodiversity. *International journal of environmental research and public health*, *13*(6), 11 pp.

R Core Team (2013). *R: A Language and Environment for Statistical Computing*. Retrieved from: https://cran.r-project.org/doc/manuals/fullrefman.pdf

Zhang, W., Goodale, E., & Chen, J. (2014). How contact with nature affects children's biophilia, biophobia and conservation attitude in China. *Biological Conservation*, *177*, 109 - 116. doi: http://dx.doi.org/10.1016/j.biocon.2014.06.011

Zorpas, A., Voukkali, I., & Loizia, P. (2017). Effectiveness of waste prevention program in primary students' schools. *Environmental Science and Pollution Research International*, *24*(16), 14304 - 14311.

Table 1

Mean Total CHEAKS Sores (± 95% Confidence Intervals) by Class, School, City, and Group.

Group	City	School	Class	Number of Students	Pretest	Posttest
Control	A	I	1	34	7.16 (± 0.80)	7.65 (± 0.84)
			2	39	7.16 (± 0.61)	7.81 (± 0.62)
	B	II	3	14	7.78 (± 0.71)	8.08 (± 0.98)
			4	12	7.25 (± 1.18)	7.27 (± 0.96)
			5	13	7.11 (± 1.20)	7.11 (± 0.89)
			6	11	6.09 (± 1.22)	7.75 (± 1.27)
			7	12	7.58 (± 1.26)	8.00 (± 1.60)
			8	14	9.00 (± 1.96)	7.42 (± 1.19)
			9	15	8.21 (± 0.69)	7.43 (± 0.53)
	C	III	10	33	8.26 (± 0.67)	6.77 (± 0.65)
			11	27	7.85 (± 0.72)	7.09 (± 0.83)
			12	31	8.12 (± 0.68)	7.00 (± 0.88)
			13	36	9.08 (± 0.60)	7.83 (± 0.95)
			Control Total	291	7.75 (± 0.25)	7.45 (± 0.25)
Experimental	C	IV	14	36	7.28 (± 0.57)	8.83 (± 0.34)
			15	35	6.96 (± 0.76)	7.42 (± 0.70)
		V	16	32	7.03 (± 0.68)	7.83 (± 0.72)
			17	36	7.18 (± 0.75)	7.31 (± 0.79)
			18	35	8.58 (± 0.63)	8.00 (± 0.63)
			19	43	8.24 (± 0.67)	8.63 (± 0.62)
	D	VI	20	37	7.00 (± 0.59)	7.60 (± 0.84)
			21	42	7.17 (± 0.57)	7.87 (± 0.56)
			22	41	7.39 (± 0.63)	9.15 (± 0.51)
			Experimental Total	337	7.43 (± 0.22)	8.12 (± 0.22)
			Grand Total	628	7.57 (± 0.17)	7.82 (± 0.17)

Table 2

Multilevel Model of Change Testing the Effects of Participating in the Caring for Life Education Program (Group) and Time (Pre- vs. Posttest) on Standardized Total CHEAKS Scores. Beta-weights are given with 95% confidence intervals; degrees of freedom are computed via Satterthwaite's method.

Model Term	β	Cohen's *d*	*df*	*t*	*p*
Group (Experimental vs. Control)	0.464 (± 0.225)	0.340	569.4	4.06	< .001
Time (Pre- vs. Posttest)	0.045 (± 0.081)	0.400	31.4	1.12	.272
Group x Time	0.374 (± 0.177)	0.721	133.8	4.17	< .001

Table 3

Mean Pre- and Posttest CHEAKS Sub-Sores (± 95% Confidence Intervals) by Group.

	Control		Experimental	
CHEAKS Sub-Score	Pretest	Posttest	Pretest	Posttest
General	1.24 (± 0.09)	1.13 (± 0.09)	1.15 (± 0.08)	1.25 (± 0.09)
Pollution*	1.09 (± 0.08)	0.87 (± 0.09)	0.99 (± 0.07)	0.91 (± 0.08)
Water	1.83 (± 0.05)	1.90 (± 0.04)	1.80 (± 0.05)	1.90 (± 0.04)
Energy	1.55 (± 0.07)	1.51 (± 0.07)	1.47 (± 0.07)	1.64 (± 0.06)
Animals†	0.86 (± 0.09)	0.85 (± 0.08)	0.75 (± 0.07)	1.00 (± 0.07)
Recycling*	1.23 (± 0.07)	1.17 (± 0.08)	1.28 (± 0.07)	1.37 (± 0.07)

* Topic is addressed directly by the CFL program

† Topic is addressed indirectly but frequently by the CFL program

Table 4

Multilevel Models of Change Testing the Effects of Participating in the Caring for Life Education Program (Group) and Time (Pre- vs. Posttest) on Standardized CHEAKS Sub-Scores. Beta-weights are given with 95% confidence intervals; degrees of freedom are computed via Satterthwaite's method.

CHEAKS Sub-Score	Model Term	β	Cohen's *d*	*df*	*t*	*p*
General	Group (Exp. vs. Cntl.)	0.191 (± 0.230)	0.133	600.8	1.63	.104
	Time (Pre- vs. Posttest)	0.017 (± 0.077)	0.161	30.0	0.44	.660
	Group x Time	**0.147 (± 0.177)**	**0.271**	**146.4**	**1.64**	**.103**
Pollution*	Group (Exp. vs. Cntl.)	0.150 (± 0.232)	0.105	589.2	1.27	.206
	Time (Pre- vs. Posttest)	0.024 (± 0.178)	0.289	5.2	0.33	.757
	Group x Time	**0.115 (± 0.282)**	**0.230**	**60.9**	**0.90**	**.372**
Water	Group (Exp. vs. Cntl.)	0.381 (± 0.242)	0.257	581.6	3.10	.002
	Time (Pre- vs. Posttest)	0.019 (± 0.143)	0.326	4.6	0.35	.743
	Group x Time	**0.269 (± 0.223)**	**0.434**	**197.7**	**3.05**	**.003**
Energy	Group (Exp. vs. Cntl.)	0.418 (± 0.230)	0.292	598.5	3.57	< .001
	Time (Pre- vs. Posttest)	0.010 (± 0.161)	0.074	26.6	0.19	.855
	Group x Time	**0.295 (± 0.227)**	**0.662**	**71.5**	**2.80**	**.007**
Animals†	Group (Exp. vs. Cntl.)	0.537 (± 0.229)	0.375	600.6	4.60	< .001
	Time (Pre- vs. Posttest)	0.010 (± 0.061)	0.139	27.0	0.36	.718
	Group x Time	**0.378 (± 0.159)**	**0.582**	**260.9**	**4.70**	**< .001**
Recycling*	Group (Exp. vs. Cntl.)	0.132 (± 0.238)	0.090	587.0	1.09	.276
	Time (Pre- vs. Posttest)	0.071 (± 0.078)	0.737	28.6	1.97	.059
	Group x Time	**0.218 (± 0.176)**	**0.372**	**171.7**	**2.44**	**.016**

* Topic is addressed directly by the CFL program

† Topic is addressed indirectly but frequently by the CFL program

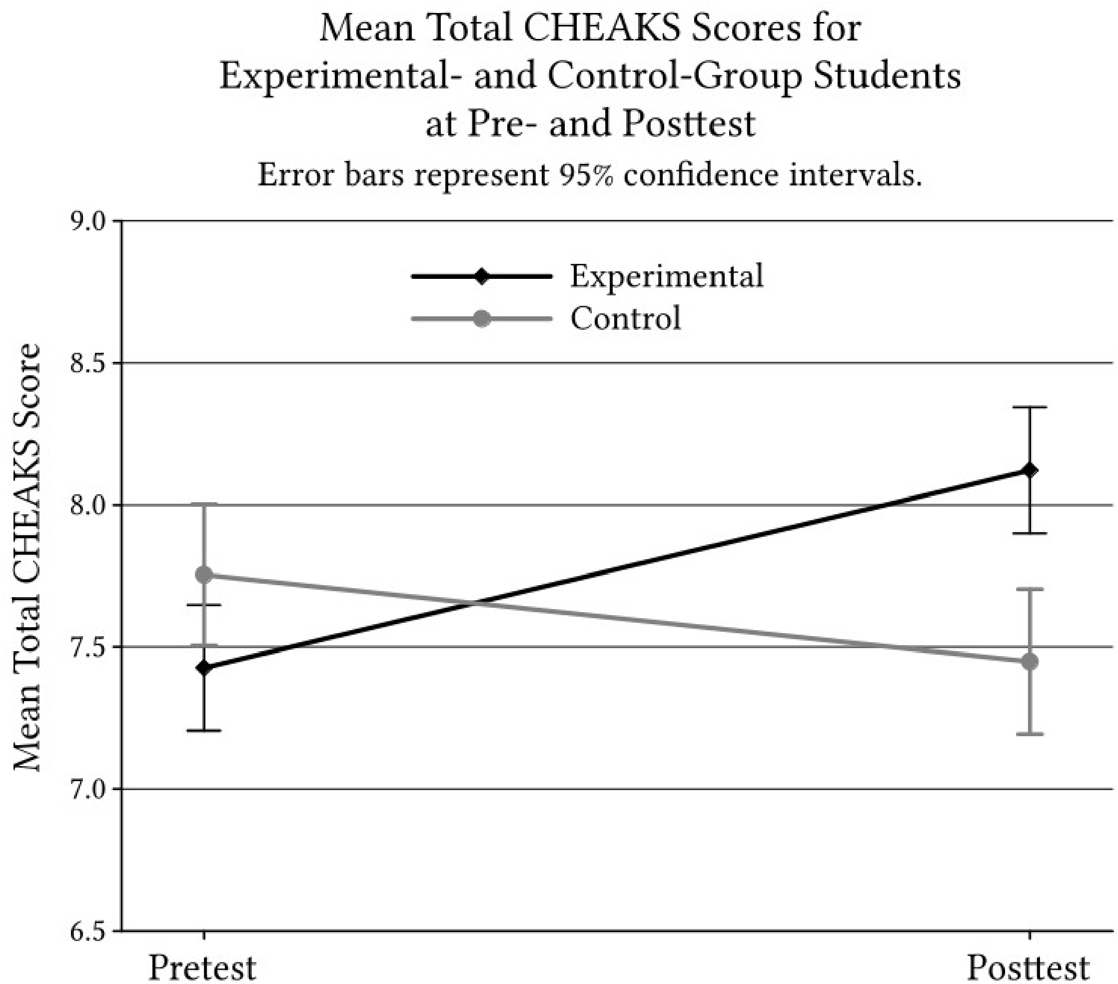

Figure 1: Pre- and Posttest CHEAKS Total Score by Group

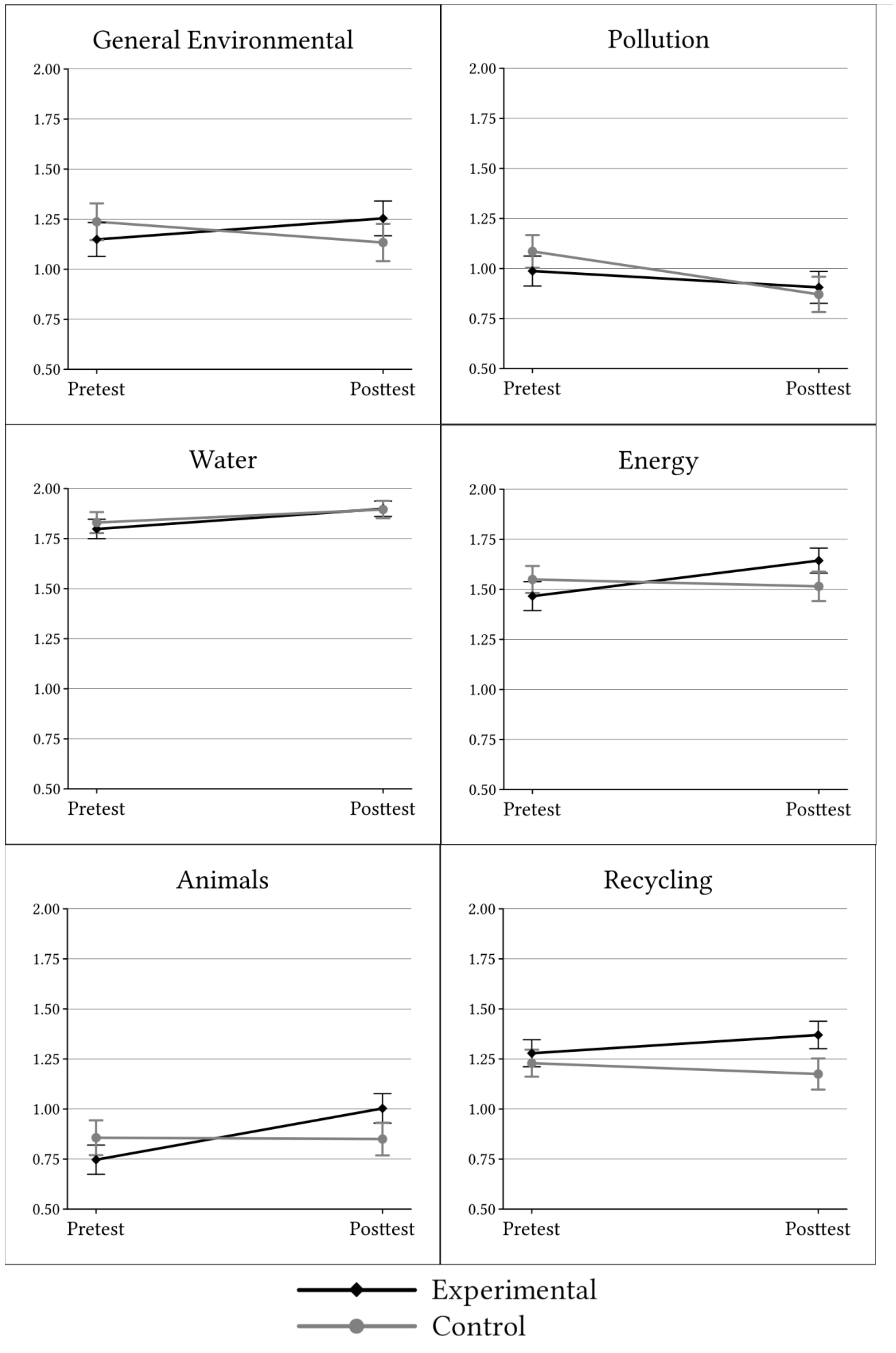

Figure 2: Pre- and Posttest CHEAKS Sub-Scores by Group