

The Buzz about Bees: Conservation Communication for Pollinator Protection and Pro-Environmental Behavior

Introduction

Pollinating insects, which 35% of global crops depend on, are a vital part of agricultural systems worldwide (Klein et al., 2006). Despite their ecological and economic importance, insects are typically associated with negative emotions (Azil et al., 2021). However, disgust and fear toward unpopular animals such as insects can be reduced through direct or virtual interaction with them (Schönfelder & Bogner, 2017a; Randler et al., 2012). Science communicators can work with educators through a variety of avenues to connect youth with nature, including insects, and increase empathy toward environmental issues like pollinator conservation. One such avenue is through electronic field trips (EFTs), which involve a live-streamed video broadcast from a host field location to a classroom or another educational setting (Blinded et al., 2019). In November 2021, [Blinded Platform Name] hosted a live EFT in coordination with the [Blinded University] [Blinded Lab Name] called *The Buzz About Bees* to connect scientists and students about the importance of bees through a real-time virtual demonstration of a bee colony. The purpose of the following study was to investigate participants' pollinator knowledge as well as EFT impacts on feelings about bees and entomology. Research objectives (ROs) included: (RO1) determine youths' content knowledge about pollinators, (RO2) evaluate the impact of EFT impacts on youths' feelings about bees, (RO3) evaluate EFT impacts on youths' interest in entomology, (RO4) examine the correlation between youths' pollinator knowledge and feelings about bees, and (RO5) examine the correlation between youths' gender and pollinator knowledge, feelings about bees, and interest in entomology.

Conceptual Framework

A framework including the concepts of connectedness to nature and vicarious learning guided the research. Nature connectedness describes the closeness and empathy people have for nature around them and how that connection will most likely lead them to want to protect it (Frantz & Mayer, 2014; Mayer & Frantz, 2014). When in-person visits to nature-based environments are not possible, technology-mediated experiences could be utilized instead (Leung et al., 2022). Bandura (1999; 2009) posited that people can learn through observation that might include dialogue with experts and demonstration of modeled behaviors.

Methods

[Blinded University] graduate students and a faculty member developed and implemented *The Buzz about Bees* EFT with the [Blinded Lab Name] in fall 2021 via the [Blinded Platform Name]. Middle and high school classes throughout the country and beyond were invited to participate in the free EFT through the program's listservs, social media, and websites. Analytics show classrooms in six states, Canada, and Turkey viewed the live EFT and 74 youth provided some responses to a post-retrospective survey. The assessment included three sections: 1) items from the Pollination Systems Knowledge Assessment (PKSA; Jimenez et al., 2022), 2) Schönfelder and Bogner's (2017b) eight semantic differential items to measure perceived attitudes toward bees, 3) modified items to measure attitudes toward entomology. For the analysis, we relied primarily on non-parametric statistics. To understand the participants' subject matter knowledge (SMK; RO1), we used index variables representing SMK as well as before and after scores for youths' feelings about bees and interest in entomology. There were five index variables in total. Gender was also a key variable and was simplified to male and female;

other responses were excluded. We used the Wilcoxon signed-rank test for RO2 and RO3 (Hollander et al., 2014). The Spearman correlation statistic (Hollander et al., 2014) was used to determine if the before and after feelings about bees correlated with the SMK (RO4). To determine if there was a significant difference in scores between gender (female versus male students) in terms of subject matter, feelings, and interest (RO5), we used the Mann-Whitney test (Hollander et al., 2014).

Results

(RO1) Participants in the program (n=64) on average answered 59.7% (SD = 10.6%) of the 18 PKSA questions about pollinators correctly. (RO2) Participants in the program scored their feelings about bees on a scale of 1-9 (1 being positive feelings, 9 being negative feelings) on 7 questions. The participants (n=62) had a significant difference ($p < 0.001$) in terms of their feelings about bees being more positive after the program, with a mean before score of 28.5 and a mean after score of 16.6. (RO3) Participants scored their interest in entomology on a scale of 1-9 (1 being positive interest, 9 being negative interest) on 8 questions. The participants (n=63) had a significant difference ($p < 0.001$) in terms of their interest in entomology increasing to more positive after the program, with a mean before score of 36.9 and a mean after score of 20.6. (RO4) There was no significant correlation between subject matter knowledge and feelings both before and after the EFT. A correlation of feelings before the EFT with subject matter knowledge was not significant ($p = 0.406$) with a Spearman's rho of 0.111 (n=58). A correlation of subject matter knowledge after the EFT was also not significant ($p = 0.721$) with a Spearman's rho of -0.047 (n=59). (RO5) Female students had higher scores than male students for SMK as well as feelings about bees and interest in entomology, but the female scores were not significantly higher. The average SMK score for males was 58.1% (n=31) and females 61.4% (n=19). The Mann-Whitney U test was not significant at $p = 0.476$. The average feelings score before the EFT for males was 28.1 (n=33) and females was 28.5 (n=20), with the p-value for the Mann-Whitney U test of 0.762. The average feelings score after the EFT for males was 15.7 (n=33) and females 17.4 (n=18), with the difference between gender not significant at $p = 0.105$. The average interest score before the EFT for males was 33.7 (n=33) and females 38.2 (n=20), with the difference not significant at $p = 0.219$. The average interest score after the EFT for males was 19.8 (n=33) and females 22.4 (n=19), with the difference not significant at $p = 0.195$.

Discussion, Conclusions, and Recommendations

Participants' SMK of pollinators appeared to be fairly high at 59.7%. The EFT did have a significantly positive impact on participant feelings about bees and interest in entomology by comparison of after versus before scores. However, participants' SMK did not correlate with their feelings about bees both before and after the EFT. Although the female scores across all metrics were higher than males, they were not significantly higher. Because there is evidence that student feelings and interest did improve due to the EFT, but these values do not correlate with SMK or gender, formal exams focused on content knowledge about topics like bees do not appear to be ideal for measuring program effectiveness. However, though it may not be reflected by exam scores, assessment of this program indicates that interactive online science engagement programs such as EFT programs may have long-term impacts on pollinator interactions (connection to nature) and student career choices (vicarious learning).

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