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Evaluating environmental behaviour and commitment of pre-service primary science teachers

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Abstract

Education for Sustainability (EfS) is crucial for changes in environmental behaviour (EB), and little is known about the EB of primary school teachers tasked with teaching EfS. This study sought to better understand the EB of pre-service primary science teachers. EB was qualitatively evaluated, characterising teachers' personal environmental activism and commitment to implement EfS among pupils and their families. Data was collected via two open questionnaires based on the Johari Window (JW) and the Authentic Inner Compass (AIC) models. Both questionnaires referred to EB twice: after exposure to the JW model and via statements from the AIC model, and again after 3 months. Findings show that the JW can reveal EB, while the AIC allowed participants to enrich their descriptions of their values, needs and commitment to EB. All participants agreed it was their duty to address EfS in class, but less than half mentioned this when describing actual behaviour. This study enables in-depth understanding of participants' EB, including their actions, barriers and concerns, which might precede planning programmes on EfS implementation. As tomorrow educators, PSTs should be the focus of such programmes, which should be part of teacher education curricula.

Keywords: authentic inner compass; education for sustainability; environmental behaviour; pre-service teachers; Johari Window

Introduction

In recent decades, environmental destruction has almost reached irreversible proportions (IPCC, 2022). One way to face environmental issues is through Education for Sustainability (EfS), which is crucial to promote changes in teachers' and pupils' attitudes and behaviours so they can minimise the harmful effects of environmental disruptions (Kuvac & Koc, 2019). In Israel, despite recent steps towards enhancing EfS, it remains challenging since there is no structured, compulsory curriculum, appropriate study materials are scarce, and there is a shortage of teachers qualified to address EfS (Abramovich & Loria, 2015; Miedijensky & Abramovich, 2019). Usually, most EfS programmes are taught in primary school because they allow greater curricular flexibility than secondary schools. Though EfS should be integrated into all topics taught in school, it is usually integrated in science lessons, if at all. In 2022, the Ministry of Education (MoE) allotted 30 yearly hours to instruction on climate change in all classes (Israel MoE, 2022). This topic can embody EfS principles. Hence, our focus on pre-service teachers (PSTs), whose motivation is crucial to their future as teachers who persist in teaching EfS (Deci, Vallerand, Pelletier, & Ryan, 1991). Moreover, they can become sustainability change agents in school and in society (Merritt et al., 2019), and

young generations might benefit from this later as adults (Gambino, Davis, & Rowntree, 2009; Walker, 2017). These PSTs attended an education college in northern Israel. The authors neither taught any of the study participants, nor assessed their work. Even though not all PSTs will be able to implement their sustainability principles due to barriers such as different school focus (Abramovich & Loria, 2015) or adjusting as new teachers (Wang, 2021), we believe it is important, especially considering the Israel MoE's 2022 climate education initiative.

Almeida, Moore, and Barnes (2018) stated that 'any program aiming to raise awareness and achieve strong educational outcomes (especially in sustainability) requires authentic teacher involvement in the planning stages' (p.239). Since one of the aims of EfS is to encourage responsible environmental behaviour (EB), it is important to evaluate PSTs' initial EB, in order to maximise EfS implementation. We also focused on participants' own EB, assuming pro-environmental behaviour (PEB) might enhance their commitment to implement EfS among themselves, their pupils, family members and close friends (Abramovich & Loria, 2015). Previous studies have indeed shown a connection between EfS and PEB (e.g., Abramovich & Loria, 2015; Klein, Watted, & Zion, 2021; Mónus, 2022). In other words, PSTs or teachers who had participated in EfS programmes improved their environmental awareness and behaviour. EB is thus crucial either to prepare an efficient EfS programme or to predict participants' willing to act as environmental agents. Our aim was to evaluate PSTs' own EB and, at the same time, help them become aware of their behaviour. That is why we chose the Johari Window model (JW), a reflective tool exposing various knowledge levels of one's behaviour — in our case, EB. We added statements from the Authentic Inner Compass model (AIC) to allow them to better express their EB. The research questions were: (1) What, if any, were the changes in the EB of pre-service primary science teachers, using the JW and the AIC models? (2) In what ways, if any, are participants, as future science teachers, committed to implementing EfS?

Education for Sustainability (EfS)

The concept of 'sustainability', popularised in the 1990s, means thinking about how actions today (especially concerning the environment) will affect future generations (Tilbury & Cooke, 2005). Defining the term 'sustainability' led to the concept of EfS, which, according to Sauvé (2005) and adopted later by others (Benavides Lahnstein & Peñaloza, 2022; UNESCO, 2020), is a modern version of environmental education and incorporates democracy, civil cooperation and social values.

The literature reveals a debate about the difference between education for *sustainable development* (ESD) and education for *sustainability* (EfS). Some feel that the term EfS is more appropriate since it focuses more on social justice, whereas ESD implies a focus on development and economics (Common & Stagl, 2005; Sauvé, 2005). Others, including the authors of this research, refer to both terms equally and consider them both to be education addressing environmental issues from several aspects such as social justice, environmental activism based on rational decisions, and so forth (Abramovich & Loria, 2015; Didham & Ofei-Manu, 2018; Miedijensky & Abramovich, 2019).

The Israeli Ministries of Education and of Environmental Protection embraced this topic and initiated actions which included an outline for an EfS programme in schools (Miedijensky & Abramovich, 2019). EfS programmes contribute to the development of PEB (Klein et al., 2021). Teachers highly affected by EfS training had a greater propensity to teach its concepts to their classes (Heimlich & Ardoin, 2008; Meichtry & Smith, 2007). A similar result was obtained with science PSTs after participating in an 'Outdoor Inquiry Unit' in which they studied different environments. Findings showed that when specifically asked for a commitment, 42% of the PSTs agreed to do so. They also expressed higher levels of environmental awareness and behaviour (Abramovich & Tal 2009). Tal (2010) examined PSTs' knowledge and reflections before and after

attending an environmental education course at a major university in Israel. Results showed an increase in knowledge they defined as important to their lives. Moreover, they acquired useful teaching strategies. Yet, there was no evidence of any behavioural change. Goldman, Yavetz, and Peíer (2014) compared the environmental literacy of PSTs, in three colleges of education in Israel, some of whom specialised in the environment. Results showed a significant difference in favour of the 'environmental' PSTs, and while differences in EB were significant for recycling and civic actions, other components, such as environmental activism or environmentally responsible consumerism had not changed. The authors recommend embedding EE in a basic mandatory course for all PSTs. Gan and Gal (2018) examined PSTs who participated in The Green College EfS programmes for enhancing PEB. Their research showed that PSTs with high levels of self-efficacy for promoting EfS, were also those who showed pro-environmental behaviour.

However, EfS implementation in Israel has challenges, especially since it has no independent curriculum, and is mostly embedded into science education. This leads to unmotivated, unenthusiastic teachers who lack relevant knowledge, skills or a supportive, attitude at school (Zaradez et al., 2020). Another problem is the focus on teaching 'science' (scientific facts concerning diverse environmental issues) while overlooking the development of critical thinking, taking a stand and expressing emotions and experiences — all crucial for developing a relationship with and affinity for environmental issues (Tsevreni, 2011). These reasons emphasise the need for teacher education colleges and departments to implement EfS as part of their curriculum for all PSTs, focusing on enhancing PEB combined with strategies to implement EfS among their pupils (Gan & Gal, 2018; Goldman et al., 2014).

Environmental behaviour (EB)

One of the main goals of EfS is to enhance PEB (Boeve-de Pauw, Gericke, Olsson, & Berglund, 2015; Gan & Gal, 2018; UNESCO, 2020). It is hard to predict participants' EB or define what qualities or conditions are needed to initiate environmental actions or feel the urge to deal with environmental issues as a personal lifestyle. Researchers have attempted to crack the environmentalism code and define its variables. For example, knowledge is often supposed to be the first step of environmental responsibility: concern for the environment and commitment to act pro-environmentally is based on deep understanding of the system and its complexity (Shamuganathan & Karpudewan, 2015). However, knowledge alone does not necessarily lead to action. A PEB shift also demands a strong sense of responsibility (Gould, Ardoin, Thomsen & Roth, 2018; Stern, 2000) and sense of efficacy (Gan & Gal, 2018).

There are many models for predicting PEB based on a wide variety of variables (values, knowledge, attitude, etc.), which may be categorised as incentives or barriers, or as external (e.g., economic factors) or internal (e.g., motivation) (Abramovich & Loria, 2015; Kollmuss & Agyeman, 2002; Newman & Fernandes, 2016). The value-belief norm theory states that if one's values mature into an ecological worldview they will evolve into beliefs — awareness of consequences and ascription of responsibility — that will lead to developing pro-environmental personal behaviour (Stern, 2000). Chen (2015) confirmed the applicability of this model to predict Taiwanese PEB towards global warming, with one limitation being the reliance on participants' subjective self-reporting. Bamberg (2013) claimed that successful change in behaviour depends on three phases: goal intention, behavioural intention and implementation intention. As claimed earlier, many factors and conditions are responsible for people's EB action or non-action. To simplify the evaluation of behaviour while assessing existing behaviour, we used two tools: the JW and AIC models. The former is a feedback tool to effect self-awareness of one's overall behaviour (Saxena, 2015), while the latter concerns value virtues, basic need-satisfying life aspirations and intrinsic interests — all of which are variables that help participants appraise their behaviour (Assor et al. 2019; Assor, 2018).

The JW model

This model discloses self-awareness of one's behaviour, attitude, feelings, knowledge, experience, motivation etc., from four perspectives or 'quadrants': *open* — what we know about ourselves that is also known to others; *blind* — what is known by others but not to us; *hidden* — what we know yet don't reveal to others; and *unknown* — to both us and others (Jack & Smith, 2007). This tool enables us to examine how we view ourselves and how others view us, and how we become increasingly more open to others as we get to know them and share information about ourselves. The main purpose is to enlarge the *open* area by informing people about their blind area and enabling them to open up and reveal their hidden area. This tool can improve interpersonal relationships and team development (Saxena, 2015). It also allows formative feedback, with a 'critical friend' approach that allows discussion, joint problem-solving and reduction of task complexity. In addition, it ensures delegation of responsibility, respect for different opinions, trust-based relationships, mutual assistance and mutual study (ASSET, 2017).

In this study, we used the JW model to raise participants' awareness of their own behaviour, taking them out of their comfort zone and asking them to write not just about their open behaviours but also their hidden ones. Moreover, we asked them to ask a reliable close friend to enlighten them about their behaviour. We used three of the quadrants: *open*, *blind* and *hidden*, hoping participants' EB would be clearly specified.

The AIC model

Making decisions and taking actions is a common step we all take. Ideally this should rely on what we truly value, need and want, encouraging us to make satisfying moral decisions about important issues. In other words, having an AIC might spur us to develop long-term goals and commitments based on values, needs, interests and preferences (Assor, 2018). An optimal AIC has two components: (1) authentic values, need-satisfying aspiration and interest (the AIC foundation) and (2) autonomous commitment to future-oriented goals, plans or decisions based on that foundation. This foundation begins to develop in childhood, while autonomous commitment emerges during adolescence (Assor et al., 2019). The AIC model is used in social-emotional learning. For example, Russo-Netzer and Shoshani (2020) found that a higher AIC score in adolescence is related to higher prioritisation of meaning and of positivity. The literature indicates that having an AIC is associated with increased vitality, self-esteem, fewer behavioural problems and low depression levels (Assor et al., 2021; Russo-Netzer & Shoshani, 2020).

In our case, we focused on the EB of science PTSs, assuming their EB consists of a set of values, needs and preferences and that they act accordingly, assuming no barriers are involved (Kollmuss & Agyeman, 2002). We found that the statements (e.g., "I have values that reflect the kind of person I truly want to be") predicting a sense of AIC, might also describe EB, even though it is usually used in psychology and social studies (Assor, 2018). PEB is based on one's worldview, attitude, values and personal circumstances. As mentioned earlier, taking environmental actions depends on many variables, yet we felt we could determine the AIC model variables as vital ones that might help participants describe their EB. In this manner, in our research, the JW model is intended to reveal participants' open, hidden and blind EB by revealing their behaviour, attitude, feelings, knowledge, experience, motivation and so forth. The AIC model better describes participants' EB referring to their principles, needs, interests, goals and commitment (see Figure 1).

Method

Participants

We applied via email and college Facebook pages to primary science education PSTs. We chose primary education since implementing EfS among young children might benefit them as adults
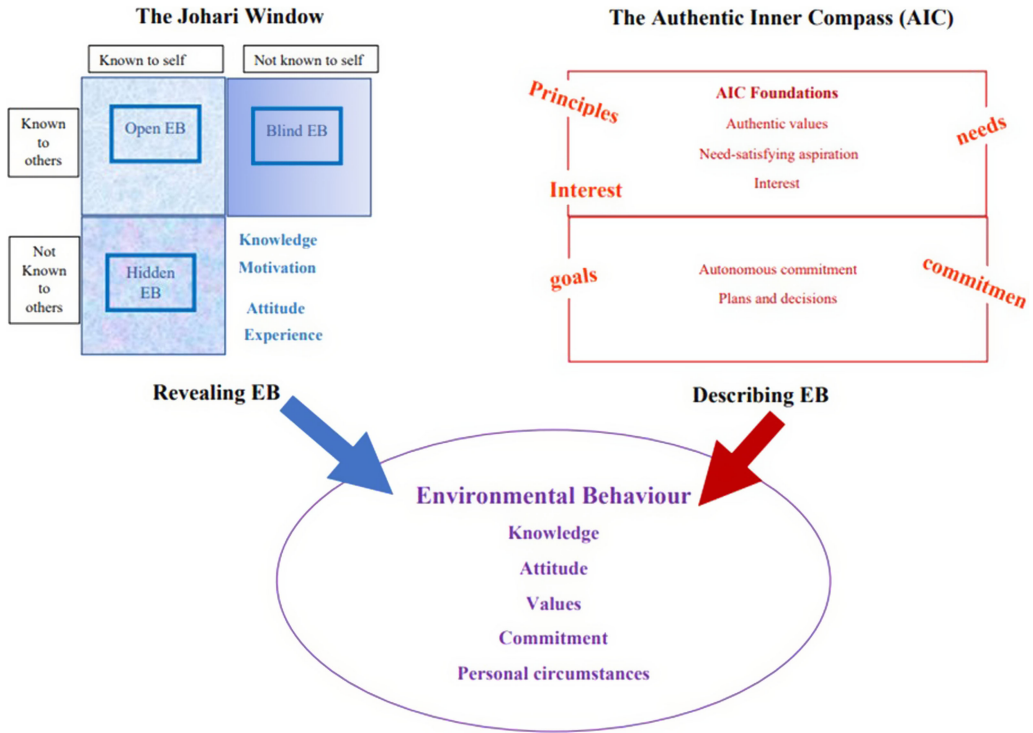
Figure 1. The relationship between the JW and AIC models and environmental behaviour.

(Gambino et al., 2009; Walker, 2017). We also chose PSTs majoring in science since most teacher education colleges in Israel implement their EfS programmes through the science departments (Tal, 2010). PSTs ($N = 35$) who confirmed their participation in the research included 23 B.Ed. students, and 12 attending an 'academic retraining' programme. Of these, 26 were from the Jewish (Hebrew-speaking) sector and nine from the Arab and Druze (Arabic-speaking) sectors. Age range was 22–38 years.

Research approach and data collection
We employed a qualitative interpretive approach in which the researchers advance an interactive process that relates to the interconnectedness of the research components (Creswell & Poth, 2018) in order to deeply understand and evaluate participants' EB at the start of the academic year and 3 months later, at the end of the semester. Participants were given two online, open-ended questionnaires. The questionnaires revealed their EB via the two models to evaluate their meaningful behaviour.

The first open questionnaire related to the JW model. The three quadrants (*open*, *blind* and *hidden*) were described to the participants, who were then asked to respond to three questions: (1) Describe your EB. Please be specific and give examples (open behaviour); (2) Ask someone close to you (who knows you well) to describe your EB. Write his/her words (blind behaviour); (3) Describe your hidden behaviour. Define situations in which you know you don't act as an environmentalist yet; you don't usually reveal it because you are ashamed of this or don't want to harm your image (hidden behaviour). Participants were not aware of the JW quadrants; they were referring to various aspects of their behaviour. Our aim was to reveal their hidden and blind behaviour to expand their behaviour. As mentioned, uncovering hidden or blind behaviour might broaden the open area (Saxena, 2015) and thus raise EB.

In addition, participants were given 10 statements aligned with the components of the AIC model (authentic values, life aspirations and interests and autonomous commitment) (Assor, 2018) according to which they should describe their EB. The statements included values and principles (e.g., I have principles and values that usually enable me to know the right thing to do in difficult situations), needs (e.g., When making important decisions, I usually know what my true needs are), interest (e.g., I have things that really interest me and that I want to invest time in), goals (e.g., I have long-term goals that I fully identify with) and commitment (I have commitments which give me direction in life). These statements served as scaffolds for the participants, especially for the Arabic-speaking students, who had to describe their EB in Hebrew and add authentic examples. We assumed those statements might help them better describe their meaningful behaviour.

The second open questionnaire assessed self-reported behaviour 3 months later (at the end of the semester) and was used to elicit whether any behavioural change had occurred. Participants were reminded of the JW model and asked if any behavioural change had occurred. They were then given the 10 previous AIC model statements with which to describe their EB. In addition, an open question concerning EfS was added: Do you think there is a connection between the science teacher and EfS? Justify your answer in detail.

All participants who confirmed their participation in the research signed an informed consent form and were willing to complete the questionnaire, in which they wrote their name, age and status in the college (e.g., third year, B.Ed. degree).

Data analysis
Behaviour statements were collected from the three quadrants of the JW model and compared with the participants' behaviour statements from questionnaire 2. We also compared behaviour statements with and without using the AIC model. Then, we divided the EB into behaviour types, which were then classified and divided based on previous studies (Abramovich & Loria, 2015). Statements were classified into general care for the environment [e.g. " I care for the environment and pass it on to my children" (Kim — pseudonym, Questionnaire 1)] and deep commitment and understanding of their behavioural consequences [e.g. "I do my best in order to take care of the environment: I separate organic waste in order to turn it into a compost and return minerals to the soil, I use disposable dishes only when needed, I take baskets when I go shopping and clean around me when I am walking on the beach, still I am not involved enough in preserving the sea." (Yana — pseudonym, Questionnaire 2)].

In addition, participants' statements about their behaviour were analysed based on AIC components: (1) authentic values, life aspirations and interests; (2) commitments to act (intentions) in favour of the environment; (3) vague or unexplained behaviour; and (4) actual commitment based on meaningful EB (Abramovich & Loria, 2015; Assor et al., 2019). We examined each statement separately (participants' descriptions of their EB sometimes included several statements). Descriptions of EB consisting solely of the AIC original statements were ignored.

In order to establish credibility and data validation, we conducted the following stages (Creswell & Poth, 2018): (a) we established a common platform for coding and develop a preliminary code list, (b) each researcher independently coded the categories, (c) all researchers compared the findings and (d) the percentage of agreement was calculated. First, the agreement was 90%. Then, we further discussed the controversial statements and reached complete agreement.

Findings

The findings first present the change in participants' behaviour before and after being exposed to their blind and hidden behaviour, and the classification of the statements into types of behaviour.

Then we present participants' expressions of their EB, with and without statements from the AIC model. In the third section, we describe the four categories that appeared in participants' EB using the AIC model. In the final section, we present participants' commitment to implement EfS among family, close friends and pupils. In all examples, participants are indicated by pseudonyms.

EB based on the JW model

Findings indicate that the JW model allowed participants to reflect on their 'hidden', or 'blind' behaviour showing both barriers and signs of behavioural change. For example, about hidden behaviour, Sara wrote: 'When I'm tired, I would rather use disposable dishes than wash them. I do this although I am aware of the amount of waste and its consequences.' . . . . (Questionnaire 1).

Sara was aware of what counts as environmental actions and yet, she found it hard to act according to her environmental awareness. Asking her husband (blind behaviour) about her behaviour revealed that in his opinion she is 'all in', thinking of the environment in every move she makes. Three months later she wrote: 'After being exposed to my hidden behaviour, I try to reduce the use of disposable dishes, separate waste and teach my pupils to reduce and recycle waste.' (Questionnaire 2). Revealing her hidden behaviours probably led Sara to consider her actions and match her behaviour to her awareness. She also mentioned her pupils and her efforts to give them practical ideas to preserve the environment.

It seems that Sara's behaviour evolved and after revealing her hidden behaviour, she improved it. Observing herself through her husband's eyes, she consciously continued to be environmentally proactive, feeling she has to set an example for others. Sara became a role model to her students, discussing environmental issues embedded in the science topics. For example, addressing the extinction of species when teaching about habitats.

The response from Lili shows the potential of the JW model as a tool that might reveal EB and improve it. Table 1 shows Lili's responses to her open, blind, and hidden behaviours, and her behaviour 3 months later.

The example affirms that Lili improved her recycling behaviour. Under 'hidden behaviour', she claimed she was aware of the importance of recycling but did not do it because of the inconvenience. Three months later, she stated she had begun to recycle plastic bottles despite the distance of the recycling bin from her home. She also added an explanation for her actions. Maybe expressing what she didn't do, along with the recognition of its importance, encouraged Lili to start recycling. She admitted that she fails to do it consistently, still, whenever that happens, her conscience bothers her.

In both examples, it seems that participants were aware of what is more or less impactful on the environment but preferred to act according to their convenience. Yet, after expressing their various kinds of behaviour, they changed their attitude and evolved their EB.

As mentioned, statements were classified into behaviour expressing general care for the environment and behaviour based on deep environmental understanding. Most participants, (69%) expressed general care for the environment. For example, Linda wrote: 'I reduce waste and save electricity, it's a habit of mine since I was raised to do so. I also reduce the use of disposable dishes because it might harm the environment.' (Questionnaire 2). Linda presented a habit-dependent behaviour, combined with general care for the environment. Nineteen percent of the participants improved their stated behaviour from general care for the environment to behaviour based on deep understanding. Assma wrote: 'in my opinion it is important to understand the environment's needs and address them, and I act according to my beliefs, I save water, recycle waste . . . ' (Questionnaire 1). In Questionnaire 2, she wrote: 'After recognizing the importance of our actions on the environment and the consequences of pollution, I started to spread the idea of looking after the environment among my family and friends, together with enhancing my own EB.' Assma became aware of the consequences of her own actions concerning the environment and acted with deep understanding and feelings of responsibility. In general, 50% of the

Table 1. Lili's responses to questionnaires 1 and 2

Open behaviour	Blind behaviour	Hidden behaviour	Self-reported behaviour after 3 months
I try to save water as much as possible, such as turning off the water while I brush my teeth and wash my face. In the shower, I try to minimise water usage.	My friend claims that my environmental behaviour is expressed by using glass bottles and not plastic bottles.	I don't separate my waste because it requires me to leave it in the house until I can reach the recycling station (which is quite far from my home). I prefer not to have a lot of garbage hanging around, and my main priority is to get rid of it as soon as possible.	I definitely see a change in my behaviour, knowing it's for saving our planet. I've started to collect plastic bottles in bags to take them to the recycling bin. I do so because I feel bad if I throw a plastic container into the regular garbage and not in the recycle bin. I am aware of the importance of my actions.

participants referred to their hidden and/or blind behaviour when they wrote about their behavioural change. For example: Roni focused on saving water (open behaviour) whereas her boyfriend described her unwillingness to separate waste (blind behaviour). As for her hidden behaviour, Roni described her tendency to boil water many times before using it. After 3 months, Roni described her behaviour in the following words: "My whole conception of recycling has changed. Now I make an effort to recycle as much waste as I can, in order to avoid throwing away piles of waste. Additionally, once I had realized the electricity use when boiling water, I do it when I am really convinced I am going to use the water." Roni improved her EB by relating to her blind and hidden behaviour. Her actions were based on her understanding of the consequences of her actions for the environment.

The next section will deal with participants' expressions of EB. How using sentences from the AIC model influenced participants' descriptions concerning their EB.

Declared environmental behaviour according to the JW and AIC models

Another factor examined participants' behaviour following the JW model and compared to behaviour based on sentences from the AIC model. Most participants (72%) mentioned the same actions in both cases, yet, relying on the AIC model statements enabled them to clarify why they acted as they did, and express their needs and values concerning the environment and their commitment to it. For example, using the JW model, Anna wrote:

> . . . as for my behaviour, I can admit there has been a change. Instead of throwing paper into the regular bin, I gather all the used paper in a special box and take it to the recycling centre. I also do the same with empty bottles and try and embed environmental actions among my family.

Based on the 10 AIC model statements, she wrote:

> Once recycling became my target, I did it under any condition [commitment], trying to convince my family to join me. Even though I had difficulties at first, I care about the environment, value and appreciate it and know what might happen if tons of waste are buried instead of being re-used or recycled [values]. This is why I keep on doing these actions, even at less convenient times [long-term commitment].

With the AIC statements Anna could express her actions as values and understanding-based, leading to long- lasting commitment.

Another example is Ranin from the Druze sector. In questionnaire 1, she wrote about her open behaviour: "I recycle bottles, don't throw waste, taking care of street cats, and comment to people if I see their behaviour might harm the environment." Using the sentences from the AIC model, Ranin expressed herself as follows:

> My aims are to take care of Mother Nature. This was one of the values I grew up with, and tried to preserve it, including cleaning sites, explaining to my pupils the importance and beauty of nature [values and commitment]. I feel totally committed to defend nature, to volunteer to clean it and handle tours [commitment]. The only time I feel confused is when I have to comment to adults how to behave, or youth that I am not familiar with. I try to do it gently, with a smile.

Ranin's description of her behaviour was very plain. Once she read the sentences from the AIC model, she could express her efforts concerning nature preservation, her enthusiasm when dealing with her pupils and hesitation when she had to comment to strangers. Ranin's behaviour became tangible and detailed. These sentences also helped students whose first language was Hebrew. For example, Tamar, wrote in questionnaire 2 about her open behaviour: "I reuse paper and take baskets when I go shopping." Using the sentences from the AIC model, Tamar wrote:

> My EB had totally changed. My targets, though seeming little, are meaningful to me and might be a wake-up call for those people I try to convince to follow my actions [commitment]. Some of my aims [goals] are not to use disposable dishes under any conditions, separate waste, save water and keeping my surroundings clean. I believe I have to set an example, [commitment] be kind and respect everyone, not underestimate or judge anyone concerning their actions, [values] still try to show them what actions might benefit the environment.

The expression of Tamar's behaviour became totally different after she read the sentences from the AIC model. Still, she used only the essence of the sentences in order to describe her EB.

All three examples showed how the sentences from the AIC model improved participants' expressions concerning their EB. In fact, these sentences seemed to boost the participants' ability to express themselves. In all cases, participants used the sentences as scaffolds or a basis for their EB descriptions.

EB based on the AIC model

As mentioned in the data collection, participants were given 10 statements from the AIC model and asked to describe their EB according to statements they chose. Their expressions concerning their EB were examined through four categories: (1) authentic values, life aspirations and interests; (2) commitment to act (intentions) in favour of the environment; (3) vague or unexplained behaviour; and (4) actual commitment based on meaningful EB. For example, Assma wrote: 'We need to take care of the environment because a polluted environment might harm our health. [commitment to act — intentions] Moreover, we must take care of animals by giving them a clean environment [values]' (Questionnaire 1). In questionnaire 2 she wrote:

> Now I realise I know a lot about the environment, I feel I can contribute through Facebook and by writing web posts [autonomous commitment-empowerment] … I learn constantly and act according to what I've learned. Once I know and understand what should be done to improve the environment, I do it without hesitation, embracing new principles [values and principles leading to meaningful behaviour].

Assma had undergone a change from intentions to act based on general statements concerning the safety of humanity and animals, to self-reported actual behaviour based on knowledge values and commitment.

Table 2 shows the distribution of the four categories of AIC components, from participants' answers about their EB to both questionnaires.

Table 2 shows that on both questionnaires, about 40% of participants' statements were based on values, while about one third of the statements from the second questionnaire, were based on participants' actual commitment to meaningful EB.

The final part presents commitment to implement EfS among their family, close friends and pupils.

Participants' commitment to implement EfS among family, close friends and pupils

From Questionnaire 2 we learned that all the participants agreed there is a close connection between science teaching and the commitment to address EfS. For example, Narmin wrote: "There is a strong connection between teaching science and embedding sustainability principles within science topics. The main aim is to implement knowledge, enhance students' values and environmental awareness so they can feel part of the environment." However, only 43% mentioned commitment to implement EfS: 14% mentioned family and close friends and 29% mentioned school education. For example, Dana described how she and her family care for the environment:

> One of the most important principles is keeping nature clean. We, as a family, spend almost every week in nature, believing experiencing nature is the best way to learn to love and protect it. I set an example to my kids trying to preserve plants and animals, not throwing waste and even gathering waste others have left behind.

> At home, we separate waste into different bins at home and take them to the community centre. It is very important for me to do this with my children in order to raise their awareness. In addition, whenever there is an environmental dilemma, we talk about it. I believe these ways help me educate them to be skilled citizens and act wisely in favour of the environment. (Quest. 2)

Dana thus expressed value-based actions with deep commitment to and appreciation of the environment. Her care for the environment is expressed also by educating her children to consider the environment as a vital component whenever they take certain actions. In addition, Dana mentioned her future position as a science teacher and the idea of teaching environmental issues as part of her science lessons:

> I definitely think there is a connection between the science teacher and environmental education. Environmental education is of great importance to me, and an integral part of science teaching, as almost every area of the science curriculum connects to the environment (natural resources, animal habitats, electrical energy – it is impossible to teach these subjects without mentioning the human impact on the environment and the resulting damage). I think that every science teacher should integrate environmental education into the topics s/he teaches to promote sustainability. Personally, I'm glad for the opportunity to integrate education for values of saving the environment and sustainability within the framework of my teaching and plan to incorporate it in my lessons and to serve as an example to my pupils in my environmental behaviour. (Quest. 2)

Table 2. Frequency of behaviour statements distributed by AIC components

	Authentic values, life aspirations and interests	Commitment to act (intentions) in favour of the environment	Vague or unexplained behaviour	Actual commitment based on meaningful environmental behaviour	No. of statements
Questionnaire 1	42%	32%	15%	11%	66
Questionnaire 2	37%	11%	7%	34%	62
An example	I try to educate my children according to my values, especially preserving our natural resources. (Yaffa, Quest. 1)	There are actions that should be avoided like throwing waste in a public area. I intend to spread environmentalism among young people. (Veronica, Quest. 2)	Me and my family reuse and recycle waste, save electricity and water. (Sali, Quest. 1)	. . .I act according to my values and try to influence my surroundings. I never throw waste, I avoid harming the environment and I will always choose the environmental way even if it means making an effort to do it . . . (Sara, Quest. 2)	

Another example is Alia, who wrote of her environmental activities at a youth centre:

> As an instructor at the youth centre, with the cooperation of the local council, we clean our village with the help of residents. We turned our village into a clean and beautiful place. Now we are waiting for a budget promised by the council for flowers that will be planted all over the village. (Quest. 2)

Alia added: 'I'm now very cautious with my environmental actions, trying to set an example for all the youth I instruct.' It seems that Alia described ordinary actions. However, she also wrote that she and all her family deal with waste separation, even if it involves effort, since there is no recycling centre in her village. She was not convinced who is to blame, the state or the local council that didn't make this issue as a priority. She feels hurt that people in her village are unaware of the damage they cause by throwing litter around the garbage bins and in areas around the village, especially construction waste.

Similar to Dana and Alia, other participants declared that educating their future pupils on environmental issues is one of their future commitments. Yona mentioned her EB among her pupils during her practicum:

> . . . I asked my pupils to write on both sides of the paper and not to throw it into the regular bin. I felt they were unwilling to do so, and thought, after all, they are not obliged to obey, I am not really their teacher. . . . I decided to teach them about paper recycling and its importance to our world. They were so impressed that they started to write on both sides of the paper and recycle used paper. (Quest. 2)

Yona gave an example of her ideology, not to demand environmental actions but to explain them so they are based on understanding.

Dana, Alia and Yona, along with most of the participants who mentioned their commitment to implement EfS, also expressed meaningful EB. This might be because of the environmental change they had undergone and the willingness to spread it as a result. In Sivan's words: " . . . before, I only focused on how to preserve the environment, now I try to influence others, trying to explain the importance of the environment . . . "

Discussion

The aim of this study was to evaluate participants' own EB and help them become aware of their behaviour. We also wanted to examine whether there had been a change in participants' EB and their self-reported commitment to implement EfS.

Participants' environmental behaviour

Results show an overall improvement in participants' EB. For the JW model, revealing their hidden behaviour and being aware of how their close friends perceived them (blind behaviour) helped participants improve their EB. It seems that the JW model indeed helped them become aware of their overall behaviour (Saxena, 2015). The change was from being aware, yet still not taking steps to match their awareness with actions. This gap has been mentioned and examined by several researchers (Abramovich & Loria, 2015; Bamberg, 2013). Still, revealing hidden behaviour and seeing how others perceive them (blind behaviour), changed their behaviour even though their barriers had not vanished. This suggests that the JW model might be the "bridge" between awareness and actual PEB. Participants' statements showed that 19% of them improved from general care for the environment to behaviour based on deep commitment. The change might be due to revealing hidden and blind behaviours, allowing the open behaviour to expand (Saxena, 2015). Nevertheless, the minor change could be due to participants' difficulties in fully expressing themselves in academic writing (Klages & Clark, 2009). This possibility was intensified with students for whom Hebrew is a second language (Cohen-Azaria & Zamir, 2021). We used the AIC components as a potential aid to help participants better appraise and express their EB (Assor, 2018), since the AIC model statements could serve as scaffolds. Comparing participants' behaviour using both tools reveals that most of them mentioned the same behaviour in both cases and yet, describing their EB independently was somewhat superficial, while using the AIC statements allowed them to express their values, needs and commitment to EB more clearly. The findings indicate that only 11% of participants affirmed their deep commitment to the environment in Questionnaire 1, while 34% declared so in Questionnaire 2. It seems that the AIC statements spur participants' inner compass. This might explain the development of long-term goals and commitments based on values, needs, interest and preferences (Assor, 2018).

Participants' commitment to implement EfS among family, close friends and pupils

All participants agreed that they should deal with EfS with their pupils. Yet only 43% mentioned EfS: 14% mentioned family and close friends and 29% mentioned school education. This might imply autonomous commitment to future-oriented goals, plans or decisions based on the AIC (Assor et al., 2019). The others still need to develop a sense of responsibility or self-efficacy for promoting EfS (Gan & Gal, 2018). This might be successfully achieved by a well-planned EfS programme (Almeida et al., 2018; Abramovich & Tal 2009; Luan et al., 2020).

Participants also revealed obstacles such as economic situation, lack of infrastructure, convenience and lack of motivation, all mentioned in previous studies (e.g., Abramovich & Loria, 2015; Gould et al., 2018), even though using the JW model allowed some of the participants to express how they acted despite the obstacles. Stakeholders should recognise these difficulties when organising an intervention programme to enhance meaningful EB or PEB (Abramovich & Loria, 2015; Gould et al., 2018).

Conclusion

The overall findings show that using both the JW and the AIC models allowed us to evaluate participants' self-reported behaviour, including obstacles and the level of behaviour, whether expressing general care for the environment or actions based on real commitment and

understanding. The JW model raised participants' awareness of their hidden and blind behaviour, thus expanding their open area to a wider EB (Saxena, 2015). Statements expressing values, needs, preferences and commitment appeared to help participants express their EB using values, abilities and responsibility for the environment. Using these tools might reveal participants' behaviour including their actual actions, obstacles and concerns. Acquaintance with participants' EB should underlie planning interventional and supportive programmes designed to increase PEB and commitment to implement EfS principles (Gan & Gal, 2018). In our study, participants' EB can be examined relatively simply, with a bonus of revealing and expanding one's EB. Still, participants should be involved in the planning stage to achieve real educational outcomes (Almeida et al., 2018). The findings indicate that participants became more aware of how they could act for the environment and overcome EB-related obstacles (e.g., Abramovich & Loria, 2015; Gould et al., 2018). It is our belief that this was the first step on their way to becoming environmentally oriented citizens.

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