Article

Education for Sustainable Development: A Study in Adolescent Perception Changes Towards Sustainability Following a Strategic Planning-Based Intervention—The Young Persons' Plan for the Planet Program

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Abstract: In 2016, the United Nations (UN) launched the 17 Sustainable Development Goals (SDGs) as a framework for sustainable development and a sustainable future. However, the global challenge has been to engage, connect, and empower communities, particularly young people, to both understand and deliver the 17 SDGs. In this study, we show the benefit of a strategic planning-based experiential learning tool, the Young Persons' Plan for the Planet (YPPP) Program, to improve the underlying competencies of Australian and Mauritian adolescents in increasing understanding and delivering the SDGs. The study was conducted with 300 middle to senior high school students, in 25 schools throughout Australia and Mauritius, over an 18-month period. The intervention included the development of research, strategic planning, management, STEM (Science Technology, Engineering, Maths) and global competency skills in the students, to enable them to build and deliver regional and national SDG plans. Research methods included pre- and post-intervention testing of the attitudes of these students to sustainable development outcomes and compared these attitudes to subsets of scientists and the Australian national population. Our results, from both qualitative and quantitative evidence, demonstrate significant improvements in these adolescents' appreciation of, and attitudes towards, the SDGs and sustainable outcomes, across a range of key parameters. The results from the 76 students who attended the International Conference in Mauritius in December

2018 demonstrate significant improvements in mean levels of understanding, and attitudes of the students towards the SDGs awareness (+85%), understanding/engagement (+75%), motivation (+57%), and action orientation/empowerment (+66%). These changes were tested across a range of socio-demographic, geographic, and cultural parameters, with consistent results. These findings have significant implications for the challenge of sustainable education and achieving community engagement and action towards the SDGs in Australia and Mauritius, particularly for young people. As the intervention can be replicated and scaled, the findings also highlight the opportunity to extend both the research and this type of experiential learning intervention across both broader geographies and other generation and community segments.

1. Introduction

1.1. Addressing the Challenge of Community Engagement in Delivering the United Nations Sustainable Development Goals (SDGs) and Sustainable Outcomes

The shape of tomorrow's world will depend on ways in which young people engage with decisions that are being made today. With the launch of the Sustainable Development Goals (SDGs) in 2016, the United Nations (UN) established the first global framework to 'end poverty, protect the planet and ensure prosperity for all' [1]. With 194 countries signing up to this framework, the UN SDGs, therefore, provide the global agenda for a sustainable future. Whilst this is a major step forward in the collective agenda of sustainable development, the challenge is, and will continue to be, how to engage, connect, and empower communities to deliver these Goals.

A review of the implementation of the precursor of the SDGs, i.e., the Millennium Development Goals (MDGs), highlighted the limited success in the achievement of the stated goals [2]. The ability to 'think global, act local', and to engage and empower individual countries and communities to become engaged and empowered to deliver these goals, proved to be a challenge, even with the more limited scope of the MDGs as compared to the SDGs [2]. A key criticism of MDG deployment was the ability to engage at the level of the community or 'individual citizen'. In effect the MDGs were often perceived by communities and individuals as 'imposed from outside', and, therefore, lacking applicability at a local level, with communities often not having a general understanding of what was trying to be achieved and how they could be involved in delivering on the Goals [2]. Three key challenges, therefore, remain for the successful implementation of the SDGs i.e., (i) Education for sustainable development [3] (ii) community engagement: To demonstrate applicability of the SDGs to local economic, ecological, and social contexts; and, (iii) community empowerment: To take action to implement the activities that will fulfill the Goals [4].

Developing global goals, and cascading these from an international level to national, regional, and local deployment, has a long history in the conduct of global corporations through the development and application of global competencies and strategic planning [5]. The global success of many of these corporations provides an opportunity to learn from their experience and leverage key competencies, such as strategic planning and global competencies [6], in delivering outcomes for the SDGs.

In this study, we assess the impacts of a global competency and strategic planning-based intervention and experiential learning tool, the Young Persons' Plan for the Planet Program ('the Program'), in addressing the objectives of community engagement and empowerment with middle to senior high school students.

1.2. Adolescent Engagement for a Sustainable Future Earth

Recent climate demonstrations, across the world [7] have highlighted that today's youth want their voices to be heard in determining the future trajectory for the planet. Key, therefore, in the implementation of the SDGs will be the young people who will inherit the planet from the negotiators who developed the Goals [8]. Adolescents, however, are one of the more challenging demographic segments to engage, at both community, and political levels [8]. This is often driven by their sense of disenfranchisement from society, which is increasing over time [9,10]. However, adolescents can also be change agents, driving innovation and political movements that flow through to broader society [10,11]. A further reason for choosing adolescents to test this intervention was the potential to develop an education program to equip future political, business, and community leaders with the skills to deliver on this agenda of global sustainable development.

1.3. Education for Sustainable Development

The United Nations Educational, Scientific and Cultural Organization (UNESCO) has identified Education for Sustainable Development (EFSD) as a key support mechanism underlying the successful delivery of the SDGs [12]. The Organisation for Economic Co-operation and Development (OECD) [13], and the Global Education at Asia Society (CGEAS), note the significance of key global competency skills in the delivery of the SDGs, and their achievement by 2030 [14]. In developing global competencies, four domains have been identified by CGEAS: (i) Investigate the world: Investigate the world beyond the immediate environment; (ii) Recognise perspectives: Recognize own and others perspectives; (iii) Communicate ideas: Communicate ideas effectively to diverse audiences; and, (iv) Take action: Translate ideas into appropriate action to improve conditions [14]. These four domains were incorporated, therefore, into the core of the Young Persons' Plan for the Planet (YPPP) Program approach. Within these four domains, five additional key competencies were identified as having the potential to contribute successfully to EFSD, and were incorporated, therefore, into the development of the program: (v) A systems approach to the 17 UN SDGs [15]; (vi) STEM skills (Science, Technology, Engineering, Mathematics) [16]; (vii) Strategic Planning [17]; (ix) Challenge-Based Learning [18]; and, (x) a Sustainable Mindset [19].

1.3.1. A Systems Approach to the Sustainable Development Goals

A key consideration in addressing and delivering the SDGs are their scope and depth. As an example, the Bill and Melinda Gates Foundation Global Challenges focused on the first six SDGs [20]. Others advocate a more holistic and systems-based approach, addressing all of the 17 SDGs simultaneously because the individual SDGs are interconnected [15]; for the same reason, a strategic planning approach would advocate addressing all 17 SDGs. Education for sustainable development also takes a holistic and systems-based view of sustainability [21]. The YPPP Program was designed, therefore, to support students in taking a systems-based view of the SDGs by addressing all 17 of the SDGs and their interconnectivities.

1.3.2. STEM (Science, Technology, Engineering, and Mathematics) Skills

STEM learning and skills have been identified as key components in the broader education system and have an important role to play in education for sustainable development [16]. Of particular importance is the development of the scientific method and research skills for investigating the world-enabling students to move beyond opinions to science-based facts in developing and delivering solutions [16], the key role of design and digital technology skills, in achieving sustainable development, is also recognized, and, therefore, also incorporated into the program [16].

Designed as a STEM learning journey and incorporating CARMA (Contextual, Authentic, Relevant, Meaningful, and Applicable), a contemporary program developed at one of the inaugural participating schools (Kent Street Senior High School, Western Australia), the program focused on preparing and

providing students with the 21st Century skills identified as being required for Australia's future 4IR (Fourth Industrial Revolution) workforce [22] and the educational reforms currently being implemented in Mauritius [23]. As part of the program students were encouraged, therefore, to develop an acute awareness of both biophysical and societal global issues that require STEM understandings, skills, processes, and scientific knowledge to solve. For this reason, the program also provided an external learning experience integrated with the traditional curriculum through CoRE (Centre of Resources Excellence) [24] and Global Competency [12] learning model methodologies. This enabled, in a real-world context, the interconnectivity of the SDGs to be appreciated and acknowledged as the program invited students to explore and interrogate the SDGs within the students' own local, regional as well as national contexts. The program encouraged students to engage in high-level discovery, exploration, inquiry, and investigation to identify and present a diverse array of potential articulations of the SDGs in their region. Working collaboratively within a student centered or directed learning system, students were encouraged to recognize the relevance, meaningfulness, and purpose of the SDGs and their impacts on their own lives. The collection and management of research data, within the program, was also designed to instill a sense of responsibility, and ultimately a need and desire to problem solve.

1.3.3. Strategic Planning

As noted already, by cascading strategic planning capabilities and competencies, from international to regional and local levels, corporates achieved significant success in meeting their global objectives [5]. These capabilities include the ability to plan and succinctly communicate this plan through strategic planning processes such as VMOSA (Vision, Mission, Objectives, Strategies, Actions) [25] and VOSAM (Vision, Objectives, Strategies, Actions, Measures) [26].

A significant challenge for the delivery of the 17 SDGs is also prioritization—the ability to focus on the most urgent and important areas both within individual SDGs and across the SDGs as a whole. To address this requirement, additional strategic planning tools, including the Pareto Principle (80:20 Rule) and Urgency/Importance Matrices [27] were incorporated into the program. To facilitate communication, participants were encouraged to develop further strategic planning and global competencies such as leadership, teamwork, interpersonal, and media communication within the program.

1.3.4. Challenge-Based and Action Learning

In the education environment, the importance of challenge-based, action, and experiential learning is emerging as of critical importance to address the complexities of the current global context [1,28]. The applicability of this learning approach, to the complexities and interconnectivities of the 17 SDGs, has been identified as critical to the successful delivery of the SDGs - a challenge that has been described as a 'wicked problem' [29]. Figueiro and Raufflet highlight that the inclusion of action and experiential-based learning in education for sustainable development has the potential to 'increase student motivation and critical thinking skills' in management curricula [1]. The use of management tools such as strategic planning as the framework for this experiential learning and the delivery of the SDGs, however, is novel. Challenge-based, action, and experiential learning approaches were, therefore, key components of the program design. Although the use of challenge and action-based learning has been highlighted as a useful methodology in management teaching on sustainability, the use of management training skills such as strategic planning as the basis for challenge-based and action learning is novel. [1].

### 1.3.5. Achieving a 'Sustainable Mindset'

Successfully delivering the SDGs will require significant changes across a range of biophysical, social, cultural, and economic systems [15]. Further, Meadows highlights that one of the most important leverage points for systems change is a paradigm mindset shift [30]. As highlighted by

Costanza et al. [31] the paradigm mindset shift required will be the transition from a 'business as usual' mindset to what has been termed a 'sustainable mindset' [19]-both individually and as a society. Furthermore, Costanza et al. note that Scenario Planning can also be effective in achieving this key system change leverage point [31]. The program, therefore, included the development of scenario planning and visioning competencies that could further support this paradigm mindset shift.

1.4. Developing the Young Persons' Plan for the Planet Program

These key competencies, described above, were integrated and developed into a strategic planning-based intervention and experiential educational framework entitled the Young Persons' Plan for the Planet Program (YPPP, the program).

The integrated program design involved six key phases of the SDG Plan development illustrated in Figure 1.
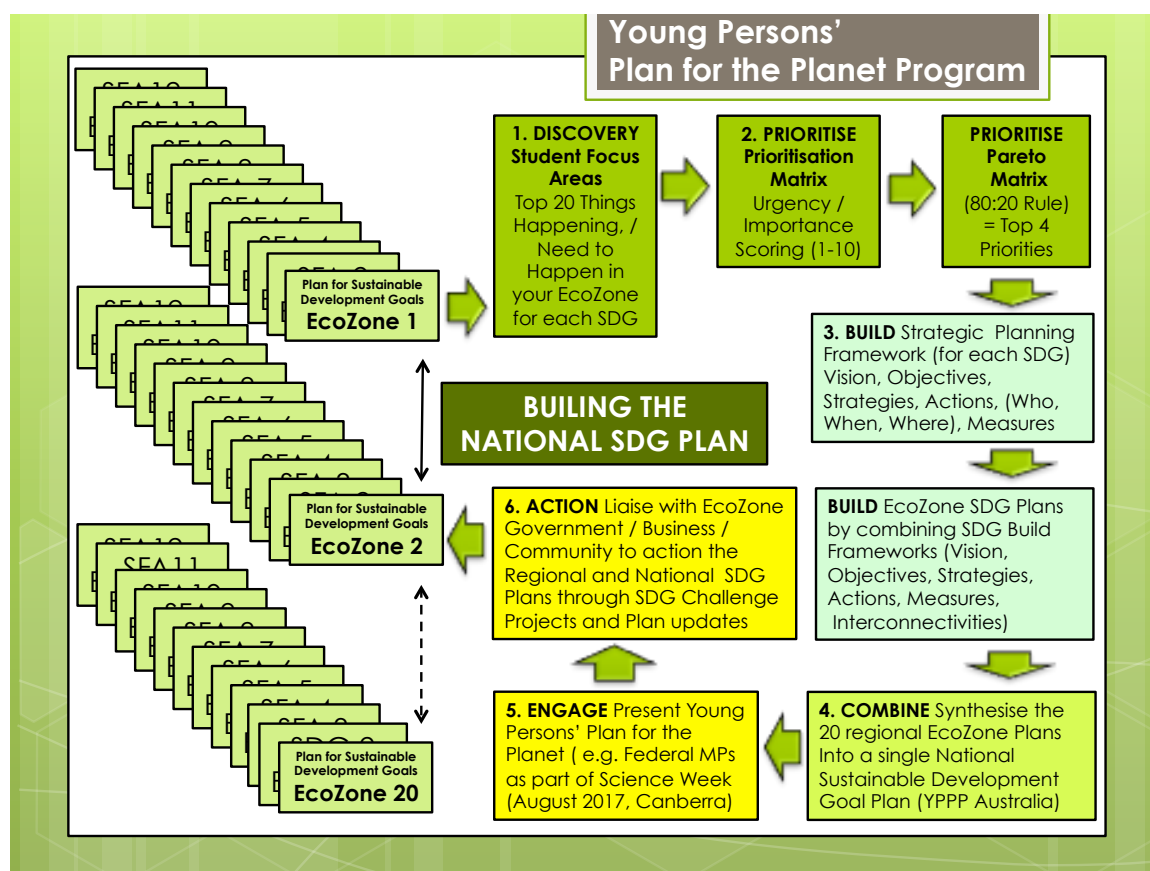
Figure 1. The six phases of the Young Persons' Plan for the Planet (YPPP) Program intervention.

These key phases were (i) Discovery: In this phase, participants were asked to examine the SDG they or their team had been assigned to, and identify key initiatives that were already happening or initiatives that participants identified as needed to happen, to deliver on each SDG in their EcoZone (see definition of Ecozone below); (ii) Prioritise: Using strategic planning tools, participants were then asked to prioritise these initiatives and identify the top priorities for their EcoZone; (iii) Build: Again using strategic planning tools, participants were invited to build a one page vision and strategic Plan for their SDGs for their EcoZone; (iv) Combine: Participants were then invited to combine their individual EcoZone plans into a regional SDG Plan. These regional Plans were then synthesized by the students into a national Plan and published as either the Young Australians' and Young Mauritians' Plan for the Planet (Available in Supplementary Information). Participants completed the synthesis process utilising strategic planning and management tools; (v) Engage: Participants were invited to

present the national SDG Plans to relevant politicians and community leaders (Figure 2); and, (vi) Action: In 2018 the program was expanded to include the development and delivery of SDG Challenge Projects in priority areas of the regional and national SDG Plans.

Figure 2. Australian students presenting the Young Australians' Plan for the Planet to the national Science Minister at Parliament House, Canberra in 2017.

The overall approach of the program, therefore, focused on facilitating a learning process that aimed to develop students' social and emotional enterprising skills (e.g., prioritization, organization, communication, and self-confidence). These have been identified as mandatory intra- and interpersonal attributes essential in the development of the necessary technical skills required to engage effectively with the SDGs and their interplay and operationalisation within a region [32].

The program also focused on the facilitation of high-level cognitive and critical thinking, interpretation and evaluation of data and their respective scenarios, as well as key STEM skills. The integration of these outcomes, within the program design, into a holistic Plan aimed at understanding, confidence, and empowerment for students engaged in the strategic planning-based pedagogy. The overall program design was based on the work by Scoullos (2013) who outlined the key learning components of education for sustainable development: (i) Interdisciplinary and holistic, (ii) learning centered and participatory, (iii) values-driven, promoting critical thinking, and exploring all interested sides, (iv) forward looking and promoting medium and long-term planning, and (v) locally relevant, encourages multilateral collaborations among schools, local actors, and authorities, scientific communities, the private sector and NGOs, and (vi) revealing global issues and connections as part of everyday life [33,34].

1.5. Research Questions

We tested how this strategic planning-based pedagogy and experiential educational framework (the program) affected attitudinal changes of adolescents towards the SDGs and sustainability outcomes, based on the following research questions.

(i)　　What is the impact of a strategic planning-based intervention (YPPP Program) on awareness, understanding, motivation, and action orientation towards the SDGs and sustainable outcomes, in an adolescent subset of the Australian and Mauritian population?

(ii)　　What is the impact of a strategic planning-based intervention (YPPP Program) and alternative motivational framing of the global context on plans for achieving sustainable outcomes and the SDGs in an adolescent subset of the Australian population?

(iii)　　What is the impact of a strategic planning-based intervention (YPPP Program) on the preferred scenarios for Australia in 2050 for a subset of Australian adolescents, and how do these results compare to the preferred scenarios of the national Australian population?

(iv)　　What is the impact of a strategic planning-based intervention (YPPP Program) on the attitudes to climate change of Australian adolescents, and how does this compare to a subset of scientists and the attitudes of the national Australian population?

Section 2 of this paper describes the methodology used to test the impact of the Young Persons' Plan for the Planet Program on a subset of the adolescent population in Australia and Mauritius. Section 3 provides the results of this research and an analysis of these results. Finally, in Sections 4 and 5, we discuss some of the implications and conclusions from these results for education for sustainable development, and the opportunities for further research.

2. Research and Methodology

2.1. Target Segments

2.1.1. Selection of Australia and Mauritius for the Study

To test the application of these key components of education for sustainable development it was important to identify a set of diverse economic, ecological, and social contexts in which the students lived. The intervention was initiated in Australia, which provided complex ecological issues and a highly multicultural society with diverse social structures, living across a range of geographies, from highly urbanized to highly agricultural environments [35]. Mauritius offered a valuable comparison of the application of the program and provided a cultural contrast with three principle languages (Creole, French, and English), compared with one principle language (English), in Australia. The countries also provided a mixture of developed and developing economic, ecological, and social contexts. The geographical proximity of the two test environments allowed for participant interaction over the study period, increasing co-learning opportunities.

Australia and Mauritius were divided into regions, entitled EcoZones (Ecological, Economic, Social Zones), based on an aggregation of Local Government Areas (LGAs), with each school allocated the development of a 'strategic plan' to deliver the SDGs for their specific EcoZone. For Australia, fourteen schools covered fifteen different EcoZones mapped against state, territory, and local government boundaries (Figure 3). For Mauritius, ten schools covered the nine existing regional districts. Once the EcoZone SDG Plans were completed, students were tasked to synthesise these regional EcoZone SDG Plans into National SDG Plans: The Young Australian and the Young Mauritians' Plan for the Planet.

Figure 3. The 20 EcoZones for Australia.

2.1.2. Selection of Schools as the Location of the Intervention

Testing the program within schools provided a consistent and accessible environment covering the full range of geographic, social, and cultural contexts. The sample represented in both the Australian and Mauritian case studies included government, private, and independent schools. The program was targeted at middle to senior high school students, and the intervention was extracurricular, which ensured that no curriculum changes were required. This allowed the program, and associated research, to be rapidly deployed and effectively managed.

The school environment also facilitated the engagement and support of key stakeholders such as national Science Centres (Australia-Questacon, Inspiring Australia; Rajiv Gandhi Science Centre-Mauritius), the United Nations (Information Centres and regional associations), and national and regional universities (Australian National University, University of NSW, University of Technology, Sydney, James Cook University, Charles Darwin University, Curtin University (Australia and Mauritius) and Charles Talfair Institute (Mauritius)).

2.2. Timeframes

The programs were launched in Australia as the Young Australians' Plan Program for the Planet in February 2017, and in Mauritius, as the Young Mauritians' Plan for the Planet Program, in February 2018. Both programs operated over the full school year and were voluntary extra- curricular activities. There was no cost to participating schools, removing the risk of resources as a constraint on students' opportunity to take part in the program.

2.3. Funding and Sponsorship

Initial funding and resources for the program and research were provided by a range of government, business, and community sponsors: The Australian Research Council, Australian National University, Questacon and Inspiring Australia, the Rajiv Gandhi Science Centre, the University of NSW, University of Technology (Sydney), James Cook University, Charles Darwin University, Curtin University, and the Mauritius Commercial Bank. Other key stakeholders included the United Nations Information Centre (Canberra), Future Earth (Australia and Asian Regional Hub), and the Foundation for Young Australians. In Mauritius, 700 copies of the Young Mauritians' Plan for the Planet were sponsored by the Mauritius Commercial Bank (MCB) and distributed to Mauritian Members of Parliament and all libraries and secondary schools in the country. This potentially had a significant impact, as three

months later the program was covered on national television (available in Supplementary Information) and teachers reported that *'everyone in Mauritius is now talking about the SDGs'*.

2.4. Quantitative Research Design

The impact of the program was evaluated using a series of quantitative and qualitative measures. For quantitative evaluation, four surveys were conducted at the commencement and conclusion of the program testing adolescent attitudes to a range of sustainable outcomes and program impacts: (i) SDGs / Sustainable Future Earth Survey: Administered before and after the intervention in Australia; (ii) Future Scenarios Survey: This Survey had previously been administered nationally and so provided comparisons between the adolescent population subset and the national population [36]; (iii) Climate Change Survey: This survey had previously been administered to both a subset of scientists and also to the Australian population. This, therefore, provided an opportunity to compare the results of the Australian adolescent subset to these two other populations; (iv) TOBN Survey: Australian schools were also randomly assigned four pre-intervention Focus Area Briefs (Threats, Opportunities, Both, Neither), to determine whether these areas of focus influenced the outcomes of both the YPPP deliverables (SDG Plans), and on adolescent perceptions; and, (v) Program Evaluation Surveys: A series of Intervention Impact Surveys (Program Evaluations) were administered to both Australian and Mauritian students at the conclusion of the program; these Surveys and Briefs are included in Supplementary Information. Surveys (i)–(iv) were based on pre/post assessment design. Survey (v) was based on the post survey assessment design. The definition of 'attitudes' was based on the work of Milford and Duckitt (2010) and Bergman (2015) and was focused particularly on changes in student awareness, motivation, and intention to act [37,38].

2.5. Qualitative Research Design

To compliment the Quantitative Research, Qualitative Research was conducted using both face-to-face interviews and focus groups.

2.5.1. Focus Groups

Focus groups were conducted following the delivery of the program to further explore adolescents' perceptions of the SDGs and sustainable outcomes before and after their participation in the program. These focus groups included a simple one-page knowledge assessment questionnaire (included in Supplementary Information) to open up discussion on which specific aspects of the intervention were significant for participants.

2.5.2. United Nations (Information Centre, Canberra) and Media Interviews

As part of a national conference following the program, students were invited to take part in face-to-face interviews on their understanding of the SDGs and the impact of the intervention. These interviews were conducted independently by the UN Information Centre (Canberra), and provide part of the Qualitative feedback. There was also significant media interest in the program, in which the participants provided feedback on their perceptions of the SDGs, a sustainable future Earth and the impact of the YPPP Program. An example of this Media Coverage is included in Supplementary Information.

3. Results

3.1. Quantitative Research Outcomes

3.1.1. Program Evaluation Surveys

3.1.1.1. Program Evaluation Survey (Online)

At the completion of the Year 1 Program (2017) students were invited to complete an online Program Evaluation Survey. Perhaps the most indicative were the answers to the following open-ended question: 'In your own words, what do you think were the main benefits to you in taking part in the Young Australians' Plan for the Planet Program?

- Gave me a better understanding of what needs to be achieved in the world to create a better world.
- It gave us a voice and as though we have achieved something bigger than us. It also gave us good connections for future.
- Plan for the Planet has raised my awareness for the need to take care for the environment.
- The empowerment that the program gave us. To be more than teenagers and students—and instead to make a difference in the world.
- The full survey is included in Supplementary Information.

3.1.1.2. Program Evaluation Survey

For the 2018 program, which covered both Australia and Mauritius, students who attended the International Conference in Mauritius in December 2018, were asked to rate on a one (low) to 10 (high) scale both (a) key knowledge and awareness factors regarding the SDGs and sustainability; and, (b) the impact of key enablers, before and after the program. All of the 76 students who attended the final day of the International Conference in Mauritius in December 2018 responded to the survey. The results demonstrate a significant ($p < 0.01$) increase in mean rates of understanding, and attitudes of the students towards the SDGs in awareness (85% increase), understanding/engagement (75% increase), motivation (57% increase), and action orientation/empowerment (66% increase) (Figure 4).
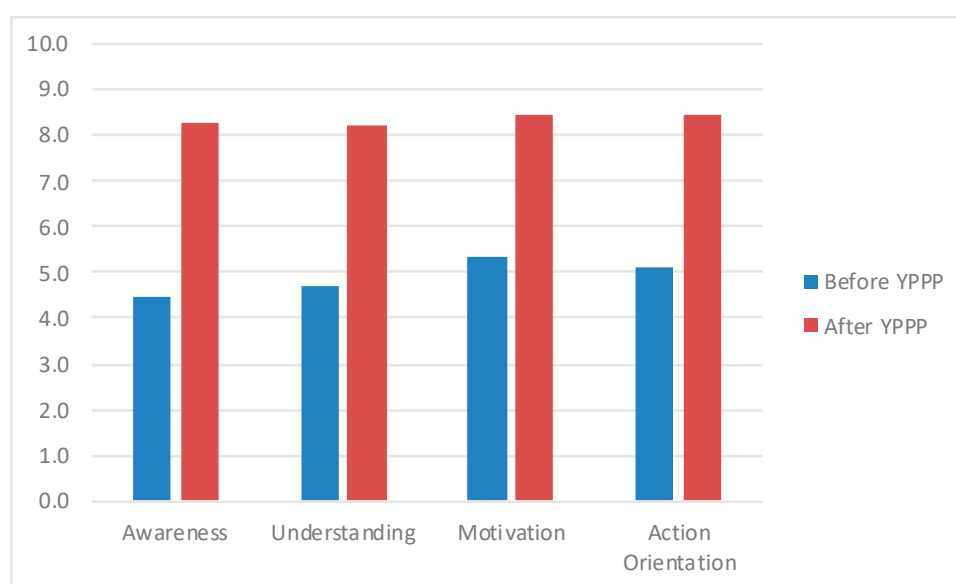

Figure 4. Before and after impact of the Young Persons' Plan for the Planet (YPPP) Program.

Although the sample size is relatively small, further confirmation of these results was reflected in the respondent statements to the open-ended questions at the end of the survey: *'very eye opening . . .*

we should never belittle the fact of how (much) we can do or change'; 'if it wasn't for this program (intervention) I would have little knowledge of sustainability and would be afraid to take action'; and, *'This program made me even more inspired and ready to help create a better future for this planet'*.

Motivation was identified the highest 'before intervention' factor, which is understandable as this program was an extra curriculum program where we would expect students, who undertook this activity over and above their own studies, to be already motivated. We noted however, that Motivation still increased as a result of the program (48%). We also noted an increase in Understanding (57%); *'The YPPP program (intervention) has really helped me understand the troubles that the world is going through but afterwards I think I have a very good knowledge about it'*.

For the competencies, the most noticeable increase in the mean in the area of Collaboration between schools (Figure 5). We would expect this given the sample was taken from the Australian and Mauritian students who attended the International Conference.
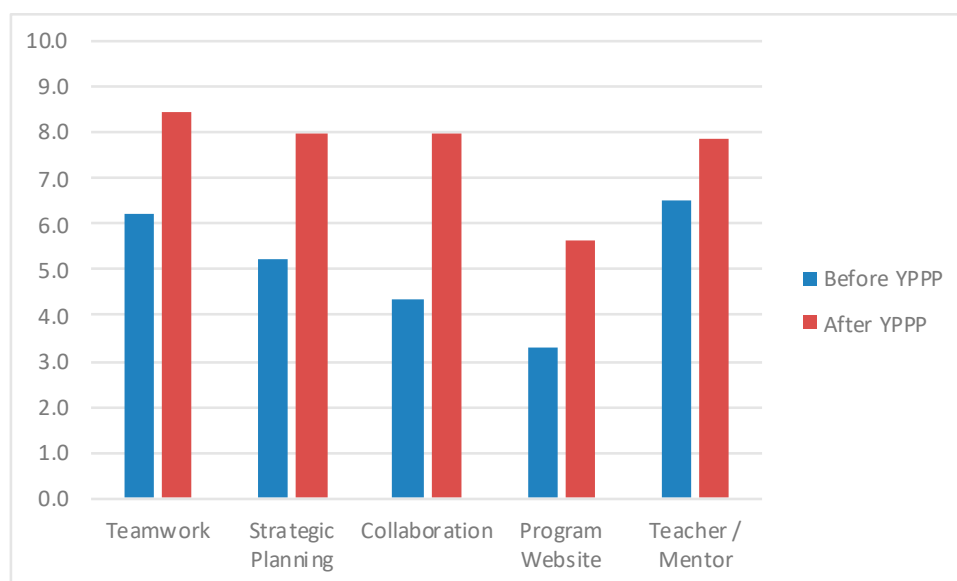

Figure 5. Before and after the program: Impact of program competencies.

Of interest is also the importance rating of these competencies before and after the YPPP Program. The results highlighted the importance of the teacher/mentor role in the YPPP Program. This is of interest as teachers/mentors regularly reported having to do very little once the students had started the intervention as the *'students drove the program'*. The important role of the teacher/mentor in initiating and inspiring the participants at the beginning of the program is, therefore, highlighted (Figure 5).

Furthermore, the importance of teamwork, strategic planning, and collaboration are also highlighted in participant responses to the open ended questions: *'this program ... gave me the ability to connect and collaborate with other global citizens'*; and, *'the world needs us, youth, to come up with new ideas to save the planet. Together with all the countries around the world, we can achieve the 17 SDGs sooner'*.

3.1.2. UN SDGs/Sustainable Future Earth Survey

One of the most noticeable shifts in the UN SDG Survey was the change in participant motivation. On the issue of Climate Action, individual participants, who indicated 'totally motivated to act' in the survey, increased from 29.7% before the intervention, to 47.9% afterwards, an increase of over 60% (Figure 6). Similarly, on issues such as Clean Energy, individuals who indicated 'totally motivated to act' increased from 28.3% before the intervention, to 46.75% after the program (Figure 6), again an increase of over 60%.
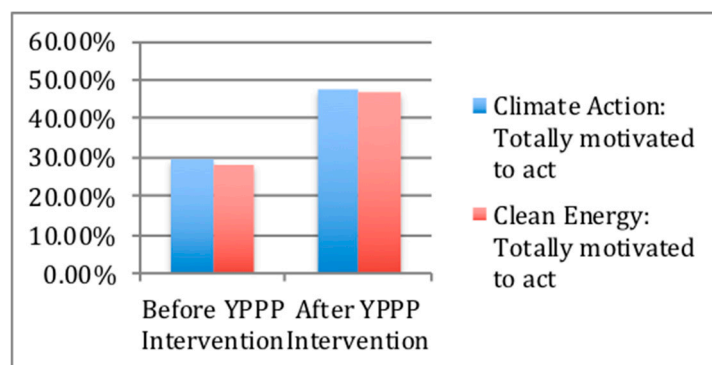
Figure 6. Examples of changes in adolescent motivation to act.

3.1.3. Future Scenarios Survey

We also calibrated participant preferred future scenarios for Australia. This research had also been conducted through a national scale survey in 2016 [36]. The results of both the national survey and the adolescent group are included in Figure 7, calculated using the Borda scoring method. The national majority preference for the Community Well-being scenario is replicated in the results for this adolescent subgroup. It is noted that Coordinated Action and Strong Individualism are higher for this adolescent subgroup and Free Enterprise is lower.
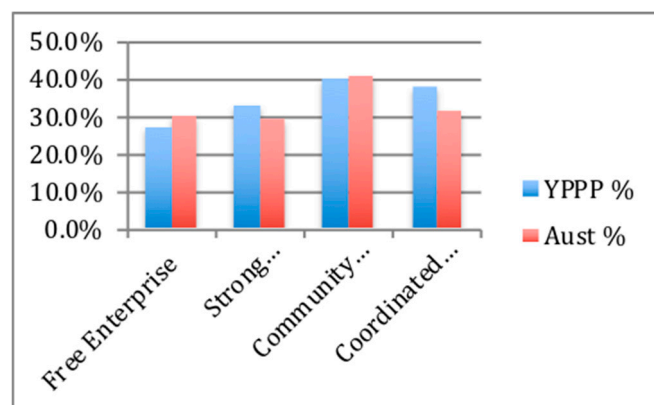
Figure 7. Preferred future scenarios for Our Future, Your Voice Survey: Australian National Survey (Aust) (*n* = 2485) compared to YPPP Program adolescents (*n* = 145).

3.1.4. Climate Change Survey

The comparison of the results of the national and scientist population subset to the adolescent subset of participants in this program confirmed consistency with the overall results of the original national survey (Figure 8).

Use of the Climate Change Survey, in parallel with the UN SDG/Sustainable Future Earth Survey, provided further confirmation of the earlier results, which showed increased participant understanding and empowerment toward sustainable outcomes. This was demonstrated in (i) the question of 'whether climate change would have an impact on personal economic and social circumstance?' In this case, individual participant scores moved from 52.6% to 72.9%, representing a statistically significant increase of 38% with $p < 0.05$. When asked (ii) 'whether scientists are overstating the impact of climate change' a comparison of individual participant results, before and after the delivery of the program, Strongly Disagree increased from 31.0% to 47.9%, again a statistically significant increase of over 50% with $p < 0.05$ (Figure 8).
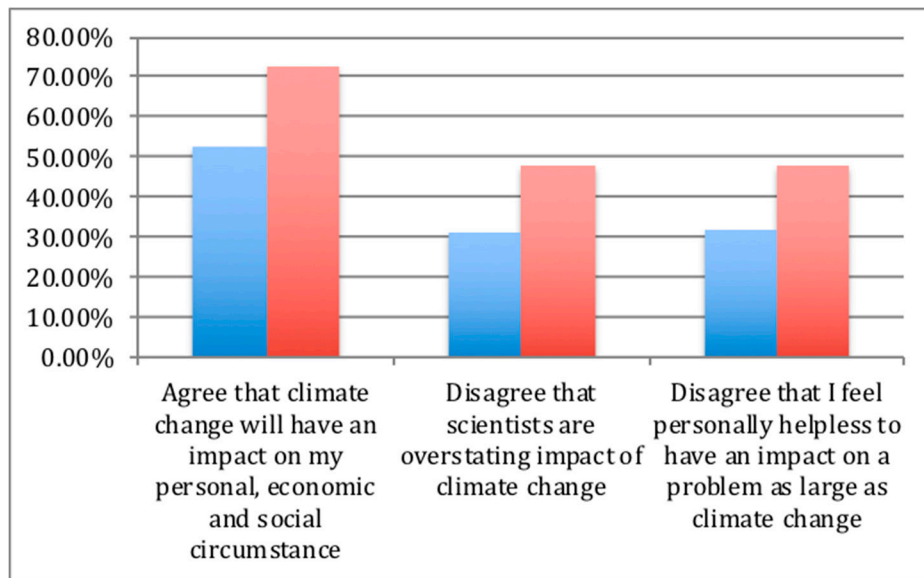
Figure 8. Changes in adolescent understanding and empowerment.

However, perhaps most importantly for our study was the increase in empowerment of participants in the program. When asked whether individual participants 'felt personally helpless to have much of an impact on a problem as large as climate change?' a before and after intervention comparison of results for individual participants who 'totally disagreed with this statement' highlighted a significant increase from 32.1% to 47.9% (Figure 9).
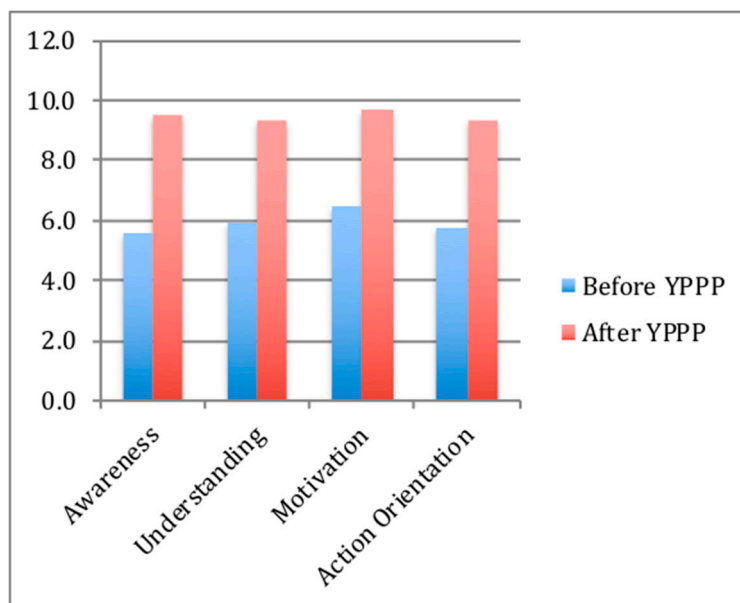

Figure 9. Results of the focus group surveys.

3.1.5. TOBN (Threats, Opportunities, Both, Neither) Survey (Impact of Alternative Motivational Framing of the Global Context on Plans for Achieving Sustainable)

This element of the research was inconclusive; although there was significant variation in the quality of the SDG Plans generated by each group of students in the program, these results could not be allocated back to a series of TOBN (Threats, Opportunities, Both, Neither) Focus Briefs provided at the beginning of the research. Key motivators and competencies were identified, however, in the

open-ended questions, and these were linked to the program team and support competencies including teamwork, strategic planning, collaboration, intervention website, and teacher and mentor support.

3.2. Qualitative Research

3.2.1. Focus Groups

Focus groups were conducted with two groups of 2017 Alumni Students—Kent Street High School (Perth, Western Australia), and Norwood Morialta High School (Adelaide, South Australia), to further explore the impact emerging from the quantitative results of the 2017 Intervention (Figure 9).

However, perhaps the most informative insight was an anecdote by one of the students on the impact of the intervention: "I woke up one morning after we had completed the YPPP Plan for our EcoZone and thought I want to do more than just develop a plan on how to implement the SDGs in our area—I actually want to start doing something! So, I contacted the other students in our groups, and we set up the Rubbish Rangers in our school. We each chose sections of the school covering all the school and made sure all the rubbish was picked up on those areas. We know we weren't changing the world, but in a small way we were making a difference already'. When asked how the other students and teachers reacted, the student that replied the other students and teachers 'asked us why we were on detention duty picking up rubbish when we such good students'. The student then proceeded to explain to the other students and teachers about this YPPP. This again reinforces that the program not only increased awareness, understanding of the SDGs—but also motivation and action orientation.

3.2.2. Media Interviews

There was significant media interest in the program, and subsequently a number of media interviews were conducted with students, teachers, and school principals. Students and teacher interviews were also conducted in conjunction with the Young Persons' Plan for the Planet Conferences in Australia and Mauritius. The feedback from these media interviews confirmed the results identified in the quantitative data (Figures 10–13).

Figure 10. Senior High School students addressing the Parliamentary Breakfast to launch the Young Australians Plan for the Planet.

Figure 11. Senior High School students speaking with SKY News at the Australian Parliament House to launch the Young Australians Plan for the Planet.
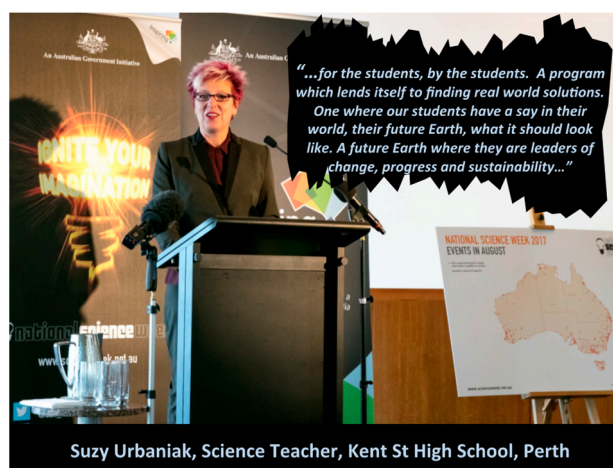
Figure 12. Winner of the Prime Ministers National Science Teachers Award (2016), Suzy Urbaniak at the launch of the Young Australians' Plan for the Planet (Parliament House).

Figure 13. Joel Buchholtz, Executive Principal, Pimlico High School Townsville and Board Member, Council of International Schools.

3.2.3. UNIC (Australia) Interviews and Australia Conference (Canberra, 2017) and Mauritius (Port Louis, 2018) International Conference Presentations

In addition to the quantitative data, other qualitative data was gathered through student interviews and presentations on both their findings on the SDGs as well as the impact of the program. These are quite extensive and, again, confirmed the findings of the quantitative research. Due to the extensive size of these interviews and presentations they have also been made available in Supplementary Information.

4. Discussion

4.1. Impact of the Intervention on Awareness, Understanding, Motivation, and Action Orientation towards Sustainable Outcomes

(i) Our results demonstrate that there was a significant impact of the program on the first research question on adolescents' awareness, understanding, motivation, and action orientation in relation to the SDGs, climate change and renewable energy. The reported transition of students from seeing the issues of the world from 'overwhelming' to 'understanding' to 'empowerment' is potentially significant due the importance placed on this type of 'paradigm shift' or mindset change' as a key leverage point in systems change (30).

We recognise that this program was an extracurricular program for students, and the voluntary nature of extracurricular activities, therefore, could predispose these students to both, an interest in sustainable outcomes, as well as a motivation to become involved. However, the significant improvements noted in awareness, understanding, motivation, and action orientation, highlight the increased empowerment the students articulated post program, even amongst those presumably positively disposed to the issues. This was also reflected in student desire to become involved in projects to deliver the SDGs, such as the 'Rubbish Rangers' Team. This raises the issue of whether the significance of these attitude changes represent what Meadows describes as paradigm or mindset shift (Meadows, 2019). The range of students who then went on to become actively involved in sustainability issues in their local communities, as well as internationally, indicated that the attitude changes were not only in awareness and understanding of the SGDs and sustainable outcomes, they were also empowering. Clearly, there is the opportunity to do further research in this area to test this apparent mindset shift, both demographically as well as generationally.

If a paradigm shift in an adolescent population is being achieved as a result of the YPPP Program, as this cohort are the drivers of future change, this could provide a significant leverage point for the systemic change required to achieve greater sustainable outcomes. This proposition provides an opportunity for further research.

(ii) The findings for research question two on alternative motivational frameworks were inconclusive. There was no evidence of any specific impact on the adolescent cohorts strategic planning outcomes based on the alternative motivational frameworks presented at the outset of the study. Of importance, however, were the impacts of the strategic planning key competencies of teamwork, collaboration, website support, and mentoring.

(iii) The findings on research question three in the Future Scenario's Survey highlighted a preference, by young Australian adolescents, for a future scenario of Community Well-being, consistent to that of the overall Australian population (36). This highlights the opportunity, identified by Ban Ki-Moon, of engaging youth in the planning and delivery of the UN Sustainable Development Goals and achieving sustainable outcomes (4).

(iv) The results of the Climate Change Survey provided two further insights on research question four; the first was a confirmation of the impact on understanding of the issues of sustainability at both individual and community levels. The link between this increased understanding and increased empowerment to take action, on issues such as climate change, resonates with Meadows identification of a paradigm shift in mindset being a key leverage point for systems change (30) It also highlights the success of one of the key program objectives, i.e., students were encouraged to increase awareness

about the world around them and, thereby, be better positioned to enact positive solutions for both themselves and their communities.

4.2. Methodology

The open-ended questions, included in the surveys post-delivery of the program, provided the opportunity for participants in the research to give feedback on the methodology used in the program. Overall, the participants highlighted how the key competencies (Strategic Planning, STEM, and Global Competencies) made a significant difference in their ability to both understand, and feel empowered to act, to address the SDG's and achieve sustainable outcomes.

In addition, in the quantitative data, as well as the focus groups and open-ended questions, the participants highlighted the importance of the 'soft skill' competencies such as Teamwork and Collaboration. This resulted in the program being modified to incorporate an increased level of team and collaborative approaches to addressing the challenges in the SDGs. For instance, at the outset of the intervention, participants were each allocated an SDG on which to focus. It became very clear, however, that participants much preferred to examine the SDGs as sub-teams or as a whole team rather than individually. This was identified as a key factor in increasing the enjoyment of the program and the program was adjusted accordingly to incorporate this.

This Teamwork and Collaboration approach was also identified as making two further contributions: (i) A sense of collective empowerment amongst the participant; and, (ii) a greater cross-cultural understanding of the impact of the SDGs and issues of sustainability in other cultures. As a result, the program was expanded to include increased interaction across both national and international geographies. This was facilitated though both remote technologies, such as audio and video conferencing, as well as face-to-face conferences, where participants were able to share experiences and learning. Details of the 'It's our future Earth' Conference 1.0 (Canberra, Australia) and Conference 2.0 (Mauritius) interaction programs are included in Supplementary Information.

Open-ended question feedback also highlighted participants' desire to get involved in action, as well as planning. For this reason, the intervention has now been expanded to incorporate an SDG Challenge Project component that participants can take part in once they have completed their SDG strategic planning stage of the program.

5. Conclusions

As highlighted above, the scope and scale in addressing the SDGs has in itself been described as a 'wicked problem' [29], due to both their individual complexity as well as the interconnectivity of the individual Goals. The novelty of the program is the development and application of key competencies such as strategic planning, STEM, challenge-based learning, and global competency skills to achieve sustainable outcomes in an adolescent population. However, the outcomes of this research have highlighted a number of opportunities for intervention programs to achieve sustainable outcomes, as well as for further research in the pursuit of sustainable outcomes. This research brings into relief a number of important issues.

Firstly, the research highlights the importance of education for sustainable development as a key factor in engaging, connecting, and empowering adolescents in achieving the UN SDGs and sustainable outcomes. Our research also highlights that such complexity and interconnectivity can not only be better understood, but also better planned for and managed, through this type of interactive and collaborative approach to education for sustainable development. This also opens the opportunity for the application of this type of educational intervention in additional demographically, culturally, and geographically diverse populations, as well as liaison between them.

Secondly, as highlighted at the outset of this paper, adolescents are often identified as a challenging group with which to engage. This study identified that a significant issue impacting this challenge, specifically within the field of sustainability, can be a lack of a voice for adolescents and sense of empowerment to be heard and make change. It is also encouraging that the findings of this study, i.e.,

engagement and connection of adolescents in the strategic planning process for the delivery of the UN SDGs and sustainable outcomes, contributes to an increase in the sense of empowerment and desire to take action.

Thirdly, our study highlights the importance of engaging and empowering youth in designing a sustainable future Earth. Further, the study demonstrates that the use of an integrated program, based on key competencies (strategic planning, STEM, challenge-based learning, and global competency skills), is not only achievable but that adolescents can both fully understand these principles and develop means to apply them in a real-world context.

Fourthly, as well as this study identifying a number of important integrated components in education for sustainable development it also highlights the opportunity for this type of integrated program to address the 17 SDGs utilising a holistic systems-based approach. Rather than the need to break down the 17 SDGs into individual SDGs, or groups of SDGs on which to focus, the program demonstrated that all 17 SDGs, collectively and as importantly, their interconnectivities, can be successfully addressed using these integrated competencies as a structure.

Finally, and perhaps the most interesting finding of this research, was the opportunity to utilize this type of intervention to achieve a paradigm shift in mindset—a key leverage point for the systems change required to achieve sustainable outcomes [15,30]. The findings in this study, in both the quantitative and qualitative data, that participants reported a significant shift in mindset from being 'overwhelmed' to 'understanding' to 'empowerment', provides the opportunity for further research on the use of this type of integrated intervention to achieve, what can perhaps be more accurately termed, a 'sustainable future mindset'.

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