

TINY BRICKS, BIG IDEAS: PROMOTING WOMEN IN CONSTRUCTION THROUGH COLLABORATIVE AND PARTICIPATORY ACTION RESEARCH IN AUSTRALIA

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Abstract: By tackling the issue of women’s underrepresentation in the construction industry, this paper offers valuable insights from the ‘Tiny Bricks, Big Ideas: The Sustainable Living Challenge’, a Construction Management Workshop designed to encourage high school girls in Australia to consider careers in the construction industry. Using a combination of Collaborative Action Research (CAR) and Participatory Action Research (PAR) methodologies, this paper presents a new methodology adopted by the University academic and professional staff, to uplift construction management discipline among high school students. Simultaneously, it contributed to empowering students to challenge gender stereotypes and to imagine themselves as future contributors to sustainable construction practices. The results demonstrate how action research can lead to transformational changes in social attitudes, time management, collaboration, knowledge, and practices, highlighting its potential as a tool for promoting women in construction diversity and presence in the Australian construction industry.

Keywords: *Action research; Construction management; High school students; Sustainable housing; Women in construction.*

1. Introduction

The construction industry continues to face a significant gender imbalance, with women making up a small fraction of the workforce, particularly in technical and management roles (Norberg & Johansson, 2021). Existing literature by Rodrigo et al. (2024) highlights persistent challenges faced by women in construction-related disciplines, including gender stereotypes, limited mentorship opportunities, workplace culture, and unequal career advancement pathways. However, proposed solutions such as early exposure through STEM outreach programs, role model engagement, and experiential learning initiatives have shown potential in encouraging greater female participation in the construction industry.

Therefore, early involvement at the school level is essential to address this imbalance by challenging gender stereotypes, promoting the social and environmental importance of construction, and inspiring career aspirations among young women. Also, high-school female students need to be aware of available construction-related degree programs, that are offered by various universities for them to enrol in these degrees. The younger generation may not want to study construction management discipline if they are not given proper background and information about it (Rokooei et al., 2025). The “Tiny Bricks, Big Ideas: The Sustainable Living Challenge” workshop was designed and developed to contribute to this goal. Accordingly, this study aims to develop, present, and improve a construction management workshop through an Action Research approach to promote women’s participation in the construction industry in Australia.

The initiative aimed to promote awareness of sustainable living through a construction-based problem-solving approach, to encourage women's participation in construction management by engaging students in hands-on learning, and to adoptive collaboration between schools. This paper narrates the design, development, implementation, and outcomes of the workshop, framed within the theoretical and methodological context of Collaborative Action Research (CAR) and Participatory Action Research (PAR). These elements will be explored in greater detail in the following sections to provide deeper insight into their application and relevance. Section 2 presents the literature review and theoretical framework while the methodology is discussed in detail in Section 3. Subsequently, Section 4 explains the workshops outcomes. Key contributions to theory, practice and society are elaborated in Section 5 followed by conclusions in Section 6.

2. Literature Review

Feldman, (2017) traces the development of educational action research in the English-speaking world, noting that its history continues to evolve as scholarly understanding deepens. He builds on his earlier work in the Palgrave International Handbook of Action Research, showing how the field is continually expanded and reinterpreted by contemporary researchers. Action Research is widely described as a collaborative, problem-focused approach that enables practitioners to investigate real issues and improve practice through iterative cycles of planning, action, and reflection. The goal of action

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research is to develop and test theories while addressing real-world problems in a hands-on manner (Azhar et al., 2010). In education, Hine and Lavery (2014) emphasise that Action Research empowers teachers, enhances professional learning, and supports school improvement through stakeholder participation. In business and management, Shani and Coughlan (2021) highlight Action Research as an emergent inquiry process that integrates action and reflection to address organisational challenges while generating actionable knowledge. Together, these studies show that Action Research is a flexible, context-driven methodology suited to producing practical change and deeper understanding. Based on the study of Coughlan and Coughlan (2025), one way the social sciences are expressed is through action research. The core concept is gaining access to meaning by paying close attention to the construction of issues, the planning, implementation, and evaluation of activities, and the way in which the collected learning influences the emergence of both practical and theoretical knowledge.

3. Methodology

The study employed an action research design characterised by iterative aspects of planning, action, observation, and reflection. The participants of Cycle 1 workshop included the university's marketing team, STEM Teacher in residence, and practising young construction professionals. The feedback received from participants of Cycle 1 workshop was incorporated prior to conducting Cycle 2 workshop with 60 high school female students and school teachers. Participants were tasked with designing sustainable houses using LEGO bricks. The activity was structured to simulate real-world construction management challenges, requiring students to consider various aspects including cost, sustainability, and aesthetic features. Team-based construction challenges encourage collaboration and problem-solving, while structured reflection sessions provided opportunities to discuss sustainable design principles and career pathways in construction management.

3.1 ACTION RESEARCH IN THEORY

Action research within the educational context is a methodical strategy aimed at enhancing teaching techniques (Pelton, 2010). It is widely used in educational settings to enhance teaching and learning. In this study, we adopted action research as a framework to guide the design, implementation, and evaluation of our workshop intervention. This will help the students to understand how a construction project works and understand the role of construction project stakeholders. Action research has the potential to bridge the gap between the construction industry and academia (Azhar et al., 2010). The model presented in Figure 1 shows Crawford's 2016 Action research design principles, highlighting the cyclical and iterative nature of the process.

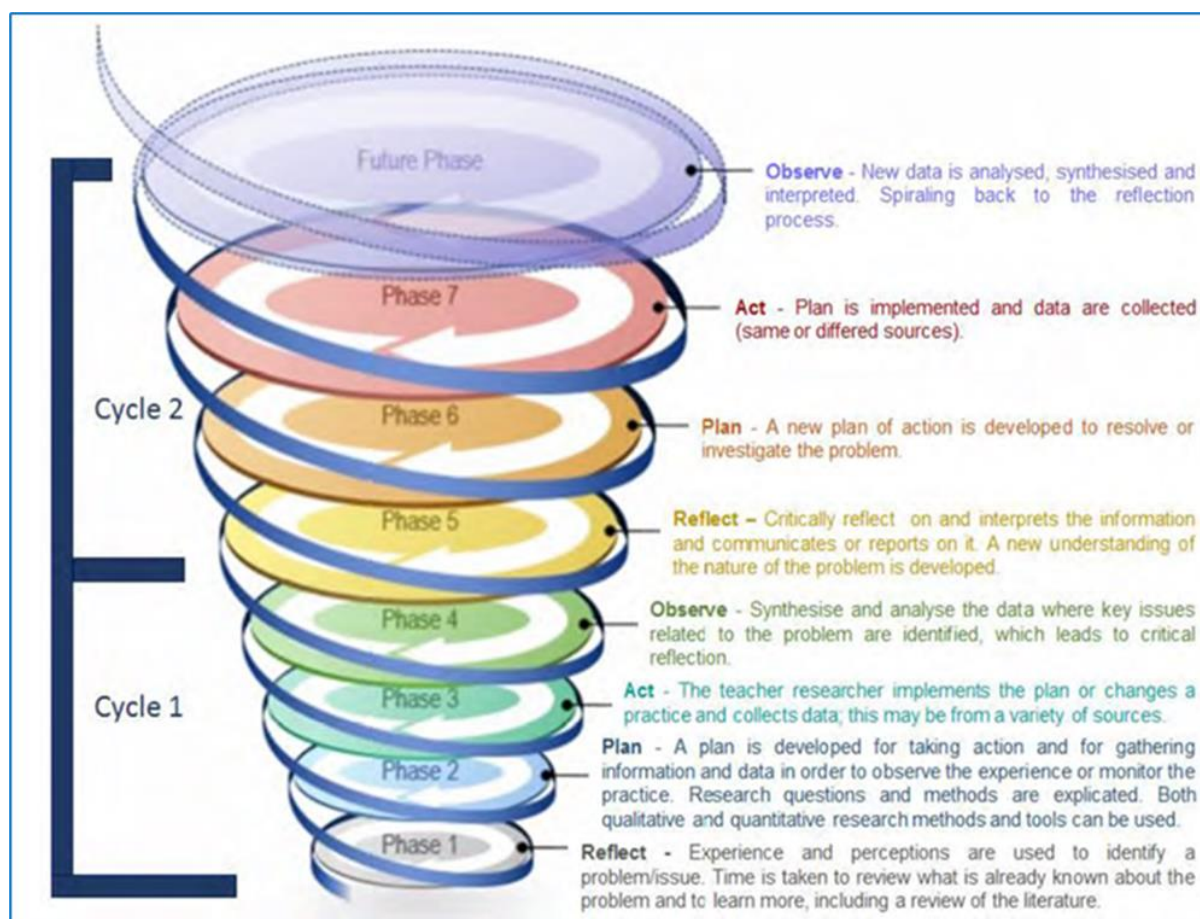


Figure 1: Crawford's 2016 'Action research design principles'
(Source: Crawford, 2022)

As shown in Figure 1, in Cycle 1, the process begins with Reflection, where practitioners critically evaluate their experiences and perceptions to identify a problem or area for improvement. This is followed by the Planning stage, where research methods and strategies for data collection are formulated. During the Action phase, the plan is implemented, and data is collected. Subsequently, in the Observation phase, collected data are analysed and synthesised, which leads back into another round of critical Reflection. As the process transitions into Cycle 2, all phases of Cycle 1 are repeated, but enhancing the understanding based on insights from the previous cycle.

Hendricks (2009), outlines four main action research approaches:

- **Collaborative Action Research (CAR):** Involves multiple stakeholders working together to share expertise and encourage professional dialogue.
- **Critical Action Research:** Aims to address social issues collaboratively to promote social change.
- **Classroom Action Research:** Focuses on practitioner-led inquiry to improve classroom practices.
- **Participatory Action Research (PAR):** Engages stakeholders to examine power dynamics and challenge unproductive structures for transformational change.

This study focused on **Collaborative Action Research** and **Participatory Action Research** as the guiding approaches. CAR enabled us to work closely with institutional stakeholders, while PAR supported inclusive, transformative practices that emphasised participation and equity.

3.1.1 Collaborative Action Research (CAR)

CAR focuses on the co-creation of knowledge through shared expertise and dialogue between different stakeholders (Kemmis et al., 2014). Within this project, CAR provided the foundation for designing the workshop curriculum. University researchers and professional staff (representing marketing, STEM Teacher in residence), as well as high-school teachers and students, worked together to develop materials that were educationally appropriate, industry relevant, and engaging for high school students. This collaboration also helped build capacity among educators, who gained confidence in introducing construction management content to their students.

3.1.2 Participatory Action Research (PAR)

PAR emphasises social change by enabling participants to explore and challenge existing power structures and unproductive practices (Kemmis et al., 2014). It is a process that combines research, education and action (De Oliveira, 2023). In this workshop, PAR principles were applied to create a learning environment where female students could question gendered assumptions about construction careers, actively participate in design-thinking exercises, and reflect on how construction contributes to sustainable living. The students were treated as active contributors rather than passive recipients of knowledge, encouraging a perception of action that challenged traditional narratives around women's roles in the construction industry.

3.2 APPLICATION OF ACTION RESEARCH IN THIS STUDY

This research applied an action research methodology using a workshop designed and delivered for high school students in Adelaide, Australia. Each workshop lasted 1.5 hours, following a structured sequence of activities designed to simulate a real-world construction management process while keeping high school students actively engaged. Each workshop session consisted of 6 groups, each with 4 to 5 students. The following steps present the structure of the workshop of this study.

Step 1:

First, a briefing session was carried out to explain the instructions for the activity.

As per the instructions, each team must design and build a LEGO house that includes an open-plan living/dining/kitchen area, two bedrooms, one bathroom, as well as a functional layout with walls, doorways, and roofing. Apart from these, each team must incorporate at least 2 sustainability features that will aim to reduce greenhouse gas emissions and improve thermal performance. Sustainable features may include solar panels, insulated walls, rainwater systems (e.g., gutters, downpipes and rainwater tanks), and rooftop gardens/ green roofs.

The minimum size of a LEGO house should be approximately 15cm x 15cm x 7cm (Length x Width x Height). The following materials were provided to the students at the beginning of the Workshop (Refer to

Figure).

- Large LEGO base plate
- Paper Money–Initial Payment \$3,000)
- Name tags (Architect, Construction Manager, Estimator, Sustainability Consultant and Marketer for easy identification)
- Price list for materials
- Calculation sheet (to estimate the cost of materials)

- Masking tape - 1
- Blu Tack
- Scissor - 1
- Paper and pencils for planning
- Measuring tape - 1



Figure 2: Materials provided for each group in the beginning

Step 2:

At the start, each team had to assign specific roles to its members, with some students taking on one or two roles depending on team size (4 or 5 members). The roles were designed to reflect the responsibilities of the construction stakeholders as shown below.

- Architect: Responsible for drawing a detailed floor plan that included all required spaces.
- Construction Manager: Plans how the team would work efficiently, prepare a resource plan, and decide which materials to be purchased first based on the initial payment received, and which materials to be purchased periodically based on instalments they were to receive.
- Estimator: Assign costs to different LEGO pieces and estimate the total project budget.
- Sustainability Consultant: Suggest at least two eco-friendly features to integrate into the building.
- Marketer: Work with the team to identify unique features that would make the design stand out and present to judges.

Step 3:

After assigning the roles, the workshop commenced with the 5-minute Planning Phase, where teams finalised roles and collaboratively sketched their housing design on paper. This was followed by the 40-minute Construction Phase, during which teams built their sustainable LEGO house based on their plan.

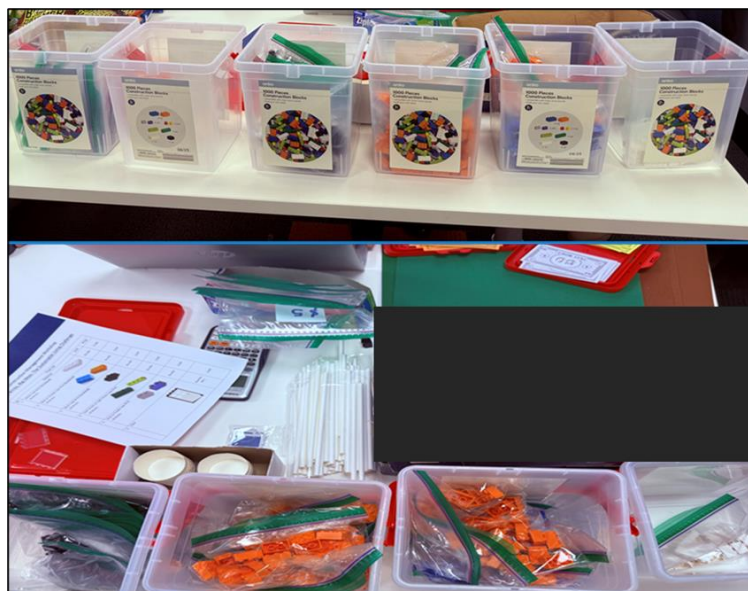


Figure 3: Materials supply desk

Apart from the materials provided at the beginning, students had to buy the rest of materials with the money provided. Other than the initial payment (\$3,000 paper money), the students received 2 other payments (instalments) at 15 minutes and 30 minutes (\$2,000 paper money for each payment). Altogether, each group received \$7,000 paper money to buy the supplies from the supply desk (Refer to **Error! Reference source not found.**). Students were also provided with a price list for the materials available for purchase at the supply desk (Refer to Figure 4).












Price List				Price List				
Nr.	Material	Unit	Price	Nr.	Material	Unit	Price	
1	White Lego Brick (Insulated) -20 Bricks-		Bundle	\$ 400	7	Window		Number (Nr.) \$150
2	Blue or Orange Lego Brick (Insulated) -20 Bricks-		Bundle	\$300	8	Gutter+ Downpipe+ Tank (5 paper straws + 1 paper cup)		Item \$350
3	Black Lego Brick (Insulated) -20 Bricks-		Bundle	\$200	9	Roof		Item \$300
4	Dark Green or Light Green Lego Brick -20 Bricks-		Bundle	\$200	10	Green Roof		Item \$400
5	Gray or Purple Lego Brick -20 Bricks-		Bundle	\$100	11	Solar Panel		Item \$500
6	Door		Number (Nr.)	\$200				

Figure 4: Price list for materials

Figure 5 presents the calculation sheet that was provided for the students to record the transactions. It represents the Bill of Quantities (BOQ) which is used in the actual construction projects to calculate the cost of the project. It was the Estimator’s role to use this calculation sheet to calculate the total cost of the project and to advise the team if they were reaching the budget and suggest design changes, if needed to ensure the budget is not exceeded.

Calculation Sheet					
Nr.	Material	Quantity	Unit	Rate (\$)	Amount (\$)
	Example:				
1	White Brick	1	Bundle	400.00	400.00
Total					

Figure 5: Calculation sheet

Step 4:

Each group had to deliver a 1-minute Shark Tank Pitch to a panel of judges, presenting their design as if competing to "win a project contract". A structured scoring template, as shown in Figure 6 was used to guide the judges' evaluation during the student workshop, ensuring consistent, transparent, and constructive assessment of each group's Shark Tank Pitch. The session concluded with 5 minutes of Reflection and Scoring where the panel announced the winning team, provided constructive feedback, and celebrated the participants' creativity and teamwork. This structured approach encouraged students to practice role-based collaboration, problem-solving, and professional communication while reinforcing the practical aspects of construction management.

Category	Allocated Marks						Total
House Design & Layout (Meets specifications: 2 bedrooms, 1 bath, open plan living, Functional layout with walls, doorways, and roofing)	Rooms (0.5 * 2 = 1)	Bath (0.5)	4 External Walls (0.5)	Roof (0.5)	Internal door openings and external door (0.5 * 4 = 2)	Window (1 window for each bedroom) (0.5 * 2 = 1)	
	Team collaboration (2)		Quality of planning (1)	Time management (1)		Clean and tidy (1)	
Sustainability Features (Use of eco-friendly elements)	Solar (2)	Insulated walls (2)		Rainwater System (2)		Rooftop garden or green roof (2)	
	1-5 materials (- 0.5)		6-10 materials (- 1)	11-15 materials (- 1.5)	16-20 materials (- 2)	21-25 materials (- 2.5)	25-30 materials (- 3)
Budget Management (Efficient use of materials - mark deduction for purchased unused materials)							
Shark Tank Pitch (Clear, persuasive, and engaging presentation) (4 marks)							
						Final Marks	

Figure 6: Scoring template

4. Workshop Outcomes

4.1 DESIGN AND BUILD SUSTAINABLE HOUSE MODELS (REFLECT, DESIGN, AND ACT PHASES)

Based on the guidance we provided (Reflect Phase), the student teams produced creative and practical sustainable house models (Design phase and Act phase). Each team integrated eco-friendly features suggested by their Sustainability Consultant, as well as cost and marketing considerations advised by their Estimator and Marketer roles. Examples of student outcomes are shown in Figure 7. The designs varied in style and sustainability strategies, including:

- Houses with **rooftop solar panels**
- Designs featuring green roofs and rainwater harvesting systems
- Compact housing layouts emphasising space efficiency, **natural lighting** in a **green roof**

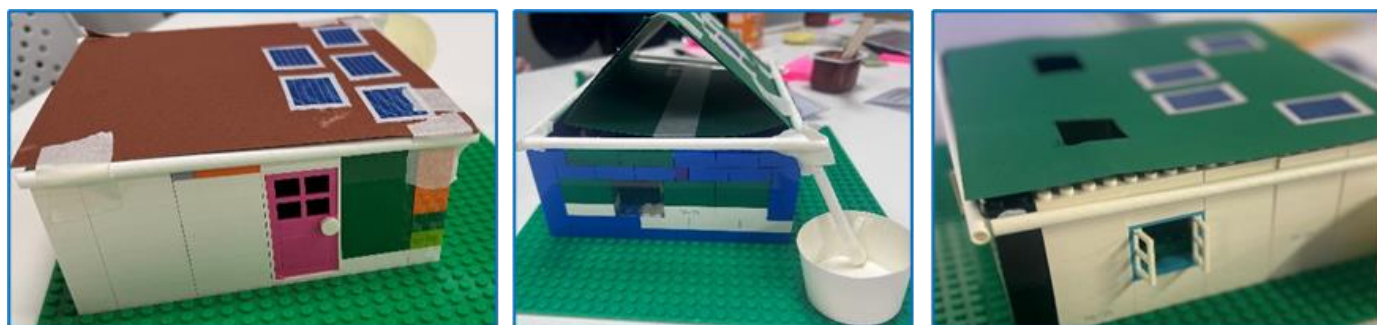


Figure 7: Student outcomes - LEGO houses

4.2 WORKSHOP EVALUATION AND STAKEHOLDER FEEDBACK (OBSERVE AND REFLECT PHASES)

Evaluation forms, as shown in Figure 8, were distributed to students, teachers, and the marketing team to assess the workshop's effectiveness.

Workshop evaluation

Thanks for taking part in this activity from [REDACTED]
 By filling out the form below, you'll help us make this activity better and come up with new ones in the future.

Which workshop did you go to?

Do you feel like you know more about this topic after taking part?

Not at all Not really I don't know Yes, a bit Yes, a lot

How much did you enjoy this workshop?

😞 😐 😊 😄

What could we do to make the workshop better?

Figure 8: Workshop evaluation form

Extracts of the feedback received from students, teachers and marketing team respectively have been presented below.

4.2.1 Student's feedback

- It was very interactive and fun. The experience was an excellent way to show what a construction management career pathway would look like.
- Workshop was well planned out with nice supporting teachers (lecturers and university students). They were fun while also being informative and expanding our knowledge.
- It flowed well and was really enjoyable.
- The workshop was great, and enjoyed every bit of it

4.2.2 Teacher's feedback

- It was great to see how construction management can be demonstrated in a simple and effective way. This workshop gave me an idea to run a similar workshop for the entire Year 10 cohort of our school (which has about 12 classes in STEM)
- We really liked how different subject areas, such as maths, design, sustainability, marketing etc, were included in one workshop.

4.2.3 Marketing team's feedback

- Overall, it was very well received, with feedback being largely positive.
- Assigning roles individually works well with school students as individual contribution motivates them to be a part of the team and improves team-work and collaboration skills.
- Linking content back to Construction Management Theory works well. i.e. you get staged payments because this is how it works in the real world; shark tank pitch, because companies usually have to bid for projects etc.

5. Contributions to Theory, Practice and Society

This research contributes to encouraging young women to join the construction industry, especially in Australia. It highlights the effectiveness of the 'Tiny Bricks, Big Ideas: The Sustainable Living Challenge' workshop in inspiring high school girls to

consider construction-related careers. The study used collaborative and participatory research methods to show how such initiatives can change approaches, improve collaboration, familiarise construction practices and build knowledge, ultimately promoting diversity in the construction industry.

5.1 TRANSFORMING PERCEPTIONS

The workshop successfully shifted participants' perceptions of construction as a career path. Post-workshop surveys revealed that many students had developed an increased interest in pursuing construction-related careers, particularly in sustainability-focused roles.

5.2 EMPOWERING STAKEHOLDERS THROUGH CAR

The collaborative approach benefited not only students but also the educators involved. Teachers reported greater confidence in discussing construction-related topics with their students, having gained knowledge from university researchers and industry professionals. This knowledge exchange exemplifies the power of CAR in building capacity and fostering mutual learning among stakeholders.

5.3 IMPLICATIONS FOR THEORY AND PRACTICE

The findings suggest that integrating CAR and PAR approaches in education can create meaningful changes in how young women perceive construction careers. This workshop presents a methodology for designing, developing and implementing a construction management workshop to promote the discipline with high school girls. For practice, such interventions at the school level highlight the need for early engagement to address gender imbalances in the workforce.

6. Conclusions and Recommendations

The “Tiny Bricks, Big Ideas: The Sustainable Living Challenge” demonstrates how action research methodologies can effectively be used for promoting construction management discipline among high school students. By combining collaborative planning with participatory learning, the initiative empowered high school girls to engage critically with sustainability and construction, fostering a sense of inclusion and possibility. This ultimately contributes to promoting women in construction and attracting more female students into construction-related jobs to resolve the existing problem on gender imbalance. Due to the fast-paced nature and demanding workload of the workshop, this workshop is recommended primarily for secondary school students in Grade 9 and above, as younger students may find it challenging. Long-term mentorship opportunities connecting students with women construction professionals are recommended to sustain interest beyond the workshop. Future programs expanding to include mixed-gender groups will provide the opportunity to explore broader dynamics of power and collaboration.

7. Acknowledgement

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