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Science Learning from the School Garden through Participatory Action Research in Nepal

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Abstract

Nepal's NORHED/Rupantaran project designed and developed participatory action research through school gardening. This study explored the ways for the community schools, science teachers and basic level (grade five to eight) students to foster a sense of agency in the school science curriculum through life-based experiential learning. Qualitative research design on thematic and verbatim methods are used to collect and analyze the data in this study. The findings show that school gardening activities are helpful and productive for science teaching and learning. The evidence from participatory action research experiences in actual school settings would provide new insights for policymakers to transform the school science curriculum. Further, the study findings show collaborative knowledge production through school gardening in a contextual environment, often neglected in community school science teaching and learning. The implications of the research findings could contribute to policy-level discussions about science teachers' professional development.

Keywords

contextual learning, participatory action research, school garden

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Nepal's NORHED/Rupantaran project designed and developed participatory action research through school gardening. This study explored the ways for the community schools, science teachers and basic level (grade five to eight) students to foster a sense of agency in the school science curriculum through life-based experiential learning. Qualitative research design on thematic and verbatim methods are used to collect and analyze the data in this study. The findings show that school gardening activities are helpful and productive for science teaching and learning. The evidence from participatory action research experiences in actual school settings would provide new insights for policymakers to transform the school science curriculum. Further, the study findings show collaborative knowledge production through school gardening in a contextual environment, often neglected in community school science teaching and learning. The implications of the research findings could contribute to policy-level discussions about science teachers' professional development.

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Introduction

Students' meaningful engagement is one of the essential features of teaching and learning. Science curriculum reforms in almost all parts of the world incorporate significant students' engagement. The primary concern is that the school science curriculum in the community schools in Nepal shows epistemologically theoretical understandings (Acharya, 2016). To address this need for transformation, in recent years, the Ministry of Education Science and Technology (MoEST), and the Government of Nepal (GoN) have prepared *Green School Guidelines* based on the draft education policy *One Garden One School* to reform school science pedagogy throughout the country. It shows the need for an urgent improvement in students' and teachers' capabilities to develop skills, namely *hands-on activities* through gardening in the community schools in Nepal. Science learning through school gardening activities is an immediate initiation in Nepal. Activity-based instruction in teaching and learning science helps to uplift students' higher-order cognitive skills like analyzing and creating (Denzin & Lincoln, 2008). In this context, Fleischmann (2021) suggests that students exposed to hands-on science instruction frequently get significantly higher scores in science than those who experienced only minds-on activities in teaching-learning activities.

The existing science curriculum and instructional practices provisioned by the National Curriculum Framework (NCF) have prioritized the meaningful engagement of students in science learning. Developing classroom discourse is arguably one of the most significant challenges faced by the teachers in the classroom (Robinson, 2018). To build a shared understanding of the fundamental concept of science by analyzing and comparing students' arguments, an urgent need for transformation is required in the school science curriculum in

Nepal. As a school science teacher and a university science teacher educator, I am continually facing the challenges of augmenting the level of discourse in my classroom to engage students in hands-on activities.

As a co-researcher in participatory action research (PAR), actions and experiences are the basis for knowledge. This article explores how school education collaborates students and teachers for transforming teaching and learning activities to (a) contribute to their learning by engaging in the school garden, and (b) co-create knowledge in action through school gardening activities. In crafting the responses to this inquiry, we (I as a co-researcher, students, and teachers) adopted two approaches: (a) learning through action (Lee & Yang, 2019), and (b) participatory action research completing work on observe-plan-act-reflect phases.

Participatory action research is a research process wherein students participate in studies both as subjects and objects with the explicit intention of bringing about change in the setting under study (Acharya, 2019; Laudonia et al., 2018). From a theoretical perspective, I reconsidered Laudonia, Mamlok-Naaman, Abels, and Eilks, (2018) how students engage in action learning. This pedagogical process involves learners working and reflecting on the actual situation in the students' work setting. In this reflection, as a part of PAR, I (as a co-researcher) explore how action learning accomplishes the cycle of PAR based on the objective of converting experience into practical understanding. It completes engaging students in research based on the experience to co-create knowledge.

From a practical standpoint, we found many instructional strategies and practices that promote the value of activity-based learning by the meaningful engagement of students in the garden. Chapin, O'Connor, and Canavan-Anderson (2003) compilated of classroom data to support students' discussions described significant purposes and uses of talk in the classroom. Teachers use experiential activities to simulate real-life experiences (Lewis et al., 2019). These fundamental and practical endeavours often referred to as experiential learning, can effectively give students a taste for using concepts in action. Connecting learning through experience discusses that reflection plays a central role in the learning process and is vital for making meaning of the experience. When given ample freedom to self-discovery with others, students actively construct the necessary knowledge to make sense of their environment (Maibaum, 2017). Knowledge exploration in PAR advocates democratic relationships (Feldman & Rowell, 2019).

This study is based on the discourse analysis within the participatory action research to create garden-based pedagogy. It provides science teachers and students with an idea with a framework for discourse analysis for curriculum change. Also, this study supports to a better understanding of students' meaningful engagement in learning. The primary question of this study is: "How can students be engaged in the school garden to understand basic scientific concepts by the contextually made curriculum at basic level community schools?" To materialize it, Tribhuvan University from Nepal, in collaboration with the Norwegian University of Life Sciences (Norway), has initiated the *Rupantaran*[1] project, 2016-2021, entitled "Innovation in Teaching and Learning through Contextualized Approaches to Increase the Quality, Relevance and Sustainability of Education in Nepal." This Norwegian Agency for Development Corporation (NORAD) funded project was to work with innovative, participatory, and rights-based approaches to improve teaching and learning outcomes of basic school students through community empowerment and sustainable improvements.

In 2017, when NORAD funded *Rupantaran* project envisioned the idea of school improvement through PAR intervention, it was a methodological practice in academic research traditions for Tribhuwan University of Nepal. Though action research was a popular methodological option among university researchers, and though PAR approaches were

[1] Transformation in the Nepali language.

popular in various development sectors, PAR was not yet discussed and practiced as an academic requirement in the university. As such, often the focus of discussions during *Rupantaran* projects' workshops and seminars would concentrate on the action-oriented collaborative nature of PAR in contrast to the value-neutral theory-building mindsets of university academics.

Participatory Collaboration Practice

We maintained a cyclic perspective for the research phases regarding the participatory and cyclical process (Carr & Kemmis, 1986; Nyanjom, 2018). Our design for the research cycles involved four key phases (observe-plan-act-reflect).

PAR Step 1: Observation and Plan

Planning was done to start PAR in an action school to analyze the science curriculum, science textbooks, and possible school gardening activities. The situation of the action school in terms of its potential garden area, classroom facilities, science laboratory and science results of grades six and seven were explicitly studied. The existing problems in teaching and learning science of grades six and seven and the gaps in actual classroom teaching and learning activities were explored. Also, the science curriculum was analyzed in terms of its contents, objectives, activities, and assessment techniques by engaging students and teachers meaningfully through a series of dialogue conferences in the workshops.

Students shared their experiences with science teachers and me (first author) through PowerPoint presentations while participating in dialogue conferences in the workshops. Students and teachers designed a sample curriculum based on school gardening activities and implemented it as a part of science teaching and learning. Also, science teachers were committed to applying students' made curriculum in their further education and learning science. In the planning phase of PAR, curriculum components and its learning outcomes with the detailed description were prepared for the mere for effective implementation of school gardening activities.

PAR Step 2: Act

According to the PAR approach, school gardening intervention/gardening activities began by using the experiences of research participants. T third phase of PAR, in which ssixth-graders designed drawings of the school garden from a dialogue conference in a workshop. One of the best sketches has been selected by teachers and students through democratic dialogues. The school garden was designed to grow vegetables and flowers. The themes of the school gardening science curricular outline were prepared by students' and teachers' collaboration.

Topics such as soil pH, the moisture level in the garden soil, soil textures, filtration and decantation processes, plant types based on leaves and roots, seed germination, compost manure preparation, photosynthesis and transpiration processes are linked with the school gardening activities. The school garden also examined the role of green plants in ecological preservation and their importance in human life. All these teaching-learning activities were linked with school gardening activities with the collaboration of science teachers and students. Intervention guidelines were prepared by research participants in the intervention phases of the participatory action research.

PAR Step 3: Reflect

It was the last phase of PAR in which students' activities were observed by science teachers and teachers' activities by the co-researcher. Significant events were recorded in each phase. For the science teacher, gardening activities provided critical reflective opportunities for science learning opportunities. As a new methodology, the school garden opened discourse significantly with meaningful exchanges documented through field notes and observation. It increased student-to-student interactions and meaningful engagement through actual activities. Students demonstrated more sustained lively activities and accountability for learning science with and without the presence of science teachers. As a co-researcher in PAR, garden-based activities provided an opportunity to see activities related to science subject. Through this collaborative inquiry and democratic dialogues, PAR researchers and science teachers enjoyed a fuller visual and auditory analysis picture of discourse. They helped them see and hear students as they shared, built, and ultimately explored knowledge together.

After a six-month time, an interval of constant engagement in the school garden, action school exemplified quality in teaching and learning in terms of the overall academic environment. We (the first author and school science teachers) noticed the transformation in science pedagogy from the silent mode of lecture method to activity-based learning through school gardening activities. All gardening activities were linked with the contextual garden-based science curriculum and related to fundamental understanding through participatory action research.

Research Methodology

This study is based on the discourse analysis within the participatory action research methodology. Population of this study were the students of grade six and seven of an action school. Six students and two science teachers teaching science subject at the basic level (from grade five to eight) were the research participants. They were selected purposively. Science teachers were experienced in their field and took teacher professional development training conducted by the Ministry of Education, Government of Nepal. But they do not have the confidence to prepare a contextual science curriculum based on the school gardening activities and collaboration with the students.

We conducted this research within a rural school in Province 3, Chiwan, Nepal. At the beginning of PAR in an action school, sixth and seventh graders and teachers participated in dialogue conferences in workshops. They also participated in the formal and informal conversations conducted within and outside the school premise. Science teachers and students have participated in the workshop before and after gardening intervention.

Participant observations were carried out during the students' engagement in the school garden for activity-based science learning. Also, four dialogue conferences were carried out to explore activity-based science learning in a workshop. Field observations were done during students' gardening activities and informal conversations with the teachers and students were carried out for collecting data. The recordings of the meetings were transcribed and analyzed with the theory of practice architectures. The theory of practice architecture is an existing justification of social reality that focuses on practice. This study is based on the activity-based learning in the school garden that helps to focus on practice.

The progress of work followed the cyclic process of action research. Observing-planning-acting-reflecting (Hearn et al., 2019; Tracy, 2019) where the steps may not always follow a chronological order. Data were collected through field observation, dialogue conferences during workshops and formal and informal conversations with the students and teachers. Major themes of the study were identified as per the objectives of the study. The main

themes and concepts were discussed thoroughly and systematically in the workshops to explore the meaning of activity-based science learning from the school garden. Another ambition linked to *communicative space* is to establish a broader understanding of others' points of view and *voluntary consensus* about what needs to be done to improve practice. The voluntary consensus is an agreement that is not enforced upon anyone (Armstrong & Tsokova 2019). Only democratic discussions dug out from the research participants in all workshops and conversations to find solutions regarding school gardening activities.

Positionality of the First Author

As a school science teacher and a university teacher educator, I reflected on my teaching and learning styles and practices. My research is rooted in the science pedagogical orientations. Yet, as Greene (1986) has stated, I am uniquely positioned as a *stranger* in a classroom that is not my own (Robinson, 2018). As a co-researcher, I describe my positionality as an *insider* in collaboration with other insiders with the benefit of entering this research space with new views to explore students a new, as a stranger might for the first time, look inquisitively and wonderingly at the world in which one lives (Greene, 1986).

Data were focused on the activities performed by the teachers and students in the garden for activity-based teaching and learning, interactive dialogues, and preparing the garden-based sample curriculum. Reflective field notes from workshops, observations and conversations were transcribed, translated and analyzed using verbatim and thematic content analysis (i.e., themes emerge from the data through a process of open coding). Open coding involved reading, re-reading, and reviewing the transcripts while writing notes (i.e., codes, in the manuscript to describe all thematic content). In PAR methodology, open coding is used to involve reading and reviewing the data (Canlas & Karpudewan, 2020). Codes were transcribed into a coding sheet and formed categories. Finally, thematic content analysis was performed which was advocated by McTaggart (1991) in participatory action research. Data were coded to identify emerging themes and patterns that were then categorized and interpreted according to their relationship to the research questions and theoretical perspective. Also, participant observation and conversations were conducted during school gardening activities. Detailed field notes from all comments, discussions and dialogue were recorded.

Since all data were collected in the Nepali language, the data analysis was performed in Nepali. During data analysis and write up of the manuscript, the original Nepali quotes were used for as long as possible to prevent losing meaning due to translation. The quotes in the final manuscript were translated by the first author and checked by the third author.

Findings as a Critical Reflection

The findings related to curriculum construction based on school gardening activities proposed by this study are an essential reflection in further works in designing and implementing science curriculum. It is based on the *One Garden One School* education policy implemented by the government of Nepal. The knowledge of praxis (knowledge in action) flows from the position that action and reflection are inseparably amalgamated, thinking and action in the school to transform teaching and learning science from the silent mode of lecture method to activity-based pedagogy. This study in the community school in Nepal draws a connection between action and reflection through gardening activities and transforming science pedagogy through the students and teacher-made curriculum. Students' garden experiences lead to critical consciousness leading to further action to transform science pedagogy in the community schools in Nepal.

Although students generally had a positive attitude towards the school gardening activities to learn science, they frequently use a garden to link science learning. One of the students shared his experience of science learning during the conversation in this way: "The school garden provides the first-hand experience for learning science, and I will never forget what I studied in the garden."

Similarly, another student argued:

> The school garden is an essential experiential class that engages us in various science learning activities. Measurement of pH of garden soil, identification of layers of soil, separating humus from the sandy soil, and the importance of compost manure for the growth and development of plants are only a few topics that we learned from the school gardening activities.

During gardening activities, students learned real-world science applications by measuring plots and recording the growth of plants. As they worked with the *collaborative inquiry*, they learned to care for living things; developed necessary discipline and collaborative life skills such as patience, responsibility, cooperation and understanding. Science teachers believe that the gardening programme helps to learn science through the meaningful engagement of students in activities. Also, the school gardening program has grown further to engage students through *learning from the school garden campaign*, which aims to transform science pedagogy in the community schools in Nepal. In working with science teachers, one of the students shared this, and "experiences change over time in engaging in the school garden activities." She further argued that "Garden activities make us realize. I think it is essential to provide a real taste of learning." When she engages in the garden for more than a week, she is eager to know the area of study from the garden activities. Her activities after intervention prove that she developed the skills of gardening and learning through such activities. She began to see that she was one of the learning community members. Through reflective dialogue conferences with the students and me as a co-researcher, she became aware that she is one of the parts of the learning activity. However, students worry about the protection of the garden from the community people who might occasionally walk over the school garden without any purpose, pluck flowers, abolish vegetables, and pull the leaves of the flowers and vegetables. Some recommended solutions to the proper maintenance of the garden need to be placed within the boundary brick wall around the school garden.

Another finding was that the school headteacher appreciated the use of the school garden for the overall physical, mental, and social well-being of students. Furthermore, it was found that involving students in gardening activities like soil preparation, solid waste management, compost preparation, planting crops and harvesting techniques made science content clear. At the same time, science teachers linked the curriculum in an integrated approach with gardening activities. It became a perfect learning opportunity for students. Furthermore, it was found that science teachers were happy to share their work garden-based science curriculum framed by the democratic dialogue and collaborative sharing with the students. In this line, one of the science teachers in the informal conversation says this:

> Today I am happy. Our work is recognized that we are applying a newly framed garden-based science curriculum to fulfil the learning objective. Our curriculum is in function. Now, it works. I can design a curriculum and implement it for teaching and learning science.

Another science teacher shared in a dialogue conference after intervention in the garden and said:

> A newly framed sample science curriculum contains gardening activities to maximize exposure to learning chemistry such as pH, soil types, soil types and humidity, nutrients, air, water, and soil minerals. School gardening activities such as planting, tending, harvesting, preparing, and linking to the science curriculum were completed by the continuous engagement of students and teachers.

Overall, all the participating students positively shared their perceptions about the school gardening activities. Research participants had a chance to appreciate the theory and practice link, investigate their implicit theory, investigate their implicit idea, construct collective knowledge, and participate in reflective practices. It is also found that PAR is useful for teachers' professional development and the changes revealed in the teachers' discourse throughout an academic session.

Discussion and Implications

This study aimed to revisit the school science curriculum through school gardening through PAR activities for collaborative inquiry among the students and teachers in the community schools in Nepal.

This qualitative research on framing science curriculum based on school gardening that does exist have focused on students' and science teachers' gardening experiences, mainly reporting constructive gardening experiences (Block et al., 2012; Bowker & Tearle, 2007; Rodriguez et al., 2015; Somerset et al., 2005). But none have shed light on the role of local bodies on this idea of its resolutions, their inspirations for school gardening, and their ideas and suggestions for perfections in designing science curriculum. As students are the primary intervention manipulators, with an occasion to express their understanding of what they believe works and what does not, an exceptional contribution to school gardening activities and developments is expanded.

Consistent with previous participatory action research on students' gardening experience is possible through participatory action research (Block et al., 2007; Rodriguez et al., 2015; Somerset et al., 2005). This research study demonstrates that science teachers and students were passionate about school gardening for science learning by using the curriculum they prepared. Like findings by Passy (2014), students undoubtedly preferred school gardening activities for education. On the other hand, the headteacher did not like such activities more due to the problem of managing periods for gardening activities.

The result of this study indicated that students' central encouragement for engaging in the school gardening science learning is having fun, which is like the result found by Bowker and Tearle (2007). It is also found that this PAR study has been directed towards real-life activities to co-construct collective wisdom by the meaningful engagement of students and science teachers in the school garden. It was like the study by Acharya, Budhathoki, Bjønness, and Devkota (2020) that *learning by doing and learning by living* are the purposes of science teaching through school gardening activities. It transforms teaching and learning science at the community schools in Nepal from the lecture method to activity-based learning. Although, the students and teachers have developed a mutual understanding of the idea of "hands-on activities" to learn science beyond the wall of the classrooms. It needs to be further researched. It appeared that we increased our self-confidence with thinking, which informed our reading and learning habits that led us to take initiative in doing activities. In this issue, Indraganti (2018) argued empathizing reflects the practitioner in participatory action research.

Furthermore, this research shows science teachers could contribute to resetting the possible ways of involving students in activity-based learning by constructing a participatory

curriculum (Jacobs, 2018; San Antonio, 2018). Also, this research suggests the potential of teachers for educational reforms in teaching and learning in the community schools throughout Nepal. School gardens and science learning collaborative activities could enable teachers to transform the rooted structure prescribed by policy through education. This conclusion would significantly benefit science teachers and school headteachers for the new and innovative approach of science learning from the garden.

In addition, designing school curriculum through collaborative inquiry of teachers and students based on school gardens proved to be brilliant endeavours to understand learning approaches. It develops the confidence of students and gained a sense of pride, resulting from continuous but satisfying gardening activities. Furthermore, it may be an exploration to shift the perspective of science in school education. By using the term, "a transformative perspective" (Ramli et al., 2021; Seniuk Cicek et al., 2019; Worthen et al., 2019), I mean that the students and teachers involved in PAR share their perspectives through dialogic conferences and try to reshape shared views and construct new values, as the science teachers interconnect what we value (i.e., knowledge adoption). I still need to find out how science teachers in PAR in gardening activities encourage students to transform dogmatic teaching into hands-on activities (Kafyulilo, 2018; Otienoh, 2015; Whalen, 2016). It may be a topic for my further research.

Also, we hope that PAR to some extent may transform the silent mode of science teaching in a teacher-dominated class into the collaborative and active engagement of students outside the classrooms to explore the knowledge of science. We hope this study could invite school science teachers, the officials of the Curriculum Development Centre, researchers in relevant fields, and policymakers to engage in public debate about the current science education curriculum where teaching and learning in the classroom context have been constantly influenced by dogma. We also hope that such open arguments could suggest a new perspective on science teachers' professional development which is a more teacher-centred bottom-up approach.

Lastly, this research has several implications for transforming the silent mode of school science teaching to activity-based learning through gardening activities. First, it seems to focus on students' involvement in open ground, as teachers think this is important (Katsarou & Sipitanos, 2019; Ping, 2015). However, the potential to work on healthy while working in the school garden needs more emphasis (Kapoor, 2019). Second, increasing the students' learning behaviours will be necessary for the student's engagement in the school garden. It will be essential to make science teachers attracted to the school garden by making it colourful. Furthermore, it is recommended to integrate better working in the school garden into the science curriculum.

Although the action school in this study has a school garden, the perceptions towards the school garden and perceived problems and barriers to the implementation were overall similar. Science teachers and students were generally optimistic about the school garden but encountered some practical issues that needed to be solved to improve efficiency. The study's findings have led to recommendations and tips for future school garden practices.

This study gives valuable insight into the implementation practices and perceptions of students and science teachers towards school gardening activities for science learning but with some limitations. At first, the school science subject teachers shared time constraint was the main reason not to participate daily in gardening activities. Second, the action school is located near the town area, limiting generalizability to schools in rural regions.

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