

Article

On the Design of a Youth-Led, Issue-Based, Crowdsourced Global Monitoring Framework for the SDGs

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Abstract: In this paper, we propose a novel methodology and design to contribute towards the achievement of the 17 Sustainable Development Goals (SDGs) adopted by member states of the United Nations for a better and more sustainable future for all. We particularly focus on achieving SDG 4.7—using education to ensure all learners acquire the knowledge and skills needed to promote sustainable development. We describe the design of a crowdsourced approach to monitor issues at a local level, and then use the insights gained to indicate how learning can be achieved by the entire community. We begin by encouraging local communities to identify issues that they are concerned about, with an assumption that any issue identified will fall within the purview of the 17 SDGs. Each issue is then tagged with a plurality of actions taken to address it. Finally, we tag the positive or negative changes in the issue as perceived by members of the local community. This data is used to broadly indicate quantitative measures of community learning when solving a societal problem, in turn telling us how SDG 4.7 is being achieved. The paper describes the design of a unique, youth-led, technology-based, bottom-up approach, applicable to communities across the globe, which can potentially ensure transgressive learning through participation of and monitoring by the local community leading to sustainable development.

Keywords: sustainable development; local community; transgressive learning; non-formal education; ESD; SDG 4.7; youth; mobile app; monitoring; reporting; spatial correlation

1. Introduction

A major challenge faced by countries striving to achieve the 17 Sustainable Development Goals (SDGs) is the development of metrics to measure their progress [1]. One target of the SDGs which is of particular interest is SDG 4.7. This sub-goal of the education SDG (SDG 4) states that countries should “By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture’s contribution to sustainable development” [2].

The achievement of each of the SDGs is measured using global indicators proposed by the international Technical Advisory Group. Global indicators are complemented by national and regional indicators to monitor country-wide achievement of the SDGs [3]. The indicators are driven by the priorities at that particular scope of the SDG—decisions on national indicators are driven by national priorities. The SDGs are then integrated into national development plans and aligned with global

indicators to the extent possible. The global indicator for SDG 4.7 as proposed by the international Technical Advisory Group is the extent to which (i) global citizenship education and (ii) education for sustainable development are mainstreamed in (a) national education policies (b) curricula (c) teacher education and (d) student assessment [4]. However, little is said about how data for informing these indicators is to be developed, and even less about how this is to be done by involving communities at the local level, an issue which this paper addresses.

Traditional education utilizes the “banking-style” approach where transfer of knowledge occurs through content dissemination (deposits made) by teachers and learning is assessed using examinations. The scope of action allowed to the students is limited to receiving, filing and storing these deposits [5]. Freire, among many other educators [6–8], demonstrated the pitfalls of this banking style of education and called for a more hands-on, experiential learning pedagogy, especially in the socio-emotional domains of learning. Studies have also shown that while most research on learning is conducted in formal educational settings [9], tackling complex problems requires expansive learning to occur in real-world situations and non-formal contexts [10].

The requirements of SDG 4.7 challenges us fundamentally to rethink and redefine the purpose of education. Education should have the power to challenge and change existing beliefs, ways of thinking and behaviour. Transformative learning, in this context, involves a transformation of beliefs, values and practices in a way that helps us live in a more socially and ecologically responsible way. Delving deeper into transformative learning, we come across a critical and action-oriented form of learning which challenges normalised systems which have become oppressive and detrimental to life. This form of learning is called transgressive learning [11]. Both these forms of learning involve learning with others, reflexive and reflective thinking, working out how to put new practices in place, and challenging the existing norm. Target 4.7 explicitly links education to the broad sustainable development agenda and captures the transformative aspirations of education in relation to other SDGs.

While education alone cannot hope to solve all development challenges, a humanistic and holistic approach to education can and should contribute to a model where economic growth must be guided by socially just and sustainable development. It requires an open and flexible approach to learning that provides the opportunity for all to realize their potential for a sustainable future and a life of dignity. This humanistic approach has implications for the definition of learning content and pedagogies, and is even more relevant today given the rapid development of new technologies, in particular digital technologies [12].

Various approaches proposed to enable learners to engage creatively and responsibly with the world are essentially learner-centred pedagogies that effectively allow the student to play an active role in the learning process. Considerable research and advocacy has promoted learner-centred pedagogy in recent years for economic, cognitive, and political reasons [13]. Research suggests that this approach can be very effective but it is also difficult to measure consistently [14]. There are now many examples and varieties of experiential, real-world learning such as issue-based learning, action-oriented learning, social learning and community-based learning for sustainable development, which put an emphasis on learner agency [15–24].

The concept of non-traditional, holistic and humanistic pedagogy is not new to India. Both Mahatma Gandhi (1869–1948) and Rabindranath Tagore (1861–1941) spoke of and wrote about transformative education as early as 1930s. In 1937, Mahatma Gandhi set out his vision for an ideal form of education for India which he called Nai Talim [25], loosely translated as New (Basic) Education. The core features of Nai Talim are respect and mutual learning between teacher and student, education for the head, heart and hand, and learning by doing. Even in India of the 21st century, this kind of education is transgressive in its potential to transform society. So, although the relevance of Nai Talim today has been studied [26,27], it is easy to understand why Nai Talim is today a small-scale experiment in a few schools scattered across the country [28,29]. The challenges of implementing such visionary ideas increase several times in a resource-poor country such as India, struggling with a large population, diversity, inequality, and issues of social justice relating to gender, caste, language,

religion, etc. So, mainstream schools continue to follow the traditional education model, with minor variations, and this we know to be the case in similarly resource-challenged developing countries. A United Nations Educational, Scientific and Cultural Organization (UNESCO) report acknowledged these challenges and many more (lack of training and time constraints for teachers shifting from the teacher-centred pedagogy to a learner-centred pedagogy being some of the reasons) and established that considerable support was needed to achieve this important goal for a transformative education system [30].

While it is widely recognized now that education and learning play an important role in human development and societal transformations [31], it is also necessary to gauge if learning has truly transpired. To measure acquisition of knowledge (understood as the information, understanding, skills, values and attitudes acquired through learning) [12], one can monitor actual change in the state of social, economic and ecological dimensions of the community. In other words, the actual behavioural change within learners that led to achieving one or more of the other SDGs can be used as an indicator for SDG 4.7.

Another important aspect of this learning process is the youth in the community. Youth are primarily affected by sustainability challenges as they have to live the bulk of their lives facing the consequences of unsustainable practices adopted by earlier generations. However, that also gives them an opportunity to bring about real change. Youth not only possess the ability to sustain involvement themselves, but can also become role models for future generations in the community. Being directly involved with the education system, youth face the many issues in the existing system. However, being aware of the problems alone is not enough. They must recognize that they also possess the creativity, potential and capacity to tackle these issues and introduce real change for themselves, their communities and for the rest of the world. At the UNESCO Mahatma Gandhi Institute of Education for Peace and Sustainable Development (MGIEP), we therefore put youth at the forefront and empower them in monitoring sustainable development in societies across the world.

In this paper, we propose a novel crowdsourcing approach to build a global monitoring framework that can monitor and understand such behavioural change within learners. Members of a community are encouraged to use a digital mobile application to send information (in the form of text, images, etc.) on SDGs relevant to the wellbeing of their community. For the purpose of this study, we focus our attention on information related to SDG 4.7.

This framework takes youth through a process of transgressive learning that is non-formal, action-oriented, empowering, and focuses on community learning for sustainable development. The mobile app not only aggregates the reported data, but also makes it available as useful up-to-date information about the existing educational environment and the active engagement of the youth. This initiates multi-stakeholder learning and accountability at institutional and administrative levels, thereby potentially transgressing power dynamics.

The purpose of this conceptual framework paper is to outline the considerations and activities to be undertaken for a successful SDG monitoring project using a youth-focused crowdsourced, experiential learning model. Specifically included in the framework are: (1) the approach/implementation methodology that can lead to desired outcomes at a community level; (2) the structure of the global monitoring framework; and (3) the parameters that can help track and evaluate the effectiveness of the framework. The structure encompasses four out of the five priorities of the UN SDGs i.e. establishing a monitoring mechanism, devising metrics, standardizing the data and evaluating progress [32]. The rest of the paper is organized as follows: The next section discusses the proposed crowdsourcing approach and details how it leads to the formation of a Global Data Monitoring Framework that communities across the globe can access and contribute to. Following this, the key parameters based on which progress can be tracked are defined. Finally, we discuss the transgressive learning instigated by the proposed framework, and elaborate on the need, advantages and limitations of such a framework. A pilot local crowdsourcing campaign has been launched by a youth-led non-governmental organization (NGO) working in the field of education with a community in the state of Gujarat, India in order

to collect preliminary data. Depending on the performance of the pilot, future local crowdsourcing campaigns (LCCs) may be instigated in other communities around the world.

2. Materials and Methods

The proposed framework intends to utilize youth-focused crowdsourcing to develop a framework that supports monitoring by both a youth-led locally-rooted NGO and by other community members for all SDGs at a community level and global level. It would enable communities located anywhere in the world to record issues they face, and monitor how the actions they take to resolve issues trigger changes over time. This approach is summarized in Figure 1.

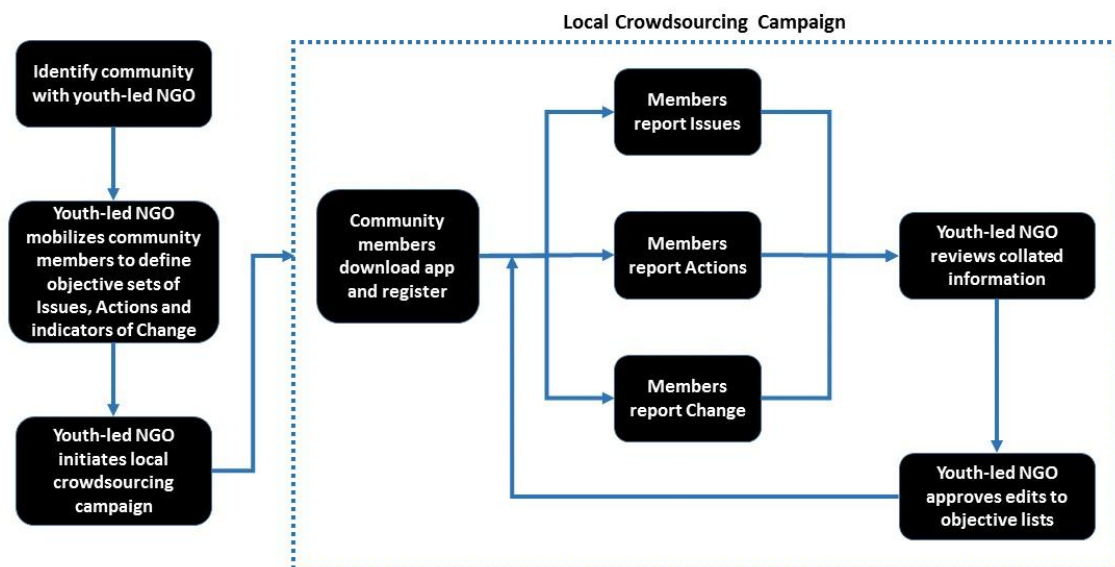


Figure 1. Overview of the proposed framework. (Source: Personal production).

We begin by identifying a local community and a youth-based NGO within that community that works towards a cause. The community may be facing a set of issues which the youth-based NGO has been working on and trying to solve. So, in the context of the local community, this youth-based NGO can be considered experts with a clear understanding of the issues in the true context. In order to monitor these issues, the NGO must first involve the community in clearly defining the issues faced.

For example, consider the example of a fictitious youth organization in Africa, India or elsewhere working towards education for children. To monitor issues pertaining to children's education faced by the community, they first need to engage the community members in defining all the issues the community has been facing. In this case it could be lack of affordable education, outdated curriculum structure, lack of skilled teachers, poor infrastructure, lack of an environment conducive to education, etc.

The youth-led NGO then initiates a local crowdsourcing campaign (LCC) by encouraging local community members to report whenever they come across any of the issues defined. Community members can use a digital application (mobile app) to report the issue, its location and provide optional supporting evidence like pictures, video clips, audios, etc. For example, if a community member notices a school where there is a lack of toilets, they can report the location of the school and select the option that refers to "infrastructure—lack of toilets". Similarly, if a community member finds another location where the environment is not conducive for education, they can choose the option that best describes the issue seen. If the NGO is able to encourage many community members to report issues they come across, over time a clearer picture of the occurrence of issues and their locations will be formed that can be easily visualized.

Now that there is an estimate of the kinds of issues and their spread, the youth-based NGO can also get the community members to define a set of actions that the members feel they can take to help fix these issues. Armed with this information, community members can use the same crowdsourcing campaign to report actions that they have taken to solve the issues.

For example, the fictional organization working on education for children mentioned earlier can work with the community members to define actions such as volunteering to teach, donating books, helping design a better curriculum, funding education of an underprivileged student, etc. As this data is reported, it can also be easily visualized with issues geo-tagged on a map along with the corresponding actions taken to address these issues. This helps the NGO get an idea of the spread of issues and what issues are being tackled.

The picture is finally completed by also crowdsourcing the reporting of change in the status of an existing issue. The community members and youth-based NGO define specific indicators of change which they use to report how an issue that was reported earlier has changed based on actions taken. In the example that we have been discussing, some indicators of change could be – student(s) being more enthusiastic to go to school, improvement in student performance, increase in student-led activities, increase in student participation, etc. This can also be visualized as earlier to get a clear estimate of where situations have been improving.

2.1. Design of a Local Crowdsourcing Campaign

1. The youth-based NGO mobilizes community members to define the initial objective sets of Issues (I), Actions (A) and indicators of Change (C). This is done through face-to-face interactions, with the entire community participating in this important first step that ensures a democratic and true representation of the context. These objective sets are then entered into the app by the youth organization.
2. The local community is trained in the usage of the app by the youth NGO through meetings and workshops. The app will not require any special technical expertise and will mostly involve multiple-choice questions in the local language, making it intuitive and easy to use.
3. The local community then uses the mobile app to submit reports of I, A, or C by choosing from the objective sets. If a community member identifies an issue, they can use the mobile app to report it. If an action is taken to address the issue, the same can be reported through the app. Similarly, the app can also be used to report a noticeable change in the issue. If the community member wishes to report an I, A or C not included in the objective set, they will have the option to mention the same through an “Other” button. This is then examined by the NGO and either collated with a relevant/similar existing option to avoid duplication or “approved” as a new option to the objective set which is then visible to all viewers.
4. All community members will have access to all collected reports from the community in the form of easily visualized maps with unique icons representing existing issues, actions taken on reported issues and changes seen in the reported issues. This also allows a member to take action or report change on issues raised by other community members.

2.2. Real-Time, Open-Source Data

As more and more reports are logged by the community, the data is updated continuously on the map in real time. Making the data open source provides data transparency and an opportunity for researchers and data analysis experts to draw interesting insights from the rich dataset collected directly from the end-users.

2.3. Quantifying the Data

In the context of the local crowdsourcing campaign described, all reported issues, actions and indicators of change are saved to a central database. The overall performance of a community is determined using various metrics that describe how actively the community engages with issues,

and how efficiently it is able to take actions that bring about positive change. The metrics mentioned in the paper are also dynamic and are constantly updated as new reports are submitted to truly reflect the community's learning. These parameters can be used to monitor the effectiveness of the framework in terms of promoting community-level learning and achieving sustainable development in accordance with the SDGs.

The performance of the app can be monitored by tracking the number of users who join/leave the app in a given time period, the number of issues, actions and changes reported. This gives us an idea of how engaged the community is with learning and development.

2.3.1. Quantifying Community-Level Responses

We define three key parameters based on the kinds of data reported by the local community:

1. Competency represents a quantitative measure of action and change and is reflected by the proportion of issues that led to action and proportion of actions that led to positive change.
2. Responsiveness for a particular issue is a measure of how quickly actions are taken to try to solve a particular issue and how quickly change occurs.
3. Learning represents how much the whole community has learnt over the period of the exercise for a particular issue-action pair and is assumed to be a function of both competency and responsiveness.

Together these three parameters can be used to develop a comprehensive spatio-temporal view of sustainable development. To model the equations for these parameters, let us represent:

- the set of reported "*Issues*" by I
- the set of reported "*Actions*" by A
- the set of reported "*Positive Changes*" by P
- the set of reported "*Negative Changes*" by N

For any given I (*the set of reported issues*), and A (*the set of reported actions*), we can define a variable that estimates a proportion of issues reported to actions taken. Let us call this P_{IA} . We can define similar variables for the sets $\{I, P\}$, $\{I, N\}$, $\{A, P\}$ and $\{A, N\}$ represented by P_{IP} , P_{IN} , P_{AP} and P_{AN} respectively. The real-world meanings that these variables will now represent would be:

- P_{IA} means "*the community is making an effort to solve the issue*";
- P_{IP} : A high P_{IP} means "*the issues are indeed being solved, but the community's actions may or may not be the reason behind it*";
- P_{IN} : A high P_{IN} means "*the states of issues are getting worse, and the community's actions may or may not be the reason behind it*";
- P_{AP} : A high P_{AP} means "*there is a high likelihood that the actions of the local community are resulting in the issue being solved*";
- P_{AN} : A high P_{AN} means "*there is a high likelihood that the actions of the local community are resulting in the state of the issue getting worse*";

These variables, finally set the stage to let us define measures for the concepts of "*competency*", "*responsiveness*", "*learning*" for a particular issue-action pair.

Competency: The competency of a local community for addressing a particular issue is determined by: (i) if actions are taken to address an issue P_{IA} (*Proportion of Issues leading to Actions*); (ii) how well the actions of the community translate to the issue being solved which is directly represented by P_{AP} (*Proportion of Actions leading to Positive Change*); and (iii) the correlation between the positive/negative change being seen across a particular issue represented by the variables P_{IP} (*Proportion of Issues leading to Positive Change*) and P_{IN} (*Proportion of Issues leading to Negative Change*) respectively. In the event that negative changes are observed, then the level of competency is reduced as actions taken for a particular issue are not contributing to the positive change or even if they are, they are not sufficient to cause a positive change.

So, we represent the *Competency* by C , and define it as:

$$C = f(P_{IA}, P_{AP}, P_{IP}, P_{IN}) \quad (1)$$

Responsiveness: We define responsiveness of a local community for a particular issue, by how quickly “*Actions*” are taken to try to solve a particular issue and how quickly change occurs. This parameter is represented by the latency between issue reported to action taken t_{IA} , between issue reported to positive change t_{IP} , and issue reported to negative change t_{IN} .

We represent *Responsiveness* by R and define it as:

$$R = f(t_{IA}, t_{IP}, t_{IN}) \quad (2)$$

Learning: Learning represents how much the whole community has learnt over the period of the exercise for this particular issue-action pair. An obvious starting point would be to model it based on the Rate of Change of “*Competency*”, and also on the idea of “*responsiveness*”; as “*competency*” represents the extent of change, and “*responsiveness*” roughly represents the rate at which change is brought about. An increase in any or both is likely to contribute to, and reflect learning. So, we represent the *Learning* of the *Community* out of the whole exercise L and define it as:

$$L = f(C, R) \quad (3)$$

and by replacing C and R with their corresponding values.

$$L = f(f(P_{IA}, P_{AP}, P_{IP}, P_{IN}), f(t_{IA}, t_{IP}, t_{IN})) \quad (4)$$

Broadly speaking, competency and responsiveness represent the ability of the community to engage with a problem and the probability of the actions taken to effect positive change. The process, leading to community development, involves both learning and feedback. The metrics of competency and responsiveness are calculated for each issue–action pair and then summarized for the whole community. This allows a macro (inter-community) and micro (intra-community) level analysis of the data. These individual metric calculations can provide insights into which are the issues that are resulting in higher or lower values of competency and responsiveness of the community. The micro-analysis gives us a clearer interpretation of issue-specific learning, while the macro-analysis includes learning from a wide range of issues and “normalizes” the learning from issues and actions of varying scales and complexities.

It is to be noted that there is likely to be a variation in the complexity of issues faced by a community, in the ease of actions that can be implemented, the degree of change that can be assessed and the possibility of recurrence of issues. An initial estimate of how these factors will influence these metrics and, therefore, learning will be obtained from the pilot study and will be incorporated into the function. There may also be a need to consider other factors at play (eg. funding, governance decisions, etc.) that can influence the situation. These factors ‘other than’ competency and responsiveness may influence the measure of Learning used here. Thus, “*Learning*” as envisaged here in the model is a broad indicator, and may need further refinement based on contextual application of the methodology.

2.3.2. Spatial Correlation

The parameters described earlier provide an important insight into the performance of the community based on the reported data from the community members themselves. Another interesting aspect to look at is the spatial component of the reported data. By understanding the relationships between an issue, its corresponding actions and the change seen, one can analyze the contribution of the geographical component of the reports.

All reported issues, actions and changes are tagged with their corresponding geo-spatial locations through the app. One can therefore examine the collective data in a geographical region—say a

particular district or state/county (depending on the resolution of the available data)—and look for patterns.

Analyzing the spatial correlation between individual measures like Issues reported and the spatial contiguity measurement (eg. Euclidean distance) between schools, communities, etc. can give us an idea of the spread of an issue across a specific geographical region. Similarly, competency, responsiveness and learning scores can be coupled with the adjacency of communities to identify clusters of communities actively identifying and engaging with issues and causing change. Furthermore, one can also conduct spatial cross-correlation between parameters using geographical distance as a differentiator between the reported locations as shown in Figure 2.

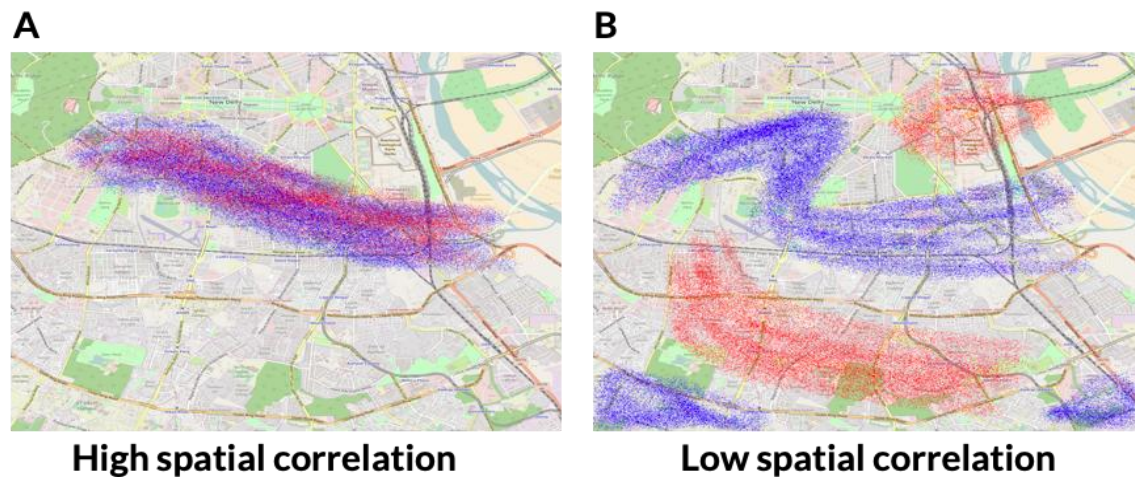


Figure 2. Every reported issue and action will be tagged with its corresponding geo-spatial location. Spatial correlation can then be calculated for the set of issues reported and the set of actions taken in order to understand if there is any similarity in their geospatial spread. The figure above shows two representative visual maps depicting a geospatial location having (A) high-spatial correlation and (B) low-spatial correlation between issues identified (in red) and actions taken (in blue). (Image source: OpenStreetMap).

All these relationships can be studied on a within-communities and across-communities scale. These results can provide valuable information for policy-makers interested in making decisions that can influence communities located within a common geographical location. The data may also be useful for community-groups to become more reflexive and aware of issues on the ground and, therefore, have the potential to inform and contribute to learning in communities and amongst youth groups, linking monitoring and evaluation to ongoing learning and change.

A key point to keep in mind is that these metrics represent the aforementioned real-world meanings, only at one fixed point of time, and as more and more reports start coming in, their values will change over time. So, for a local crowdsourcing campaign, each parameter will finally be a dynamic variable that can be represented using a time-series signal.

2.4. Global Data Monitoring Framework

The framework described so far forms the structure of an individual LCC that can be used to monitor the evolution of one community. Now, let us imagine scenarios with other communities and expand the scope of what we have established so far. If a community in a different part of the world faces the same or similar issues as compared to our “reference” community, and if the existing framework is made available to them through the app, then they can immediately use the objective sets of I, A, and C to initiate their own LCC with their local youth-led organization managing their data, adding to the objective set and tailoring the choices based on the community’s reports. This would be the most direct *transfer* of the reference community’s knowledge and learning to a new community.

If a local NGO in a different community is focusing on different issues, they can still use the existing framework by populating the objective sets with options that are relevant for their community and removing any existing irrelevant ones. This new objective set can then be used to begin the LCC, and the local NGO can manage the data reported and monitor the learning achieved over time.

In this way, the existing framework can become a Global Data Monitoring Framework and can help facilitate several LCCs all around the world.

2.5. Shared Global Taxonomy

With several communities across the globe running their own LCCs, we propose the building of a repository of information that will be the accumulation of all reported data from all LCCs. Each youth-led organization will have access to this taxonomy of I, A, and C at the beginning of their LCC to choose the relevant objective sets for their domain of interest. Any additions they make to their objective set (through the app) are then added to this larger taxonomy which is the union of all objective sets. This global pool of issues, actions and indicators of change will be exhaustive and cover all levels of granularity that a community might need for its local crowdsourcing campaign. Thus, collaboratively we build a shared global taxonomy with contributions from the community of users monitoring the objective sets for each of their LCCs as shown in Figure 3. An analysis of this shared taxonomy provides a quantifiable understanding of the various campaigns across the globe.

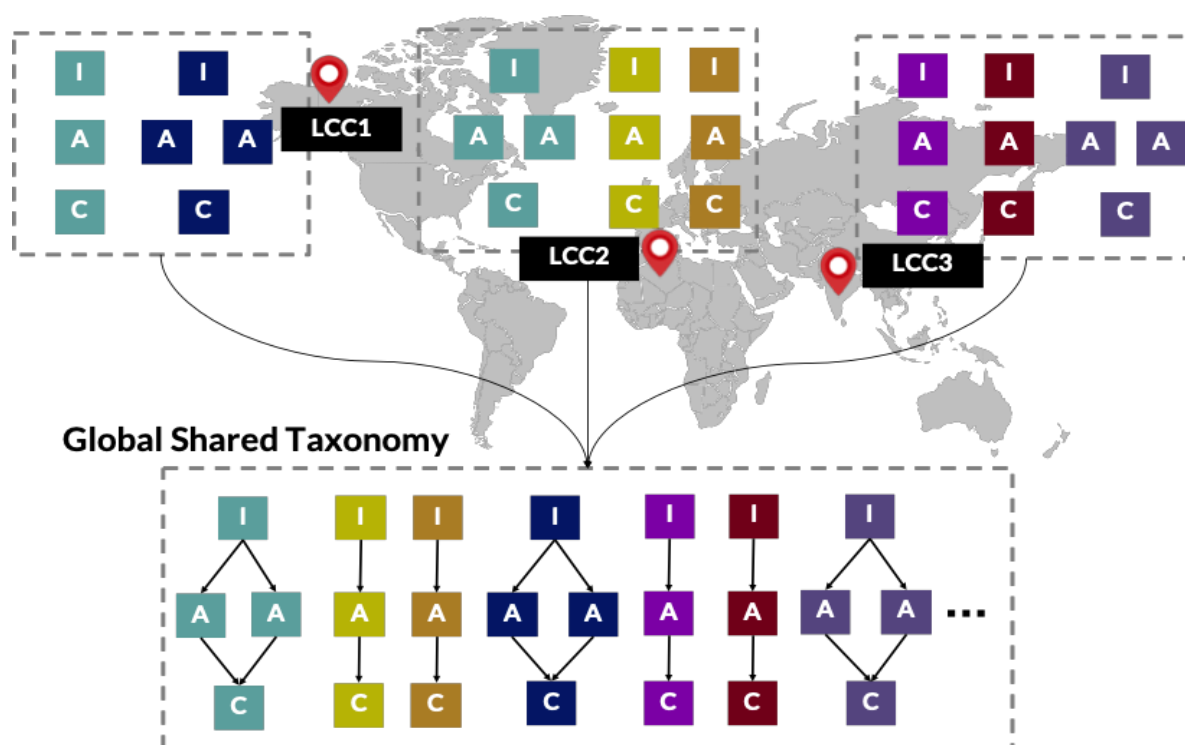


Figure 3. Representation of how a Global Shared Taxonomy can be built. In the figure above, “I” represents a reported issue, “A” a reported action and “C” a reported change. Reports with the same color represent *linked* submissions i.e. an action taken on an issue will have the same color as the issue. Similarly, a change reported will have the same color as the issue it is referenced to. Each “I” has a different color and its corresponding differently colored “A” and “C”. (A single issue can have multiple actions taken on it but only a single change) This structure, built into the three local crowdsourcing campaigns (LCCs) in three representative communities in different parts of the world, carries forward into the Global Shared Taxonomy which finally becomes a union of all the objective sets of Issues, Actions and Changes. The taxonomy grows as more LCCs contribute to it until it converges into a truly global set of indicators of Sustainable Development Goal (SDG) 4.7. (Source: Personal production).

The key component to collaboratively building this shared global taxonomy is homogenizing the understanding of reported issues. So, when two different crowdsourcing campaigns want to monitor the issue of (say) “Health of Community Members”, they should reference the same entity in the shared global taxonomy. We achieve this by using categories and maintaining a structure for each entry made.

When the objective set is being populated, every individual entry is categorized into the following components:

- **Unique ID:** A unique ID which will be used to reference an entry across the taxonomy and the applications that use this taxonomy. This may include the User ID, gender, age, phone number and other demographic data.
- **Category:** First level of description of the reported entry.
- **Issue:** Name of the Issue affecting the user.
- **Sub-issue:** Represents the Issue at a higher degree of granularity or in greater detail and helps provide clarity on what specifically is the problem being faced. An Issue can have one or more Sub-issues. Each Sub-issue can only be linked to a single Issue.
- **Action:** An active step taken by the user to help fix a Sub-issue. Individual actions are reported. Any Action can only be performed on an existing (reported) Sub-issue. Many Actions can be reported for a single Sub-issue.
- **Change:** Indicators used to monitor change in a Sub-issue. The Change can be positive or negative. Accordingly, the reported Change can be attributed to being the effect of an Action taken by the user, or not (natural change in the reported Sub-issue, or a known/unknown Action taken by another community member). An individual report of Change can, therefore, have only a single indicator (Positive/Negative) and is linked to a single Sub-issue. It may or may not be linked to an Action reported by the user.
- **Location:** Global Positioning System (GPS) coordinates of the reporting user. Geographical details (GPS location) are taken in all reported entries to associate each report with a location. The user is asked to confirm if he is (or not) at the location of the issue/action/change at the time of submitting the entry. This is to ensure that the location details saved correspond to the coordinates of the entry.

Each entry made into the app can therefore be referenced based on its structure and the category to which it belongs. (See Table 1)

Table 1. Structure of each reported entry in the Global Shared Taxonomy.

No.	Entry	Structure
1	Issue	Unique ID – Issue – Sub-Issue – GPS Location
2	Action	Unique ID – Issue - Sub-Issue - Action – GPS Location
3	Change	Unique ID – Issue - Sub-Issue (- Action) - Change – GPS Location

A Shared Global Taxonomy acts as a repository of all the reported data from various LCCs sorted in an ordered structure that is made available to all users. Every reported issue will have a unique ID representing the user who has reported the data, an Issue Name (say Cleanliness), sub-issue name (say, Lack of Toilets in School) and the corresponding GPS location from where the issue was reported (which could be linked to school or college). As all actions can only be taken on existing issues, reported Actions will have the earlier Issue structure along with added details of the action taken and its location. The same is true for reported changes in the state of an issue after an action has been taken.

Therefore, we maintain a Wiki-like shared global taxonomy that all youth-led organizations can not only use as a reference when designing their LCC, but also make their own contributions to and enrich this taxonomy. With more and more issues, sub-issues, actions, etc. added to accommodate the gamut of options explored by various communities, the moderation of “edits” done to the shared

global taxonomy can eventually happen in a self-sustaining manner by the contributing community of users, very much like in Wikipedia.

This kind of structured data lends itself easily to analysis at various levels.

- A community member can choose a Sub-issue they are facing in their own community, and use the pool of actions taken for that sub-issue (from other reports) to decide what actions they might want to take. This could also be informed by the positive changes that have been reported for particular actions as opposed to others. Actions such as conducting an awareness campaign or banning plastic in school might have been reported to effect a positive change in the Sub-issue of "Litter in school" as opposed to the action of installing more dustbins. The community member can, therefore, choose to save time and money and not install new dustbins and instead focus on taking either of the other two actions that they find feasible.
- A researcher or data analyst can select an Issue or sub-issue from the Shared Global Taxonomy and use GPS locations to study the spread of the issue in a community. The analysis can also be done between communities to pull out contextual differences in the ways the issue was addressed (for example) or also across LCCs.
- This analysis provides useful information regarding the prevalence of issues of a particular nature. This information is particularly useful in developing countries like India, where the education budget is limited. A District Education Officer can make informed decisions to utilize the budget optimally by addressing the most prevalent issues.

In this way, communities can set up their own LCCs focusing on various issues and use information from the SGT to initiate sustainable development and the achievement of the SDGs. As indicated above, the platform can, therefore, become a valuable tool for reflexive learning in communities, and amongst policy makers.

3. Discussion

Our paper proposes a novel framework for developing a shared global taxonomy to achieve and monitor SDGs across the globe. Utilizing a bottom-up approach and digital technology, the framework has the capacity to harness the power of youth in sustainable community development and to develop a reflexive learning tool for youth who are involved in the data collection and monitoring, their communities, policy makers and others engaged in sustainable development. Therefore, it offers a tool not only for monitoring learning, but also for catalyzing further learning.

3.1. Important Features of the Proposed Framework

3.1.1. Non-Traditional Learning

Institutions of education impose a structured and dogmatic form of learning with set hierarchies of teachers and students at different levels [33,34]. While many countries have made concerted efforts to move away from this form of teacher-centric learning [35,36], public educational institutions in several parts of the world continue to follow this rigid structure [37,38]. A recent review of 22 Asian countries found that the education system placed considerable emphasis on preparing children for competitive participation in the global economy, rather than on empowering them to engage with the world critically and responsibly. There was little or no emphasis on nurturing autonomous, critical, and engaged citizens with a voice in determining their own collective future [37]. This well-intentioned but oppressive form of education has stifled the freedom of students to learn.

The proposed framework, however, begins with a blank slate and lets youth define their own curriculum. The crowdsourced and bottom-up approach of the mobile app encourages youth to think critically and identify issues they feel are relevant, take appropriate action, monitor the consequences of their actions and transform their reality while also providing data for others who can join in this learning, thereby potentially expanding the learning collectively. Enabling learners to traverse this

process of reflective learning (praxis) has been shown to augment human growth and development [5]. In particular, action-oriented learning through a framework for sustainable solutions to environmental education has been achieved by engaging youth in the stages of development, planning, organization and evaluation [39–41]. The framework utilizes a unique combination of the youth’s “personal” and “digital” participation. From face-to-face interactions for defining objective sets and app training workshops to reporting and monitoring using the mobile app, youth are involved at all stages of the framework. By putting the learners at the heart of its success, the approach has the potential to facilitate a truly democratic, sustainable solution to community learning and development as it is run by the community for the community. This democratic participation and social action in a local context has been shown to instigate transformation and indeed transgressive learning [42–44]. By empowering youth to determine their own path and means towards developing the community, we also give them a power and responsibility that challenges the social norm. The framework, therefore, has the potential to be truly transgressive.

3.1.2. The Power of Data in the Palm of Your Hand

Recent studies have shown that mobile learning improves participatory learning methods that motivate and empower learners to change their behavior and take action for sustainable development [45]. With the digital platform (mobile app), youth now potentially hold, in the palm of their hands, the power and responsibility of being change makers. In this conceptual framing, the mobile app is the medium for submitting reports and registers the youth’s “digital” participation. However, the app does more than just data collection and aggregation. The app makes the reported data available to all members of the community. This data can allow members to monitor the consequences of their actions and learn from them, and also take action on issues reported by other members, thereby facilitating a level of social learning as indicated above. In this way the information from each individual learning process is used to promote a collective learning in the community.

The ease of access of the digital data can make useful information available to key stakeholders at the institutional (head of school/college) and administrative (eg. district educational officer) levels and it can provide proof of the current situation, the active engagement of the local community, and a collective understanding of the existing educational context. Not only can this facilitate multi-stakeholder learning, but the youth can also be armed with information they understand that can be used to instill accountability and tackle power dynamics.

3.1.3. Shared Taxonomy of True Indicators of the Sustainable Development Goals (SDGs)

The current global indicators for the SDGs were proposed by the international Technical Advisory Group. Even the many proposals for indicators for monitoring of the SDGs are theoretical and there is no clear consensus about which proposal is exhaustive enough, or which set of indicators to include or exclude. When several LCCs contribute to the pool of issues, the Shared Global Taxonomy tends towards the real taxonomy of issues faced by humanity. Similarly, as the taxonomy links each indicator of change with a specific issue/sub-issue, these can possibly even be mapped onto one or more of the SDGs. The crowdsourced data in the Shared Global Taxonomy has the power to directly reflect the contextual information and, therefore, provides an empirically-sourced, accurate solution to monitoring sustainable development and the achievement of the SDGs. The rich ontology of the taxonomy due to its structured nature also allows an easy aggregation of the indicators of change at any level—an issue, sub-issue, action or any level of granularity supported by the corresponding crowdsourced campaign. In this way, the information extracted from a Shared Global Taxonomy is potentially more valuable than that obtained from individual campaigns in isolation.

3.1.4. Personal Development of Youth

The LCC defined in the paper provides an opportunity for youth in the community to understand their true potential in tackling issues and effecting change as individuals and as members of a community. The potential outcome of an individual LCC is an active youth community engaged in sustainable development. With several such LCCs working in parallel, the potential exists for a large population of youth to be involved in developing their communities and monitoring their learning. This self-sufficiency and independence can contribute to the achievement of the sustainable development goals.

An important byproduct of this approach is postulated to be the personal development of youth into responsible leaders of change working in harmony with community members. Action-based learning has been shown to have a positive impact on various measures of youths' civic, social, and academic development such as social responsibility, civic sense, social involvement, leadership skills, and academic performance [46–48]. The framework provides three unique opportunities to youth: (i) an opportunity for youth to demonstrate their competence in a context that interests them, (ii) an opportunity for youth to experience autonomy—a sense of control and/or power—while engaging in community development activities, and (iii) an opportunity to connect with others in their community and work towards a common goal. Several theoretical perspectives on youth learning and motivation have shown that pedagogies meeting these three motivators ensure that students learn and have fun, and in turn have continued motivation for involvement [49–53]. The LCC, therefore, can help build motivated and confident youth working together with other stakeholders towards a common goal of community development, peace and harmony.

3.1.5. Achieving the SDGs

The second challenge that the framework confronts is that of achieving the SDGs. The essential nature of the Shared Global Taxonomy adds a key feature to the community learning experience. By making the taxonomy available to all, a youth-led NGO considering an LCC for its community has immediate access to similar issues faced by a different community, the actions that were taken and the indicators of change that were used. This information contains learning from an earlier context which can (i) be directly applied if it is relevant to the new context, (ii) be ignored, and the user can report a new action that works in his/her context, or (iii) can serve as a stepping stone to define a potential action as per the local reality. In this way, the learning of one community enriches the formation of other LCCs and, effectively, the collective learning of several other communities. So, not only is the development sustainable within a community, but a Shared Global Taxonomy is also a potentially powerful root for supporting sustainable development of communities around the world.

3.1.6. Crossing Boundaries

Although this paper presents the conceptual framework for contributing towards achieving SDG 4.7, network analysis techniques have shown the inter-connectedness of the SDGs and how the achievement of one contributes to the achievement of others [54]. The tackling of issues pertaining to one SDG, therefore, is a boundary-crossing phenomenon that has ripple effects across well-specified fields. The digital crowdsourced nature of data collection and monitoring has the potential to transgress geographical boundaries with communities practicing different cultural norms learning from each other and challenging existing unsustainable practices which have been willingly or unwillingly accepted over the years. The proposed approach, considerations, and method can be applied to other citizen science/crowdsourcing projects tackling community-centric issues leading to transgressive learning in diverse contexts anywhere in the world.

3.2. Assumptions and Challenges

The design of the framework assumes that community members have internet-enabled phones and possess the technical know-how to install and use apps. In some cases, this could limit the extent of the current framework as rural communities, especially in developing and under-developed countries, may not have access to the internet, and smartphones may be a luxury item, sometimes only belonging to the patriarchal head of the family. To account for gender-based skewness in phone ownership, demographic data collected from the users will be used in data analysis. To address the technical challenges, the app is being built to support offline reporting, and with an intuitive user interface requiring minimal technical expertise. Internet access is only needed to download the app from the generic online app store and to sync reported data to make it available to the central database for analysis and for the formation of the Shared Global Taxonomy. The digital situation in India and other countries, however, is fast changing. Mobile phone ownership and access to the internet are on the rise. Between 2017 and 2025, India is expected to add more than 200 million new mobile subscribers [55]. Government initiatives such as the Digital India program [56,57] are focusing on getting rural communities online, dropping prices of internet-enabled phones and data plans, promoting e-wallets, and setting up free Wi-Fi hotspots, etc. with similar programs being implemented in other parts of the world.

The most important challenge of this framework is its audience. There have been other mobile apps that have successfully employed the crowdsourcing strategy to tackle social causes [58–61]. The framework, similarly, depends on, the involvement of the target audience for its success. However, not only does this framework demand that community members engage with the app, it also requires that they do so over a sustained period of time. To tackle this, first, the app has been designed to be simple, intuitive and not demanding any special technical expertise to use. Secondly, a tutorial on using the app is also planned that will be made available to the youth-led NGOs. Finally, the app will contain an incentive system that keeps users motivated with rewards for crossing “reporting milestones”. All of the processes above are being rolled out in a pilot site that works with community-based NGOs and youth-led groups. The results of this piloting process will be the subject of a further paper. This paper presents the conceptual framework only, as indicated above.

4. Conclusions

For achieving the SDGs and developing sustainable communities, we need youth to be an important part of the solution. For years, youth have not been allowed to be a part of community development and sustainable practices given the dominant structuring of the education system, discussed above. Our framework recognizes this missing voice by designing an approach for youth-led monitoring of the sustainable development goals. Social, economic and cultural contexts of societies also do not remain the same over time. The issues of today may not be the issues of tomorrow. Just as new knowledge drives change in educational curricula, so too should the ever-changing nature of societies drives the evolution of educational pedagogies. The proposed framework has the potential to support a pedagogy that is not static, but allows flexibility, adaptation and innovation.

In conclusion, the paper describes the design of a youth-led, issue based, technology-enabled, crowdsourced global monitoring framework to achieve and monitor the sustainable development goals. Based on the conceptual framework, and the initial design of the mobile application, a pilot local crowdsourcing campaign has been launched by a youth-led NGO working with a community in the state of Gujarat, India, in order to test the assumptions in this paper, provide useful insights about the approach and the potential for success of the framework. Further information on the progress of the pilot programme is available on <https://mgiep.unesco.org/youth-led-monitoring>.

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