Crowdsourcing as an approach to solving environmental problems by future construction engineers

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Abstract. The article studies the role of the University of Architecture and Engineering students in the formation of the ecological culture of the population. We consider crowdsourcing as an approach to solving problems and sharing the solutions through the implementation or offering the materials in the public domain. Crowdsourcing as an approach is different from a community-based research approach. Crowdsourcing is an innovative way of people's self-realization. It is corporations' and power structures' attempt to open access to vigorous transformative activity for "smart crowd". We also explore collaborative actions that are aimed at cooperating with communities on research participating and achieving environmental change. Within the crowdsourcing technology, the solution of the problem is transferred to a distributed and very large group of people, due to which the cost and time to achieve the result are significantly reduced. That must be used in the formation of people's ecological culture, in particular students of the University of Architecture and Engineering.

Key words: ecology, crowd sourcing, exchange of solutions, collective intelligence, construction engineers.

1 Introduction
The most urgent contemporary world problem is the problem of ecology, caused by the low level of the people’s ecological culture. Evidence suggests that to overcome the environmental crisis, it is necessary to introduce innovative achievements in ecology [1-3]. One of these achievements is a new kind of collective intelligence-crowdsourcing. It can provide good results in solving environmental problems through widespread community involvement. Students of the University of Architecture and Engineering and the society can become a central force contributing to the environmental culture formation [4-6].

Crowdsourcing means attracting a wide range of people, using their creative abilities, knowledge, and experience to solve problems of innovative production. This is a voluntary subcontracting work with the use of info-communication technologies. The principle of crowdsourcing itself is very simple: the related party receives a specific task (usually via the Internet). Then, the performers offer their solutions to the customer who selects the most optimal variants and then implements them [7-10].

The use of crowdsourcing enables:
1) to attract to the project a lot of people all over the world. The number of employees of any company is always limited, crowdsourcing helps you to attract a huge number of talented people around the world;
2) to monitor the progress of the task. Crowdsourcing allows you to optimally distribute the load and, if necessary, use the auxiliary resources;

3) to find and attract outstanding specialists to work. Crowdsourcing can involve the specialists who could not be able to take part in a specific task due to some reasons [11-15]. For example, a person works in the economic sphere, but in fact, his vocation is designing. He is able to brilliantly perform tasks related to the development of design, but for one reason or another, he did not find a permanent job in this area. So the company needs that talented designer (even not entirely professional) to carry out the task;

4) get many different options for performing one task and choose the best. If the work is done by a staff member of the company, you get only one implementation option (at best, several, but not thousands that crowdsourcing let you get);

5) get options for the task in a clearly defined period of time. Most often, crowdsourcing involves the solution of goals in a certain time frame. This allows you not to delay the task for an indefinite period [16, 17].

Crowdsourcing transfers environmental research from a closed environment to an open collaboration between the society and researchers. We define crowdsourcing as a problem-solving approach that includes an organization having a large group of people who want to solve an environmental problem or part of a problem, and then share solutions. Crowdsourcing allows large groups of activists and students of the University of Architecture and Engineering to participate in environmental events. Crowdsourcing is currently actively developing as a technology for solving any kind of problems and tasks facing both business and the state and society as a whole [18-21]. Within the crowdsourcing technology, the solution of the problem is transferred to a distributed and very large group of people, due to which the cost and time to achieve the result are significantly reduced. That must be used in the formation of people's ecological culture, in particular students of the University of Architecture and Engineering [22-25].

2 Materials and methods
In our study, we used an analytical method aimed at identifying the qualitative characteristics of the phenomenon under study. This method allows you to uncover the underlying mechanisms of various processes in society, including the influence of the collective intelligence on the consciousness of an individual.

3 Results
Using the analytical method, we have identified the following.

Although there is a number of definitions of crowdsourcing, they all highlight only two main elements:

1) solving a common problem by a large group of people, including both ones who has and hasn’t got special skills;
2) exchanging the solutions through the implementation or offering the materials in the public domain.

Modern media technologies (the Internet) have turned our understanding of how relationships between people and organizations are built.

The Internet is a cultural center where organizations for the first time have shown interest in using the collective intelligence of online communities to achieve business goals, improve public participation in management, product development and problem solving.

Many companies, nonprofits, and government agencies often integrate the creative energy of online communities into everyday activities, and some of them rely entirely on online communities. This intentional combination of an upward, open, creative process with a downward organizational goal is called crowdsourcing. Online communities are fertile sources of innovation. A large number of scientific studies is devoted to crowdsourcing and the reasons for its success in recent years.
Considering crowdsourcing as an online environment, we can say that there is a distribution of problem solving and the formation of a model that uses collective online intelligence of communities to fulfill specific goals. Online communities are given the opportunity to choose actions for solving crowdsourcing tasks, which may or may not be encouraged by the organization.

In other words, crowdsourcing is the transfer of certain production functions to an indefinite number of people, and the solution of socially significant tasks by volunteers, who often coordinate their activities with the help of information technologies.

Crowdsourcing is a problem-solving approach that has gained momentum in the past decade. It includes an organization that has a large group of people who can solve a problem or component of a problem and then share solutions. This concept has made it easier for the society to participate in environmental issues. Crowdsourcing is associated with open innovation and differs from traditional ways of organizing environmental problems.

The term “crowdsourcing” was first used in the article “The Rise of Crowdsourcing” in 2006 by the British editor and journalist Jeff Howe, and then he thoroughly disclosed all the advantages of the new technology in the book “Crowdsourcing: Why the Power of the Crowd is Driving the Future of Business, 2009”.

Since Jeff Howe coined the term, there have been other definitions of crowdsourcing. The term itself consists of two words: “crowd” and “outsourcing”. The initial definition was used to describe the tasks of outsourcing companies for a group of individuals who worked collectively or individually. Jeff Howe later found this definition too narrow, and expanded it to include the application of open source principles to areas out of software.

The available sources content analysis showed that a theoretical and empirical basis has been created in science to study the crowdsourcing technologies. The topic of intellectual capital is widely considered by the following authors: D. Baker, D. Shurovieski, D. Howe [26, 27] and others. Russian authors have not sufficiently studied this topic yet. The description of this new tool for generating ideas is found in the works of G. Asmolov, A. Sokolov [28, 29] and others.

Crowdsourcing attracts performers who have the skills to solve the set tasks and those who do not have ones. These performers freely share some decisions with the public. Most crowdsourcing participants have altruistic motives, hoping to help their community or the society at large.

Another key component of crowdsourcing is solutions sharing, for example, by implementing the solution in the local community or by creating open-access materials for public use. Here are some methods of sharing materials obtained by crowdsourcing: providing crowdsourcing of images, concepts and logos to the public using an open-access website; widespread distribution of images through social networks; assessment of the effectiveness of crowdsourcing during the tests; conducting a series of personal seminars to exchange crowdsourcing data with key stakeholders.

The collective intelligence suggests that, under certain conditions, a group is better able to solve complex problems than an individual working alone. The concept of collective intelligence has its own history in political science, philosophy, social sciences and biology. The French philosopher Lévy defined the collective intelligence as “a form of universally distributed intelligence, constantly improving, coordinated in real time and leading to effective mobilization of skills”. Social reformers also used collective intelligence as a key guiding principle. Wells in 1938 described the concept of the World Brain, which will help citizens exchange information as a group, using local knowledge and experience within a common platform. He presented the platform as a nonprofit resource that would span political boundaries and help expand knowledge. Wikipedia crowdsourcing encyclopedia has something in common with the structures and functions of Wells’ original brain concept.

Empirical evidence shows that, in some contexts, the converging collective intelligence factor explains the group’s work on several tasks. Additional empirical evidence supporting collective intelligence is summarized in James Shurovsky's “Wisdom of the Crowd”. He states that collective intelligence requires four elements: diversity of opinion, independence of individual ideas, the decentralization of ideas and a way to combine individual ideas. Shurovsky shows how collective intelligence has been used in many different contexts, from forecasting markets to the Delphi method.
The Delphi method is as follows: a group of people interactively answers questions and converges in one answer. This method is widely used to achieve group consensus in the guidelines.

4 Discussions
Crowd sourcing as an approach is different from a community-based research approach. Each of these approaches has a conceptual framework, methods, and assumptions. At the same time, each of these three approaches can be used to inform people about environmental events. The similarities between community-based research and crowdsourcing are: focus on listening and partnerships with local communities; potential to increase healthy equity; recognition that communities can be a powerful source of new ideas. These areas of convergence suggest that collaborative community-based research may be a useful complement to crowdsourcing.

The positive aspects of crowdsourcing are:
- cheapness
- coming to a huge audience, both specialists and amateurs,
- new ideas that lead to innovative solutions and help to implement ambitious projects,
- the speed of solving problems,
- involving consumers in the company.
You can also highlight the pros for the crowd:
- the possibility of receiving money rewards,
- the opportunity to convey and realize their ideas,
- the opportunity to feel part of the project.

5 Conclusion
Crowd sourcing is an innovative way of people's self-realization. It is corporations' and power structures' attempt to open access to vigorous transformative activity for "smart crowd". Thus, the use of crowdsourcing principles is reasonable in the ecological culture formation of the University of Architecture and Engineering students.

Other approaches include research into actions involving the general population and youth in particular. In the environmental field, collaborative action research seeks to partner with communities to participate in research and achieve environmental change. Studies involving youth and students of the University of Architecture and Engineering allow young people to learn about environmental issues affecting their lives and then propose measures to address them. The participatory approach considers youth and students of the University of Architecture and Engineering’s potential experts and co-authors of knowledge. Common elements of crowdsourcing and collaborative research approaches emphasize participation, partnerships with the local community, and community empowerment. This allows community members and students of the University of Architecture and Engineering to research, collaborate on the development, implementation, analysis, interpretation, and dissemination of results.

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