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Empowering Green Education in TVET through International Project-Based Online Competitions

Abstract

Online competitions for the best projects related to Green is one way to spark students' interest in ecologically friendly production and incorporate green TVET in curricula. This paper reviews foundation, implementation, and a pilot trial at the community college level of a free educational platform combining crowdsourcing, crowdfunding, and crowdgaming designed to conduct online student competitions. Students can showcase their projects online (crowdsourcing), collaborate, comment, offer improvements, and rate posted projects (peer rating). Such project based learning can be combined with service learning: links of non-profit organizations and their sponsors are added to student pages. The system enables students to create free galleries (e-portfolios) with sub-galleries on various topics, including Green. Various crowdfunding mechanisms including donations and sponsorship can provide support for the competitions. Elements of serious (educational) Reality Role Playing Game can be incorporated to enhance student involvement in learning. The system can be adapted to any language, level, and TVET topics. The competitions can be run on a level of one class, school, or multiple school partners. Competitions involving international partners have a great potential to engage students in learning the best environmentally safe and prudent processes.

Keywords: *Green Education, TVET, Project Based Learning, Service Learning, Serious Gaming, Crowd Funding, Crowdsourcing, Crowdgaming*

1 Introduction

Green education is important for cultivating a workforce of the future equipped with the knowledge of ecologically friendly and sustainable technologies. Academic competitions, particularly online contests for the best student project have been proven to stimulate student interests to learn various subjects, for example, Carpio Cañada et al (2015), Battisti (2011), and Hammer et al (2012). Leveraging project based learning (PBL) pedagogy, academic contests engage students in active hands-on learning. Conducting contests online has a number of advantages:

i. Crowdsourcing, sharing user created content online, gives more exposure to student works and provides new opportunities for collaboration. It enables students from the same school or partner schools to build on the previous students' work developing posted projects and turning the best student learning materials into teaching aids.

ii. Crowdfunding, support raised through donations and sponsorship, can provide a foundation for making projects self-sustained and enhance student participation through rewards.

iii. Crowdgaming utilizing serious (educational) games can be incorporated to enhance students' involvement in learning.

The PBL-nature of contests makes them especially suitable for TVET: competitions for the best student projects can be easily incorporated in teaching any subject. Particularly, competitions for the best student projects related to green can be used to help students of any professional orientation to learn sustainability. Online competitions can be used to leverage value of any student work: from a simple homework assignment to special projects, including capstone projects. There is a number of commercial solutions, for example, Kaggle and Omnicontests, for conducting online contests. They have limited capabilities for showcasing of student work and are expensive. There is a number of crowdfunding sites, for example, DonorsChoose.org and USEED enabling raising support for educational projects through donations. There are sites engaging students in learning green through educational gaming, for example, Aqua Republica, mostly as an extra-curricular activity.

This paper describes a new free educational Project Based Service Learning (PBSL) platform (SponsorsChoose.org) combining crowdsourcing, crowdfunding, and crowdgaming. It was developed as a private initiative for free use by students of any level, any professional orientation, any language. It leverages the value of student work for raising support for educational projects and service learning: links to non-profit organizations and sponsors are added to student posts helping to spread the word about good-cause projects and raise support. It has been used for teaching various aspects of engineering, including green manufacturing in blended classroom (at a Community College in Arkansas, USA) or online settings. The system can be easily incorporated into any curriculum and can be used for conducting Green Challenges, online competitions designed to spark students' interests in learning green in any TVET program. Any teaching institution, for-profit (business), or non-for-profit (including government) organization can become a stakeholder in this project.

2 Fundamentals of the project based service learning (PBSL) platform

2.1 Project based learning

PBL has been shown to be effective in promoting long term retention and mastering various professional skills (Strobel 2009). In the typical PBL settings, students work as a group to address a meaningful problem: learning occurs through hands-on activities (Barrows 1996; Loyens, Magda, & Rikers 2008). PBL environments are student centred, support interdisciplinary inquiry, incorporate collaboration, include self- and peer-assessment, an opportunity for self-reflection, and focus on problems and skills that have real-world value (Barrows 1996; Savery 2006, Dole et al. 2015). Use of the Web technologies opens new opportunities for leveraging value of student work. Online PBL projects emphasize learning as a social activity and assert that learners' interactions with people in the environment stimulate their cognitive growth (Schunk 2008). Through the interactive process, learners collaboratively construct knowledge when they clarify their own thinking and gain multiple perspectives on a

given issue (Ching & Hsu 2013). Online PBL can leverage a number of new technology based tools, such as e-portfolios (for example, Macias 2012), wiki (for example, Biasutti & EL-Deghaidy 2015), project-based digital storytelling (for example, Hung et al. 2012), and peer rating (Ching & Hsu 2013). A growing body of research on the use of these new educational tools indicate that they have a strong potential to advance student centred pedagogy to the next level. For example, Ching & Hsu (2013) found that peer feedback facilitates project-based learning in an online environment. The results of content analysis exploring the peer feedback revealed that learners were mostly supportive of peers' work and frequently asked questions to help advance their peers' thinking. The review of these tools is provided elsewhere (Zelin 2015): the focus of this paper is on a specific implementation of a new online platform which is being developed as a portal to learning resources, authoring tools, galleries for showcasing student work, databases (galleries) of sponsors and non-profit organizations. It's a free educational tool: any school, organizations, or individuals can join the project and get ownership: to build their own gallery, a pool of sponsors, partners, and supported good-causes.

2.2 Service learning

Service learning is an educational experience allowing students to participate in an organized service activity that meets identified community needs and reflect on the service activity to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of civic responsibility (Bringle, Robert & Hatcher 1995). Service-learning enterprises ask students to make connections between activities with the community and their academic work in the classroom (Straus & Eckenrode 2014). Kolb (1984) defines four components of experiential learning cycles:

(a) concrete experience,

(b) reflective observation,

(c) conceptualization, and

(d) active experimentation.

Service learning integrates real world experience with community needs. With an advance of online education, there is a shift to online service learning. Comparison of traditional and online delivery of service learning experiences demonstrated similar outcomes between the online and face-to-face models (McGorry 2012). Waldner et al. (2010) discuss various combinations of in-class and online components of learning and service to the community:

- Hybrid service learning experiences: The instruction takes place online, but the service occurs onsite at a client organization.
- Extreme e-service learning: The instruction and service occur exclusively online. PBSL platform provides a framework and technology to further leverage this traditional Service Learning model relying on special projects.

A majority of special projects including Service Learning component is documented in a form of hard copy reports. Students get a grade and log Service Learning hours, but the information about their experiences can be used more efficiently if student projects are posted online. It gives exposure to student work as discussed by Waldner et al (2010). Adding links of non-profit organizations and their sponsors to student created pages provides additional value to student work by helping good-cause projects to increase awareness and raise support. A database of special projects sponsored by commercial partners would enable students to choose projects of interest and strengthen relationship with industry. Leveraging existing resources, for example, on environmental projects (Youth Service America 2009), the PBSL system provides not only ideas for student Service Learning projects, but also a platform for showcasing them, collaborative work, and raising support.

Additionally, the PBSL system expands opportunity to combine service to the community with learning beyond traditional special projects: any work that students do can be leveraged to promote good-causes:

- Students can post their completed homework assignments or in-class work online and add links to non-profit organizations and sponsors supporting good-causes. This model also helps non-profits to increase awareness about good-cause projects and local businesses to save on online advertising. For example, incorporating links to non-profit organizations and sponsors dealing with green with work of TVET students for general education classes or for professional orientation classes can increase exposure and awareness of TVET students about the concept of Green. This enables bringing elements of Green education through any subject: Math, Engineering, English, Food Science, IT classes, etc. as illustrated by examples of specific implementation below.
- Students can post projects, for example, Science Fair projects or Senior Projects in the corresponding galleries: SponsorsChoose.org/education/sciencefair and Sponsors Choose.org/education/seniorprojects. They can showcase not only the final e-poster, but also share supporting images, videos, and other data. Adding links to non-profit organizations and sponsors supporting good-causes enables students to leverage value of their work. Student posts can include not only the actual assignments, but also their experiences and reflections discussed by Kolb (1984).

2.3 Crowd-Sourcing /-Funding /-Gaming

Crowdsourcing

In a broad sense, crowdsourcing is posting user produced content on the Internet. It opens new opportunities for collaborative learning. For example, Sun et al (2015) used collaborative sketching in crowdsourcing design and found that participants often developed high-quality ideas from initial ideas that were regarded as poor quality. Azzam & Jacobson (2013) also found that crowdsourcing is a potentially viable resource for evaluation of designs where access to comparison groups, large budgets, and/or time are limited. Erickson (2013) analyzed crowdsourcing in various applications, including knowledge capture and provided

guidance to practitioners on how to address specific challenges and barriers to its use and acceptance. Fontichiaro (2012) discussed crowdsourcing an e-book-gathering wide, diverse opinions from different stakeholders: academics, practitioners, vendors. Beaven et al. (2013) analyzed harnessing crowdsourcing to transcend linguistic barriers through engaging online communities of translators. Forum discussions, synchronous online sessions, recorded podcasts were used as a part of MOOC (Massive Online Open Course). Hills (2015) reported a participatory action research approach to combining crowdsourced content creation with the student as producer model, whereby students' interests are used to drive the identification and creation of educational content in application to an undergraduate psychology course on persuasion and influence. PBSL provides a platform to leverage crowdsourcing in application to any TVET course offering interested educators a complete ownership of their projects and tools for collaboration. MOOCs revolutionized efficiency of teaching: an educator's work posted online can be used by thousands of learners. Still, learners' work is mostly discarded. PBSL addresses both sides of education: teaching and learning - increases efficiency of instructors' and learners' work. The best examples of student produced learning materials, including on the Green topics selected, for example, through online competitions can become teaching materials.

Crowdfunding

Crowdfunding allows people with a great idea or worthy cause to bypass traditional funding methods and take their case directly to web-savvy investors and donors (Jarrell 2013). It enables building a pool of supporters at different levels: individuals, companies, foundations and donations through microfinance tools. Antonenko et al. (2014) found that the most successful crowdfunding campaigns in educational technology tend to: a) request a modest but reasonable amount for each phase of the project, b) focus on the informal, out-of-school, rather than formal contexts of learning, c) attract supporters with a tiered system of rewards, and d) communicate with supporters and inform the public of the status of the project through periodic updates and progress reports. Crowdfunding sites such as DonorsChoose.org, USEED, ScaleFunder focus on educational applications: schools or teachers can start a project to solicit support. Some schools, like Middlebury College develop their own microphilantropy sites. PBSL also enables receiving support through typical donations based mechanisms with additional features facilitating donations including Kind points that donors receive for their donations and Donor Hall of Fame, galleries honouring support of exceptional donors. Still, the emphasis is on sponsorship and innovative entrepreneurship: helping sponsors to save on online advertising by combining marketing and charity.

It provides tools for taking online competitions to a new level: sponsors' links are shown not just on one page which is usually acknowledges sponsored support, but on hundreds of student created pages.

Crowdgaming

Serious (educational) gaming has been successfully used to engage students in learning different disciplines, for example, Oblinger (2004) and Tham & Tham (2014). Chen et al (2014) used a 3D Role-Playing Game in chemistry applications, Simpson & Elias (2011) for learning

sociology, and Rosa & Lerman (2011) for learning mathematics. Riegle (2007) discussed MMORPGs (Massively Multiplayer Online Role-Playing Games) and four potential barriers to the transformation of student work from paper-print essays to educational Role-Playing Games (RPG) websites--skills, costs, theory, and assessment. Storey & Butler (2013) analyzed game-centred approaches (GCAs) as complex adaptive learning systems and found that complexity thinking concepts in combination with the pedagogical principles advocated by GCAs, provide a robust set of analytical and teaching tools. Reality Role Playing Game (RRPG) format is especially easy to adapt to teaching green and sustainability: players save the environment – save the world (Gibson & Grasso 2009).

PBSL platform enables users to play any educational game of their choice and document progress as a part of a Reality RPG: Everyday Life Game. Users can integrate their gaming experience with learning and save the world one challenge at the time: participating in Creative Challenges addressing specific ecological, educational, and other societal needs.

3 Development and implementation

Project Based Service Learning (PBSL) was conceived as a free educational platform enabling instructors and students to leverage their work by posting it online. Many educators believe that there is value in student work beyond the academic grading: it was a personal quest to provide tools leveraging this value. Development included creating 12 modules that empower users to get access and build further databases of educational resources, sponsors, non-profit organizations, partners, authoring tools, social interaction, e-commerce, and other modules. Details on each module can be found in Zelin (2011, 2012). Stages of the system development are reflected in posts in the Inventing the Game gallery on SponsorsChoose.org. Here, the focus is placed on how instructors and students can use the PBSL system to showcase their work and raise support for their projects, particularly, through conducting online competitions.

An instructor can click just one button and create a project gallery in which students can post their work. The instructor can configure permissions to limit authoring rights only to students in his/her class(es), make the gallery password protected (completely closed) or completely open (any users can create posts). Students post their work and can rate other students' work. The instructor can create sub-galleries for each project. For example, a gallery for the Introduction to Engineering class taught at a community college in Arkansas, USA, had sub-galleries for various branches of engineering: Mechanical Engineering, Bio-Medical Engineering, Electrical Engineering, Chemical Engineering, and other galleries (Fig. 1). The instructor can post own resources, links to online resources, as well as links of non-profit organizations and sponsors. Any student assignment becomes a project. For example, students can learn various topics of engineering by creating presentations as a part of a homework assignment, delivering them to the class, and posting online.

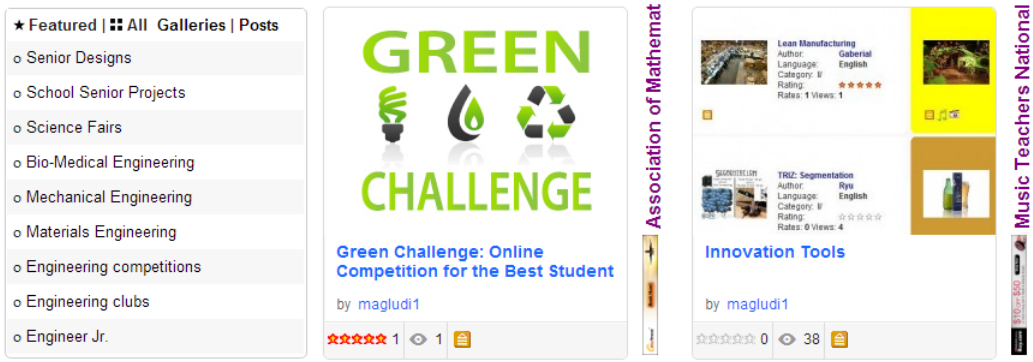

Figure 1: A snapshot of the Engineering gallery with sub-galleries for different engineering fields and projects on http://sponsorschoose.org/engineering (with links of nonprofit organizations and sponsors in purple)

This project based learning approach enables students to work on topics in which they are interested and leverage their work beyond the academic grading:

- Students build a free e-portfolio of their work. They can provide a link to a future employer to show projects completed at school. Student projects can be related to their current work if they are employed or involved in the work based training.
- Links of non-profit organizations and their sponsors are added to student pages. This helps good-cause projects to spread the word and to sponsors to save on online advertising. For many students, this Service Learning component is more important than financial rewards.
- Educators can build support for their projects and mutually beneficial relationships with local industry.

The value of student work can be further leveraged through the use of the best student posts and projects as examples for other students. Future students can use posted materials as a basis for their projects (with a proper acknowledgement). Compilations of the best student creations can be published as e-books with proceeds going to support good-cause projects and reward authors. Additionally, the quality of work tends to improve when people know that it will be publicly displayed. Sponsored rewards provided by the PBSL system also motivate students to improve the quality of their work. Thus, the PBSL system enables leveraging of student work which is currently predominantly discarded.

The instructor can configure the system to add to student pages the links of sponsors (Fig. 2) providing support to specific projects, for example, a competition for the best homework assignment on the subject taught by the instructor. This helps local industry to cut marketing expenses: the rate per click is 2...4 times lower as compared with the standard rates for online advertising. At the same time, instructors can raise support for their projects and student prizes. Also, banners and advertisements can be added generating advertising hosting fees through clicks. The system comes with e-commerce capabilities: users can create their online

shops to sell products. The instructor has various options to configure how the support from sponsor links, ads, banners, and online shops is distributed.

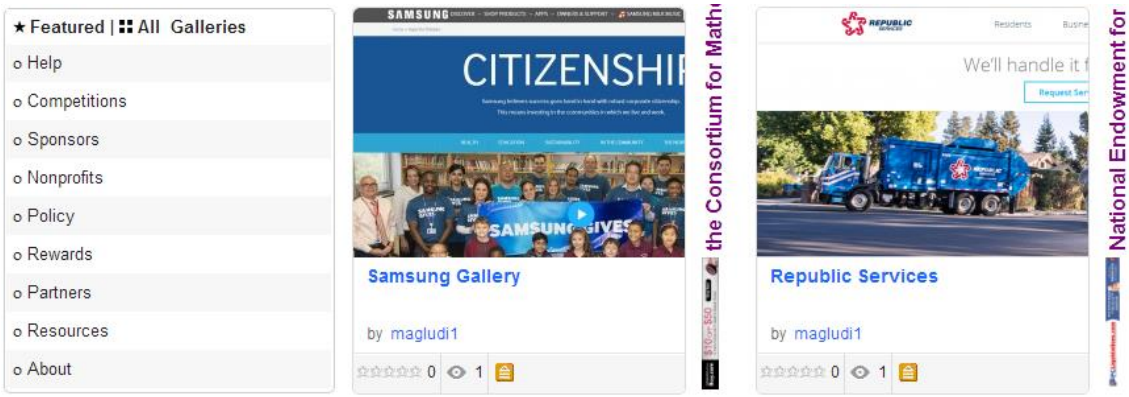

Figure 2: A snapshot of a gallery of sponsors: sponsors can showcase the best supported student works and projects.

The instructor can keep 100% of the provided support for the project needs or direct a portion towards prizes to incentivise students to do a better job: post a higher quality work. The instructor can adjust reward modules to link rewards to rating of student posts, number of views, rating of student comments and suggestions for other students, and other parameters. The instructor can invite experts to serve on a special jury panel to judge student work online. The instructor has special tools to create a rubric and send it to the members of the jury panel and a number of other tools facilitating interaction with users and collecting a feedback. For example, users can insert rating scales next to each element of their post to obtain feedback that could help improving user's creations. The rating scale has novel capabilities enabling users-viewers to calibrate their perception by comparing their rating results with the average score and track how it is changes over time.

Gaming elements were introduced into PBSL system to enhance student involvement in learning through serious gaming. As in typical RPGs, users can choose an avatar. They start at the Apprentice level. Players advance through the ranks based on the rating of their work and completing challenges tied to their learning or achieving certain profession learning goals. Their rewards increase with the advancement to higher ranks that motivates users to create better posts: do better homework and special projects.

4 Green challenge: a specific example of implementation

As a part of the Introduction to Engineering course, North West Arkansas Community College students were allowed to choose their own topic related to green technologies and give presentations to the class. A similar challenge was conducted previously at the Kent State University where students did an excellent job: came up with very informative presentations, delivered them to the class, received a grade, and that is where it usually stops. The PBSL system enables students to leverage their work by posting it online.

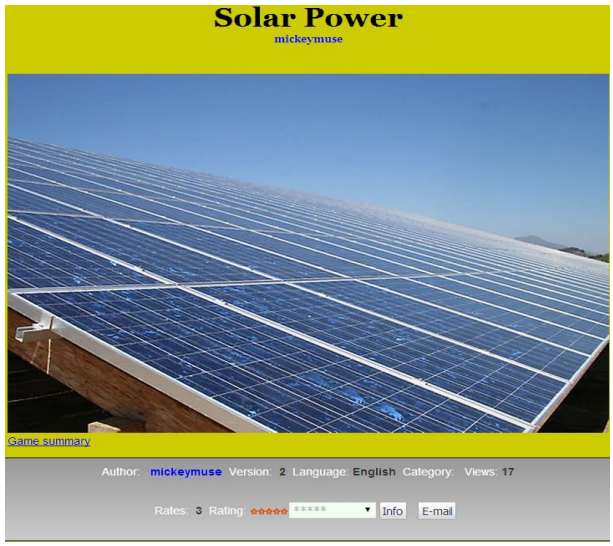

Figure 3: An example of a student post related to green technologies

Figure 3 shows an example of a student post related to solar panels with a presentation linked to the post. Viewers can see the presentation, rate the post, offer comments and improvements. Next year students can use it as a basis and further develop it giving credit to the original author. Such a collaboration is a strong motivation for students. Students are especially interested in projects involving students from other countries, and it is one of the goals of this paper to attract partners interested in engaging students in TVET and green education by using PBSL platform. Any instructor can start a gallery for his/her students' work and join the Green Challenge.

Students can upload their files, images, and videos, rate each other work (peer rating), offer improvements and collaborate online. They can use screen names to protect privacy. Elements of a serious (educational) game can be incorporated to engage students in learning:

- Level I - students puzzle together existing information pieces: text, images, audio, and videos
- Level II – add their own pieces
- Level III – Reality Role Playing Game (RPG)/Forum RPG – Everyday Life Game, in which players save the world by promoting green and sustainable technologies and helping to develop future simulation models.

PBSL enables leveraging existing resources on green. Figure 4 shows an example of how students can be exposed to Green by adding links to sites dealing with Green or nonprofits promoting sustainability in an example of a post related to another engineering topic: Innovation closely linked with green. Students can follow the link and discover the best Green sites selected based on the popular rating or number of Facebook likes.

PBSL enables leveraging existing resources on green. Students can be exposed to Green by adding links to sites dealing with Green or nonprofits promoting sustainability. Both students

and instructors can create posts related to green in a special Green gallery enabling users to share resources on sustainability and collaborate. Users can discover the best Green sites selected based on the popular rating or number of Facebook likes.

Students can also be exposed to Green through Creative Challenges, competitions for the best student post on a specific aspect of sustainability and ecological safety, such as water resource management, pollution control, etc. For example, students can join Creative Challenge: Aqua Republica leveraging an educational game Aqua Republica (Gibson & Grasso 2009) designed to teach students how to manage water resources. Students can capture the screen and create digital stories about their gaming experiences. They can receive rewards based on sponsor links, ads, and banners.

Another example of how PBSL can be used to leverage existing resources on green is related to the Project Green Challenge (Fig. 4). This excellent competition engages more than 400 schools, 49 states, 31 countries. Students submit word documents in response to daily challenges related to green, and the organizers select winners. PBSL enables participants to post entries online: gives exposure to their work and helps others to learn about green.

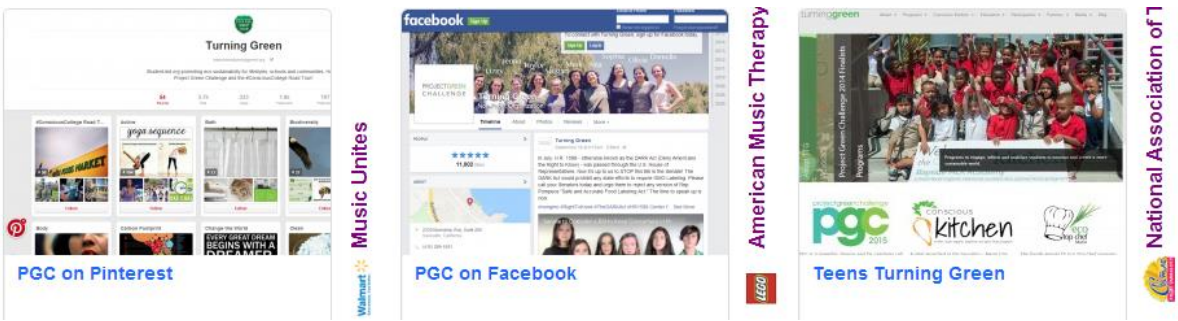

Figure 4: A snapshot of a Project Green Challenge gallery on SponsorsChoose.org designed to leverage value of students' work related to Green

Considering project based nature of many profession learning courses, Creative Challenges related to Green can be especially well suited for TVET. Students learning green in various fields (Gregson 2010) can showcase their projects and benefit from sharing them online and helping others to learn:

- construction technology students could post their projects on alternative construction - solar, recycled building materials, gravity flow water systems
- agriculture students could post projects on sustainable agriculture – organic gardening, holistic ranch management
- culinary arts students could post projects on reduction of food waste: 40% of food is wasted in the USA (Gunders 2012) .

The PBSL platform provides a sustainable system for rewarding student learning of green. Depending on how the rewards are configured, all students can get some rewards from sponsor, advertising, and banner links.

5 Lessons learned

Evaluation of the PBSL system showed its feasibility and acceptance by students. Conducted interviews and feedback collected through online forms indicate students' interest in this new free tool. Students used the system for learning about various engineering fields, including Green. For many students, collaboration with other students and ability to help good-cause projects was a strong motivation to use PBSL. More rigorous assessment of efficacy of PBSL is required and planed in future trials. One of the goals of this paper is to find partners and independent evaluators.

Conducted trials identified the following risks and limitations:

i. Inappropriate content. As with any open crowdsourcing system, control of content of posted materials is important, especially, considering educational nature of the project. Registering users have to affirm that they will use PBSL system only for educational purposes. The system has filters for inappropriate terms, and users can report inappropriate content.

ii. Copyrighted materials and plagiarism. Students' score depends on the appropriate acknowledgement of sources of the used materials. The PBSL tool assembling text, images, sound, video-files into posts has special fields for the URL addresses of used materials and author information. Posts using materials without owners' consent are removed. An instructor can press a “Find Similar Content” button and find posts with similar content. Additionally, unique reward mechanisms make collegial honest behavior more profitable than unauthorized use of the original content and plagiarism.

iii. Advertising links. Some users might prefer advertising free posts. Both users-authors and viewers have an option of switching off advertising completely or partially (control number of shown ads).

iv. Dishonest clicks. Some users demonstrate unfair behavior by clicking advertising links just to get rewards or make advertisers (for example, competitors) to pay. The PBSL system has checks preventing this type of abuse of the system and punishing dishonest behavior. For example, information about dishonest users who are caught can be posted in the Gallery of Unfair Players, and their reward goes down.

Also, some students might not have Internet connection/computers at home: they can use library or school computers to post their work.

The future plans for development of PBSL include establishing partnership with professional societies, including organizations promoting green, educators who would like to try PBSL or

are interested in contributing to its development, non-profit organizations and sponsors. We are building a database of projects addressing specific ecological issues: students can address real world needs in their projects. We invite constructive criticism and are open to partnerships to evaluate and improve PBSL.

6 Summary

Project Based Service Learning (PBSL) platform is a free educational resource developed to engage students in learning, particularly, green and sustainability and provide support for educational projects. It combines crowd sourcing-funding-gaming and can be used for online competitions for the best student project on Green topics.

PBSL enables instructors to create online galleries with sub-galleries for different projects in which students post their projects, find and share resources, sponsors, and partners. Links to non-profit organizations and sponsors are added to student pages: this new service learning model helps to increase awareness about good-cause projects and get support, and it helps to local businesses save on online advertising. PBSL provides novel tools for inviting judges, creating rubrics, rating projects and their components.

PBSL provides a number of new incentives engaging students in learning, particularly, green: collaboration with peers, social interaction, rewards, ability to contribute to a good-cause, serious gaming elements. Involvement of students from different countries increases student engagement in green competitions: it is proposed to conduct online International Green Competitions.

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