

Integrating Crowdsourcing in Education: *Investigating its potential for students & teachers*

Final Report

Dr.ir. Javed Khan¹, v.j.khan@tue.nl, Assistant Prof., Industrial Design Dept., TU/e

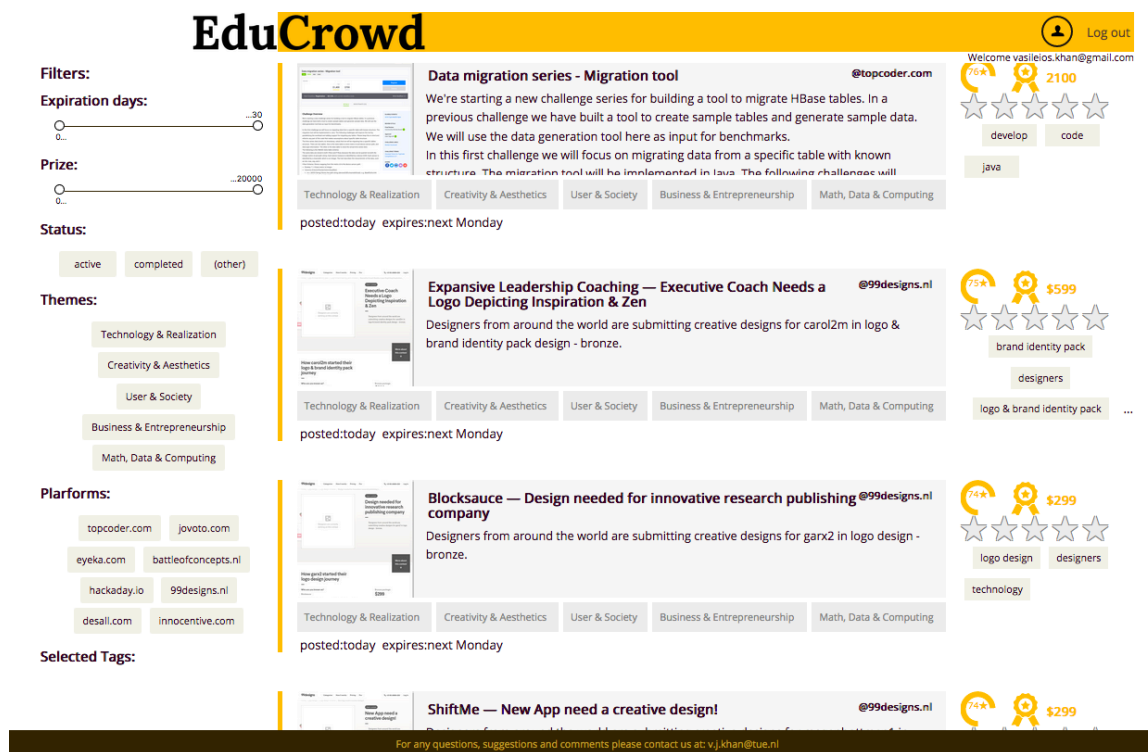


Figure 1: As part of this project we designed and developed [Http://EduCrowd.tue.nl](http://EduCrowd.tue.nl) a web crawling and recommendation system for supporting the integration of design-related crowdsourcing tasks into educational activities at the ID department

¹ Contact author

Table of Contents

Executive Summary	3
Introduction	4
Activity 1: In-Depth Interviews	6
Method	6
Results	9
Co-creation session	11
Activity 2: Web Crawler Data	14
Activity 3: Educrowd.tue.nl	18
Activity 4: Educrowd.tue.nl Data	22
Activities realized with the given budget	23
Conclusion	23
Future planned activities	24
Acknowledgements	24
References	25

Executive Summary

Educators actively seek the involvement of external parties in their educational activities to increase the relevance of teaching to society, motivate students and enrich the content of the course with potential applications of the taught material. Whether it is a guest lecture from an industry expert, a project inspired by an industrial context, a hackathon or an internship, all are sought after activities for both students and teachers alike.

Crowdsourcing platforms, are a novel form of online websites that offer work, mostly in exchange for money. Usually, contributors, commonly referred to as “workers”, compete to get the prize, usually monetary, associated with the work. There are literally hundreds of different platforms that offer thousands of tasks at the time of writing this report. Since tasks are already publicly available online, there is a unique opportunity to integrate their performance in educational activities.

In this project we set out to investigate and better understand what are the attitudes of students and teachers alike when it comes to integrating crowdsourcing tasks into educational activities.

More specifically we:

1. Conducted in-depth interviews with 30 students and teachers about the concept itself to capture their attitudes. Our main conclusion is that overall students are quite enthusiastic about the concept whereas educators are skeptical of the extra time that this activity might require from their side.
2. Developed a web crawler to gather tasks and data around those tasks from eight design-oriented crowdsourcing platforms. Our main conclusion is that there is a plethora of design related tasks for our department.
3. Developed a website to present crowdsourcing tasks from these eight crowdsourcing platforms and a recommender system based on students' activities on the website. The website/platform is available at: [Educrowd.tue.nl](https://educrowd.tue.nl).
4. Captured data of 10 ID students in a two-week trial of [Educrowd.tue.nl](https://educrowd.tue.nl). We captured both the data while they browsed online. Our main (tentative) conclusion is that ID students do not find a match with their learning activities of the tasks that are presented in EduCrowd but do find the tasks original and attractive.

Introduction

Educators actively seek the involvement of external parties in their educational activities to increase the relevance of teaching to society, motivate students and enrich the content of the course with potential applications of the taught material. Whether it is a guest lecture from an industry expert, a project inspired by an industrial context or an internship, all are sought after activities for both students and teachers alike. However, for teachers having a constant pool of relevant real-world assignments is both difficult and time-consuming.

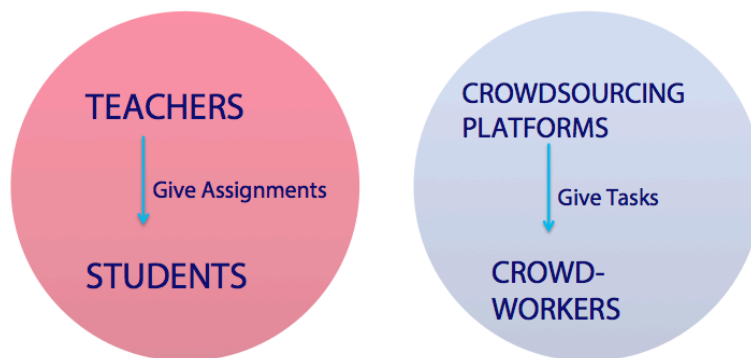


Figure 2: A rather simple model of education seems to match very well with current online platforms known as crowdsourcing platforms. We ask the question with this project: what is the overlap between the two circles? How can we, as educators integrate crowdsourcing into education? What are the opportunities and challenges of this idea?

Crowdsourcing is a development that has captured the attention of the public. In crowdsourcing, websites -online platforms- offer work, usually in exchange for money, which can be conducted by virtually anyone, but also other tasks that require more specialized skills. Usually, contributors -commonly referred to as “workers”- compete to get the prize associated with the work. There are literally hundreds of different platforms that offer millions of tasks at the time of writing this paper. Since tasks are already publicly available online, there is a unique opportunity to integrate their performance in educational activities.

Our assumptions at the start of this project were that this integration will: stimulate students’ external motivation; improve students’ understanding of real stakeholders’ requirements and ways of communication; help teachers and students benchmark the students’ competencies in relation to real-world competition; offer teachers a steady and on-demand pool of industry- relevant activities.

The concept of crowdsourcing (CS) is relatively new, as one of the first papers related with the topic emerged only in 1999. In Malone and Laubacher’s *The dawn of the e-lance economy* (e-lance as opposed to freelance), the core idea behind crowdsourcing is explained, without using the actual term (Malone and Laubacher, 1999). The first mentioning of the term “crowdsourcing” appeared in a 2006 *Wired* article by Jeff Howe, in which he connected crowdsourcing to traditional outsourcing. Howe defined

crowdsourcing as “the act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call” (Howe, 2006). In a later publication, Howe stated that crowdsourcing can be specified towards four main types: *crowdfunding*, the currently well-known form of tapping into the world financial resources; *crowd wisdom*, harnessing the collective intelligence; *crowd democracy*, using the crowd to shift through things and vote; and *crowd creation*, using the crowd to create what you want to sell (Howe 2008). In the last years scholars have come up with alterations of this definition, but the core of this research is based on Howe’s idea of crowdsourcing.

There have been previous successful endeavors of crowdsourcing in education. In one of these, professor E. Gehringer led a project in which 120 students were involved in creating a textbook for a computer science and computer engineering class. All of the information was gathered by the use of an online platform where the students could post their own work and review the work of others. Not only did this project result in a new textbook, the students’ participation in the project was beneficial for their learning experience, because of a more elaborate involvement into the matter. This example displays forms of *crowd wisdom* and *crowd creation*. In another example, the California State University of Fullerton used crowdsourcing to come up with new educational strategies for the institution. Through the use of e-mail, the community was asked to suggest future steps and opportunities, which suggests *crowd wisdom* and *crowd democracy*. Another relevant example we can list is Shinefund (found at <https://shinefund.org> and formerly known as Takeashine), which is a CS platform that promotes young individuals who do not have enough money to enjoy higher education. These prospective students are able to upload their profile and explain why people should fund their education.

Although all the aforementioned examples are both relevant and successful there is more potential to integrating crowdsourcing in education. First, the previous examples are not scalable. These are one-off attempts that will be effortful to be replicated in other environments. Furthermore, crowdsourcing’s application to design has not been really attempted. With this project we try to bridge this gap.

Activity 1: In-Depth Interviews

Based on our previous research (Khan, Dhillon, Piso, & Schelle 2016), we aimed to further investigate the overlap of crowdsourcing and education and the problems this overlap might entail. We subsequently shaped our findings to the educational implementation of crowdsourcing, to show the value of implementing CS to the educational community. A concrete outcome of the in-depth interviews was design recommendations on how to approach the concrete implementation of crowdsourcing in modern design education. Our main research question was: *“How to integrate crowdsourcing (CS) tasks in design education?”*

As the above question can be widely interpreted, we decided to further specify the main research question to the following sub questions:

- *What is the attitude of students and faculty towards the integration of crowdsourcing in design education?*
- *What are important criteria for students and faculty when selecting crowdsourcing tasks to fit within design education?*
- *What is the most convenient medium to implement the integration of crowdsourcing in design education?*

Method

Based on a review of the courses we offered at the ID department and a review of platforms and tasks that are currently on offer (Figure 3) we created a total of eighteen (19) different proposals that integrated various CS-based projects into the department's educational system. Three (3) of these proposals were more general and connected to the competency areas (holistic clusters of knowledge and skills) within ID. The other fifteen (15) were connected to specific elective courses, which cover a smaller, more specific set of skills and knowledge. The proposals had the format of a slideshow presentation (created on Google Drive –Figure 4 for an example slide). These proposals would be the base of our in-depth interviews with students and faculty.

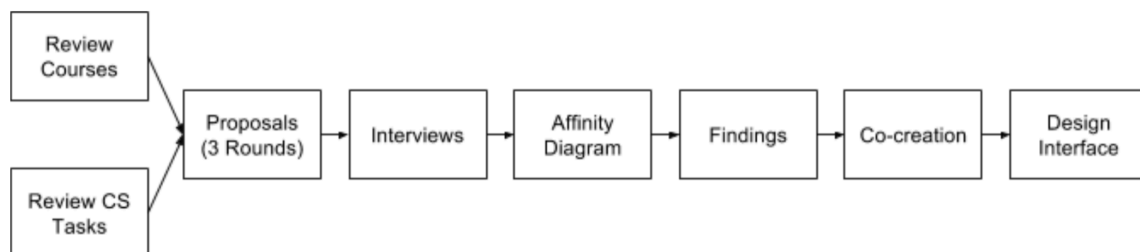


Figure 3: Process



Integration Proposal

Use 3D pasta as shape exploration and rendering exercise.

- Explore shape, interaction, material/texture.
- How is it printed?
- How do people eat it (interaction with sauce)?
- How do you communicate it?

Extracurricular: translate to 3D model (real world practice)

- Hand in on Desall and maybe get chosen.

24/04/2017 - 10

Figure 4: Example slide of one of the final proposals. Complete slideshow can be found at: <https://tinyurl.com/y8t5nnfo>

Due to time limitations, it was not possible to do an in-depth investigation of all the proposals we created. Therefore, we decided to make a selection of three by rating all the proposals on four criteria:

1. Originality/creativity (How original do I find the CS task to be?)
2. Match to the learning objectives (How closely do I think that the CS task matches the course's learning objectives?)
3. Attractiveness of the platform/task (How much do I think that the platform will be attractive for students)
4. Flexibility (How flexible is the CS task for integration in Education?)

Four raters rated all the proposals we created and based on the weighted average ("match to learning objectives weighted double in comparison to the other criteria), the best two and the worst proposal were chosen for further investigation. This was done to see whether the worst fitting proposal was still good enough to provide reasonable results and thereby play a role in taking the implementation of crowdsourcing in education to its fullest potential.

The three proposals - the two best fitting and the worst fitting one - that were chosen by the team, were investigated using semi-structured interviews with both students and teachers within the ID department. The interviews lasted roughly twenty (20) minutes a piece and in total, 24 of them were conducted. A selection of the questions for the students in our pool is listed below:

- Have you heard of crowdsourcing before?
- What do you think of this proposal?

- What challenges or opportunities do you foresee?
- What kind of help do you expect from the school when completing this task in this course?
- Do you think the skills gathered from this CS task are useful after you graduate?
- What do you think an industry-related task adds to a course?
- How do you feel about exposing your design work to the public on a CS platform?
- In case you win prize money for your work, what should happen to the money?

For the teachers, the questions were similar but more focused on the educator's point of view.

We selected students that had followed the course before, in which the proposal was based on and the teachers were responsible for one or more courses. During the interviews, audio recordings were made, which subsequently were transcribed. These transcripts were analyzed following the procedure of a bottom-up thematic analysis approach (Braun & Clarke, 2006) (Figure 5).



Figure 5: Affinity diagram, part of the thematic analysis we followed of the interview transcripts.

Our findings were then presented to a special co-creation session with two educational experts. These experts are non-teaching staff engaged with innovation in education at the TU/e. The aim of this session was to convert the findings in the affinity diagram into design ideas that we could further iterate upon. Lastly, the design ideas were combined into an interactive prototype, that was further tested by participants and resulted in some final feedback for implementation of the actual interface.

Results

The results can be divided over 6 main topics. The following section will present each topic with quotes to support it. Behind each quote the participants; (Age (Nr.), Gender (M/F), Years in department (Nr. + YiD); Appendix) is mentioned. An example would be: (19, M, 2 YiD; A7) is this example the participant is a 19 year old male in his second year in the ID department.

Current experience with CS

The participants were asked about their experience with crowdsourcing. The biggest part of the participants did not know what it is and lot of them confused CS with crowdfunding: *"I don't know exactly what it is. I know that, you know, it's like Kickstarter and you ask people to fund your project, but I don't know specifically."* (19, M, 2 YiD; A1) Although crowdfunding is a form of crowdsourcing, it is not the same. There were already a couple of participants that had contributed to CS platforms, but this was only a small part of the participants. *" I actually participated myself in design challenges, just to kind of earn some money, if possible."* (19, F, 2 YiD; A2) . The students know that the chance of winning is very small, which can be disappointing.

First impression of proposal

The majority of the participants reacted positively towards the proposal, although teachers had an overall more critical view of the concept than the students. These results are further elaborated in the quantitative results section.

Support

The following question was in the interview: *"What kind of help do you expect from the university?"* The answers can be divided into the following categories:

1. Hand-in check

A teacher made the following statement: *"The teacher' responsibility is to say okay, you're able to enter this stuff, your level is good enough. This prevents them from, let's put it very bluntly, making a fool of themselves by entering this contest."* (60, M, 27 YiD; A3) This category contains statements about the responsibility of the university to preserve the student's reputation.

2. Step by step

The students explain that they need a clear time schedule and assignments. Not every student will know where to begin, or how they are suppose to plan their time. Students will need deadlines and iterations, just as any other course.

3. Boundaries

There should be clear boundaries set by the university that determine the number uploads a student is allowed to make. The student needs to know what is expected.

4. Course structure

"I think it's really important to structure the course differently. So that you replace another assignment by this crowdsourcing thing." (20, F, 2 YiD; A 4) This category explains the

obvious, if there will be CS tasks in education, they will have to replace fictional assignments in the course.

5. Other

Some courses do not have regular deliverable files. An example for this is Digital Craftsmanship. The end product for this course is an algorithm, which generates a pattern. The CS platform will need to support these kind of files. Secondly, for some assignments the course will need extra user/context information to fully reach the potential of the learning goals. CS platforms will need to be able to provide this kind of extra information.

Motivation for doing the task

Managing expectations will be important, that is why understanding the students' motivations is crucial.

1. Realistic tasks & application of skills

Contributing to a CS platform will ask for more professional skills, which is beneficial for the students learning process. A teacher made the following statement: *"The students only start seeing the value of the theory when they actually start working on the practical stuff."* (60, M, 27YiD;A1 2).

The students believe that realistic tasks will give them a sense what companies actually look for within the field of design and how the students can contribute to it with the skills that they have. The following student was asked what an industry related task adds to a course: *"I think having experience from outside of the theory. Breaking free from the theoretic bubble .Because then you get a sense of what companies actually want and expect from designers."* (20, M , 2 Y i D ; A 5)

Another student was asked the same question: *" I think it makes it more touchable. Sometimes it's really an abstract concept and when you see it really be made and be used by companies, then I think you both have a better match between your skills and the companies' requests."*(20,M,2 YiD; A6)

By applying their skills directly to a real life case, the purpose of the course is explained with a very practical example that the student can take place in. *" I think it's quite interesting that you try to combine the skills that you pick up in a course and immediately apply them to a real case."* 7 (19,M,3YiD;A)*"you can see what you can do in the future, what industrial design is made for"* (21, M, 2 YiD; A 8).

Because of these reasons the students expect that they will have a higher motivation and feeling of purpose, and therefore be happier.

2. Recognition & competition

The following statement explains students thoughts about the benefits of competition & recognition from CS tasks. *"I like the fact that you now are trying to give an extra dimension to a final exercise and instead of trying to do your best for a grade, you're also trying to do your best to win something and to actually achieve something with your final deliverable."* (20,M,2YiD;A1 3)This statement clearly shows that students will be

motivated by being able to compete for recognition and prize money. Almost half of the students explicitly mentioned this.

Students are convinced that real cases are beneficial for their portfolio. *"If you're a student and you do win that challenge, or you get an honorable mention or whatever, it contributes largely to your portfolio, since you won something which you can already show."* (20, M, 2 YiD; A9) A possible downside to the competition element was detected, which is that students might compare themselves with professional designers on the platform which could make them feel insecure. *"Well, it could also make you perfectionistic and feeling not good enough maybe, because you will probably compare yourself with designers that are much, much better than you are. So it could make you a little bit insecure, I think."* (20,F,2YiD;A1 4)

3. Network

The participants think that CS platforms could provide networking opportunities. *"You get a connection with the real world, and in larger projects, or projects with more, like, clients involved, you have an opportunity to build a network, just like when you would have clients in your design projects."* (25,M,1YiD;A1 0)

4. Experience is more valuable than money.

Students emphasize that the experience is more important than the money from winning a CS task. *"So the money will be a bonus perhaps, but I'm not sure if it's necessarily a very important addition. I think many people would do it anyway if they didn't get money, because you took the course that you wanted to."* (19,M,3YiD;A1 5). The chance for a student to actually win the prize money is not very high, considering all the participants in the CS task. *"I think a lot of people just participate not expecting to win this."* (19,F,2YiD;A3 0)

Co-creation session

From the co-creation session information was retrieved, which was mainly pointed towards visualizing a platform for integrating CS into education. The session consisted of a part where sketches were produced by all participants (example sketches in Figures 6 & 7), followed by an extensive discussion. This information can be divided into two categories: profiling and interface.

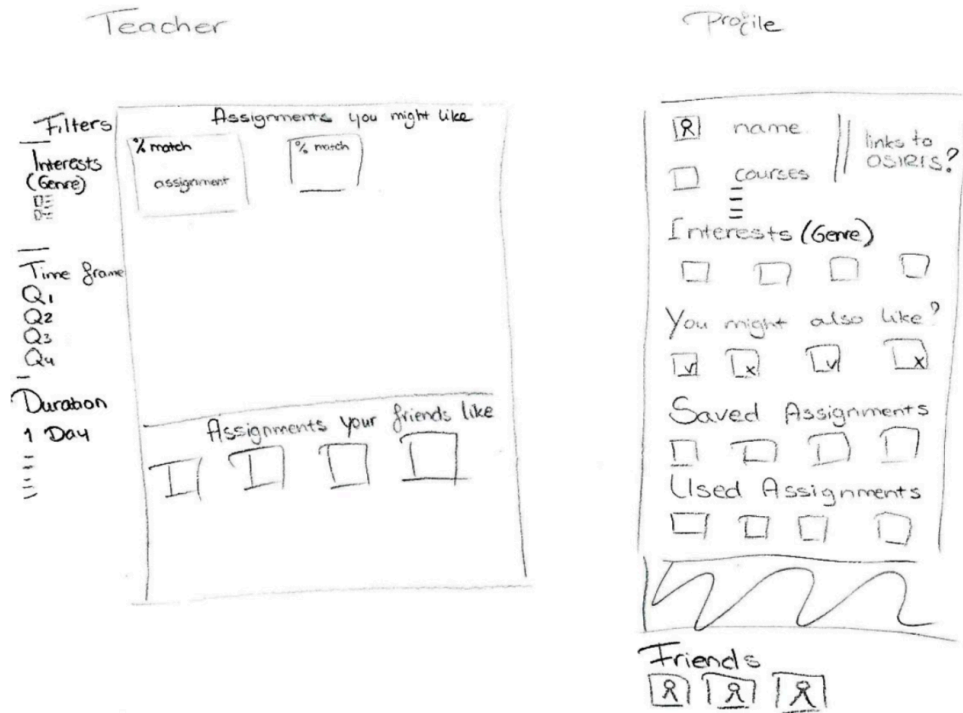


Figure 6: One of the resulting sketches from the co-creation session, depicting community profiling.

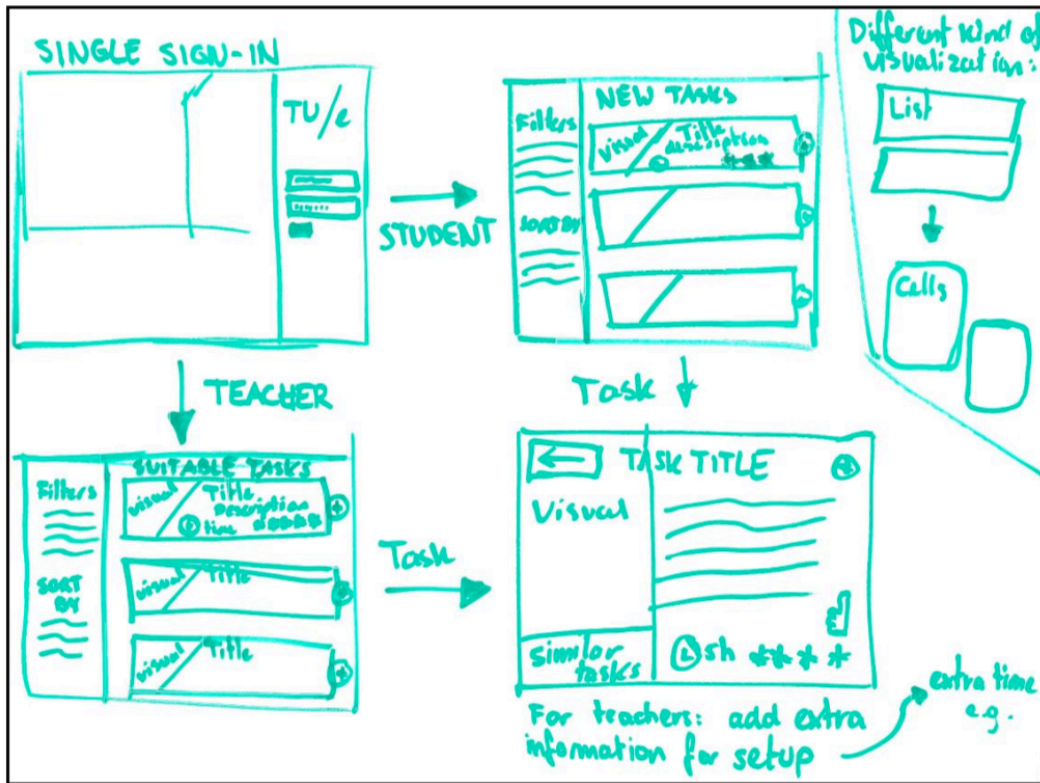


Figure 7: One of the resulting sketches from the co-creation session, representing the workflow.

The following results were derived from the discussion in the co-creation session. The results are sorted by relevance for this project:

1. *Category-based search engine*
2. *Ability to save or like a task*
3. *Offer companies the chance to add their challenge to the university directly.*
4. *Further elaborate the match to vision & course: Go more in depth on how the match to the course is synthesized, with a more elaborated visualization.*
5. *Search for CS tasks to choose elective*
6. *Nugget task: This is a small tasks which can be done is a small amount of time*
7. *Bronze, silver, Gold: Earn badges according to experience and results on the platform*
8. *Earn XP on the platform: XP stands for experience points*

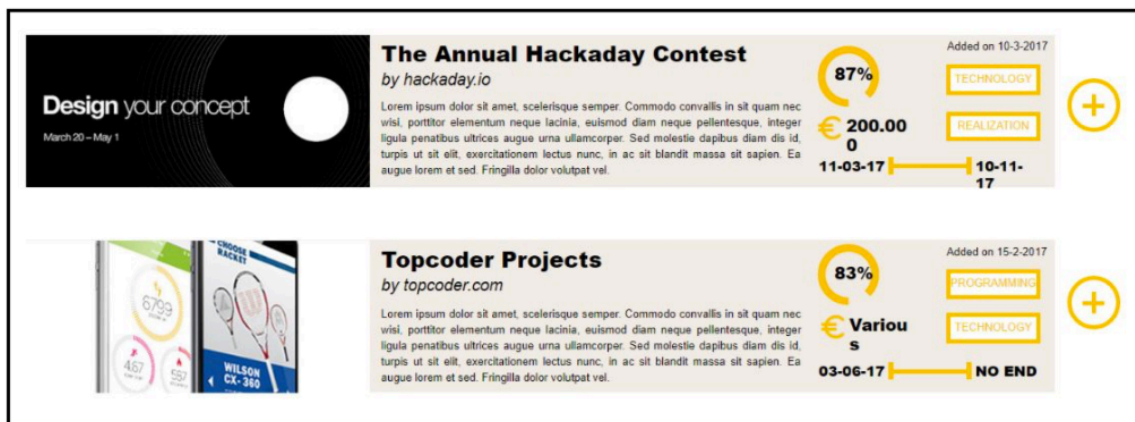


Figure 8: A screenshot of the page with the search engine list of the interactive prototype that was developed prior to actually developing Educrowd.tue.nl

Activity 2: Web Crawler Data

Part of the software developed for Educrowd.tue.nl is a webcrawler. The crawler gathers data from the following eight design CS platforms:

- topcoder.com
- jovoto.com
- eyeka.com
- battleofconcepts.nl
- hackaday.io
- 99designs.nl
- desall.com
- innocentive.com

A preliminary analysis of the crawler data reveals that there is a plethora of available tasks but most of them come from one platform (Table 1).

Table 1: Most tasks are of graphic design nature and stem from one platform

CS platform	Number Of Tasks (between 26/6/17 to 11/8/17)
99designs.nl	1151
topcoder.com	184
innocentive.com	69
jovoto.com	46
eyeka.com	24
desall.com	8
battleofconcepts.nl	4
hackaday.io	2
sum	1488
avg	186
sd	394.5025801
avg/platform	55.83333333

Table 2: Distribution of tasks posted on a certain date (from 26/6/17 to 11/8/17). The average prize of money available per day is 141,883.5 (SD=184107). Since prizes are in different currencies, but mainly in USD and EUR, the figure of more than 140K can be roughly estimated to be of USD (\$).

Date Tasks Posted	Number of Tasks on that Date	Prizes Total (currency agnostic)
01/07/17	5	11700
30/06/17	10	16750
08/07/17	1	1500
14/07/17	5	25500
15/07/17	2	3750
22/07/17	5	7746
13/07/17	12	13350
29/06/17	2	7501
03/07/17	1	2250
12/07/17	10	15350
18/07/17	6	21948
27/06/17	8	2800
28/06/17	7	8150
16/07/17	1	2499
19/07/17	1	12000
21/07/17	4	17499
27/07/17	133	152756
02/07/17	2	4250
05/07/17	2	2500
26/07/17	76	122055
11/07/17	5	4610
28/07/17	76	113647
17/07/17	2	3279
08/08/17	69	41817
10/07/17	3	3470
06/07/17	18	86510
26/06/17	39	253485
07/07/17	6	12150
09/07/17	12	42840
29/07/17	84	54076
03/08/17	87	118990
20/07/17	65	2523125
10/08/17	69	94336
06/08/17	119	119045
09/08/17	63	41283
11/08/17	82	66394
02/08/17	104	56628
07/08/17	79	194734
31/07/17	60	61934
30/07/17	78	45073
01/08/17	75	272067
sum	1488	4661347
avg	36.29268293	141883.5
sd	39.84234174	184107.2713

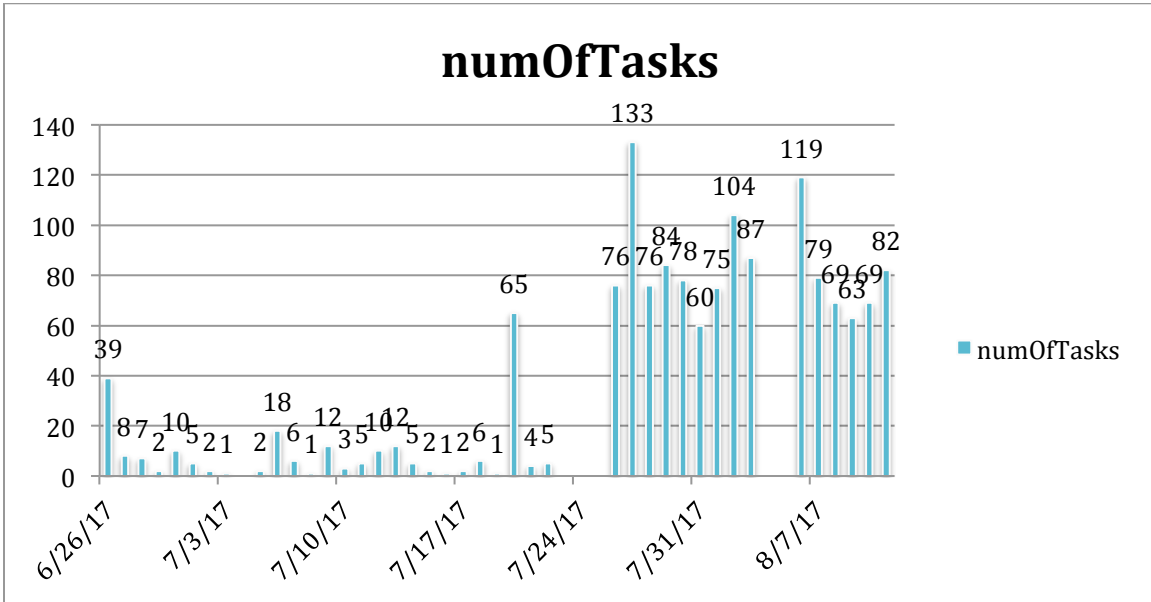


Figure 9: graphical representation of Table 2. Clearly there are some days in which many more tasks are published. The crawler could therefore serve as a notification system for both students but also CS companies.

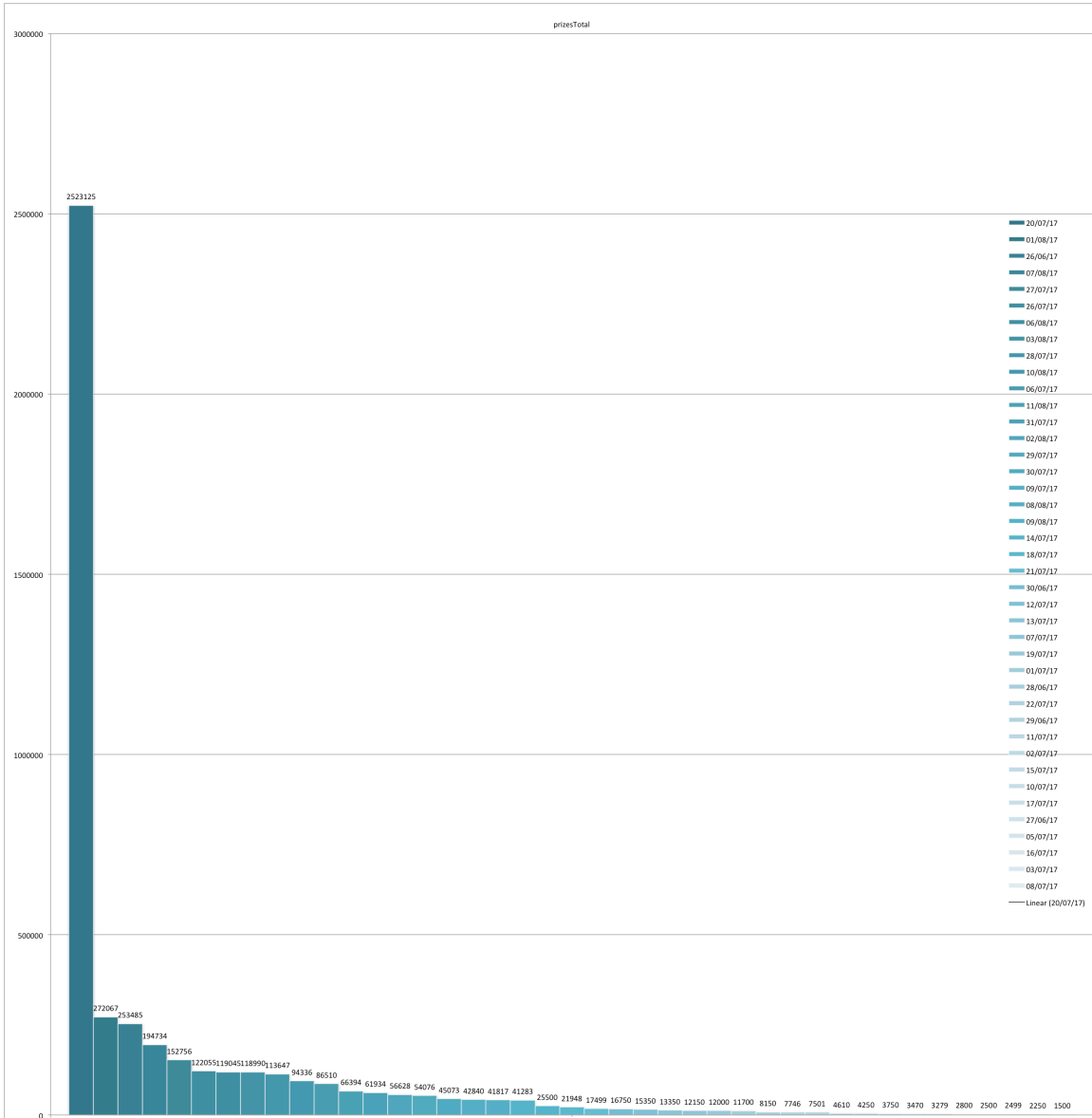


Figure 10: graphical bar chart of Table 2 data. Prize reward distributed over time and ordered according to value. There was one day (20/07/2017) that the eight CS platforms we were crawling had an accumulated value of prize money or more than 2.5M.

One can conclude that this crawler could in the near future serve as a “barometer” of the status of design tasks that are published in CS platforms. Future work would necessitate the inclusion of more platforms and a more accurate crawling of data.

Activity 3: Educrowd.tue.nl

In this part of the report we present Educrowd with screenshots. The platform is accessible at: <http://Educrowd.tue.nl>.

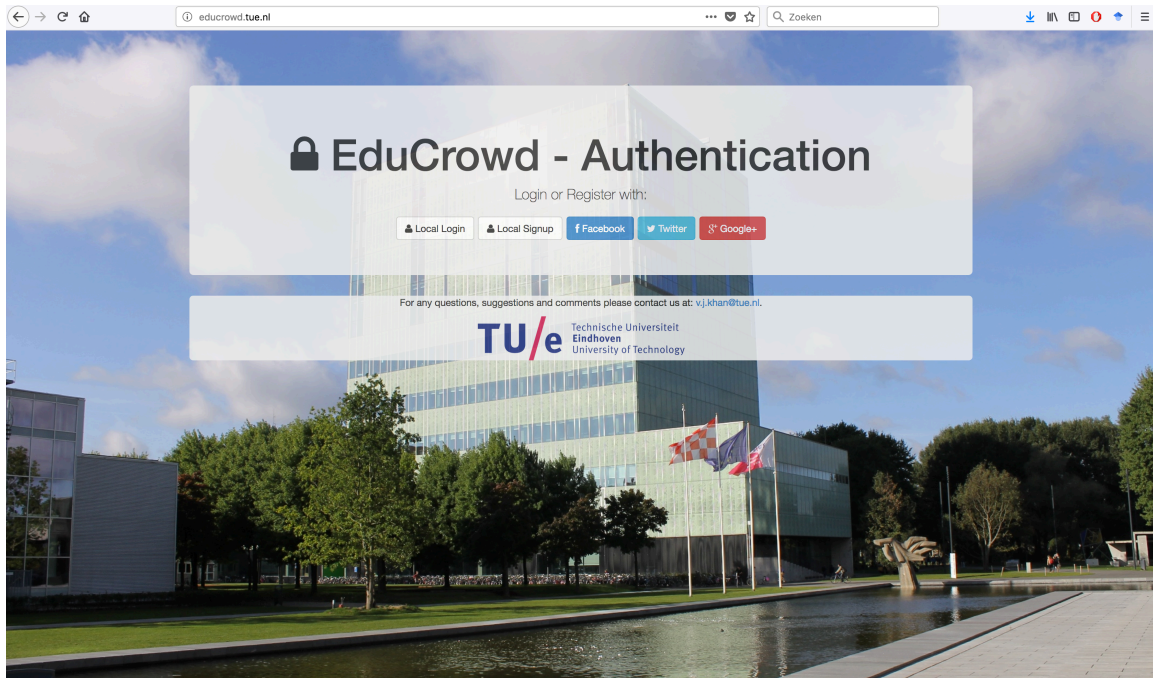


Figure 11: homepage of Educrowd. One can login with their favorite social media accounts or choose their own email and sign up.

Filters:

Expiration days: 0...30

Prize: 0...20000

Status: active completed (other)

Themes:

- Technology & Realization
- Creativity & Aesthetics
- User & Society
- Business & Entrepreneurship
- Math, Data & Computing

Platforms:

- topcoder.com
- jovoto.com
- eyeka.com
- battleofconcepts.nl
- hackaday.io
- 99designs.nl
- desall.com
- innocentive.com

Selected Tags:

CallClever — Modern contemporary logo for virtual call answering service @99designs.nl

Designers from around the world are submitting creative designs for reuFk in logo design - bronze.

Technology & Realization Creativity & Aesthetics User & Society Business & Entrepreneurship Math, Data & Computing

posted:today expires:next Thursday

74% \$229

logo design designers

business & consulting

Left Hand Blue — Talent Booking Agency needs hand-crafted watercolor logo @99designs.nl

Designers from around the world are submitting creative designs for jaimeywb in logo design - bronze.

Technology & Realization Creativity & Aesthetics User & Society Business & Entrepreneurship Math, Data & Computing

posted:today expires:next Thursday

74% \$299

logo design designers

business & consulting

EBT Solutions — Design logo for new worldwide commercial pilot training program @99designs.nl

Designers from around the world are submitting creative designs for michaelvarney in logo design - silver.

Technology & Realization Creativity & Aesthetics User & Society Business & Entrepreneurship Math, Data & Computing

posted:today expires:next Thursday

74% £379

logo design designers

business & consulting

ActionPoint Advisors — Startup Analytics Consulting Firm - New, Unique Service to Traditional Audience @99designs.nl

Designers from around the world are submitting creative designs for lmillerrx in logo design - bronze.

Technology & Realization Creativity & Aesthetics User & Society Business & Entrepreneurship Math, Data & Computing

posted:today expires:next Thursday

74% \$299

logo design designers

business & consulting

Figure 12: main screen of Educrowd

72h Admin App - Group and User Management Enhancements

Code TCO18 Angular.js (1.0) CSS HTML JavaScript REST AWS

Review “72h Admin App - Group and User Management Enhancements” @topcoder.com to help EduCrowd offer better recommendations:

Please rate the following statements:

- * The task matches my courses' learning objectives disagree agree
- * The task is original disagree agree
- * The task is attractive disagree agree
- * The task is flexible for integration in Education disagree agree

Just focus on the content of the task and do not mind the task's deadline (it might have already expired)

In which of the following themes does this task belong?

- * Technology & Realization
- Creativity & Aesthetics
- User & Society
- Business & Entrepreneurship
- Math, Data & Computing

* Please give an overall rating for this task:

☆☆☆☆☆

Figure 13: by clicking on a certain CS task a user (in our case students and teachers) could rate a certain task in four dimensions. Based on their rating the recommender system builds a profile and then bases recommendations upon.

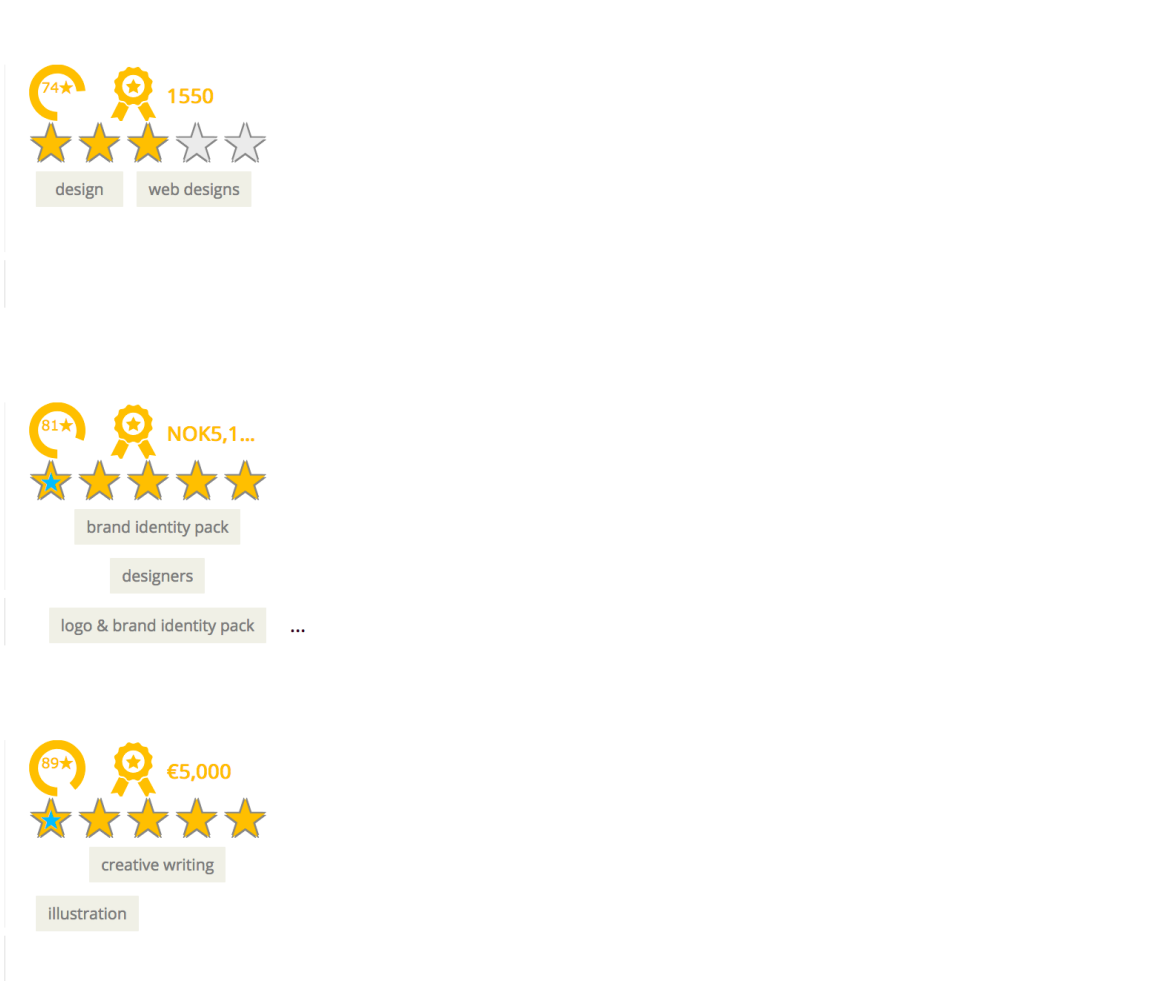


Figure 14: close-up of right part of the main screen. The result of the recommendation is seen first in a certain percentage that matches a student’s profile. Furthermore, tags from the CS platform and a personal and community rating is represented in stars. Finally, the prize money is seen.



Figure 15: detail of EduCrowd's footer

Activity 4: Educrowd.tue.nl Data

As earlier mentioned, a group of 10 ID students were asked to daily browse EduCrowd.tue.nl. A preliminary analysis of their ratings is not a positive one.

In the first question (matches course's learning objectives) the average rating is $M=1.7$ (scale from 0 to 4, min: 0, max: 4).

In the second question (task is original) the average rating is $M=2.2$ (scale from 0 to 4, min: 0, max: 4).

In the third question (task is attractive) the average rating is $M=2.3$ (scale from 0 to 4, min: 0, max: 4).

In the fourth question (task is flexible) the average rating is $M=1.7$ (scale from 0 to 4, min: 0, max: 4).

Please rate the following statements:

- * The task matches my courses' learning objectives disagree agree
 - * The task is original disagree agree
 - * The task is attractive disagree agree
 - * The task is flexible for integration in Education disagree agree
- Just focus on the content of the task and do not mind the task's deadline (it might have already expired)

In which of the following themes does this task belong?

- * Technology & Realization
- Creativity & Aesthetics
- User & Society
- Business & Entrepreneurship
- Math, Data & Computing

* Please give an overall rating for this task:



Figure 16: screenshot of the ratings 10 ID students were asked to daily perform for two weeks.

Activities realized with the given budget

Table 3: Activities realized with the given budget

Activity	Amount of money spent (in Euros- including VAT)
Hiring Masters' student assistant	3321.47
Hiring Bachelors' student assistant	1200.57
Transcription service for audio records of interviews	807.79
Hiring third-party development company (including server costs)	18150
Topping up funds M Turk crowdsourcing study	84
VVV coupons for participants' incentives	727.50
Total:	24291.33

Conclusion

Crowdsourcing is a rapidly growing concept that is slowly integrating the design world, online. Due to the abundance of online tasks, crowdsourcing has the opportunity to be implemented into education. Motivation, match to the learning objectives and support from the university are among important factors to realize this.

Regarding the attitude of students and faculty towards the integration of crowdsourcing in design education we can conclude that the majority of staff and students reacted positively towards the proposition of integrating CS into ID education. Only 17% of participants were negative about the concept, which shows that there is wide support for integration of crowdsourcing in education. But, we also find that students and staff do require that the integration is properly evaluated and well organized, before it is fully implemented into the educational model. Generally teachers were more critical than students, when it comes to the integration of CS. They tend to see more bottlenecks and technical complications, but it is unknown whether this is due to staff having a different (more time-consuming) role in the process, or because they have a more critical view in general. This positive attitude though is not entirely backed up by EduCrowd's recommender system data (from two week study with 10 ID students). Students' average rating was $M=1.7$ (scale from 0 to 4, min: 0, max: 4). However, they thought that the tasks presented in EduCrowd were original ($M=2.2$; scale from 0 to 4, min: 0, max: 4) and attractive ($M=2.3$; scale from 0 to 4, min: 0, max: 4).

Regarding important criteria for students and faculty when selecting crowdsourcing tasks to fit within design education we can conclude that "matchmaking" between available tasks and a student's profile was deemed important. This finding lead to the

development of Educrowd.tue.nl, a recommender system (among others) that aims to be the virtual matchmaker. A rather surprising result is that it is not money, but the task experience itself, which is the greatest motivator for students. Students tend to perceive the prize as an added bonus for putting in a lot of work, but they claim to get their main motivation for working in real-life projects.

Regarding the most convenient medium to implement the integration of crowdsourcing in design education we can conclude that Educrowd.tue.nl is an important first step in addressing the matchmaking need that was previously described. The results from the co-creation session showed that not only the researchers involved, but also the educational staff was considering this database-driven recommendation system.

Future planned activities

1. Presentation at the National Interdisciplinary Education (NIE)² 2018 conference on the 30th of January 2018. Our abstract has already been accepted for presentation at the main session of the conference. One of our main goals beyond presenting the results of the project is to find partners to continue the research and development of EduCrowd
2. Presentation at TU/e Innovation Day on the 31st of January 2018
3. Submission of the research efforts to one of the following conferences: Human Computation (HCOMP) 2018³; or to the 21st ACM Conference on Computer-Supported Cooperative Work and Social Computing (CSCW) 2018⁴.

Acknowledgements

I would like to thank from the bottom of my heart Ros Felix, master student at the time at ID and bachelor students: Ko Derks, Willem van de Loo and Bjorn Schulpen for their initial involvement in the project. Parts of this report are based on their final report, in turn part of their educational activity: research project in the Design for Creatives squad of the ID department. I would also like to thank Mrs. Chantal Brans for her active involvement in this project. Her expert advice assisted us in several crucial parts. Furthermore, I thank all the participants of our research studies together with all the individuals who provided feedback on our process and final deliverable. Finally, I would like to extend my gratitude to both my co-investigators Migchiel and Panos for their continuous support throughout the project.

² <https://www.nie-conference.nl/>

³ <https://www.humancomputation.com/>

⁴ <https://cscw.acm.org/2018/>

References

Malone, T.W. & Laubacher, R.J. (1999). The Dawn of the E-Lance Economy. Nüttgens M., Scheer AW. (eds) *Electronic Business Engineering* . Physica, Heidelberg. doi:10.1007/978-3-642-58663-7_2

Howe, J. (2006, June). The Rise of Crowdsourcing. *Wired magazine* , 14(06), 1-5.
http://sistemas-humano-computacionais.wdfiles.com/local--files/capitulo%3Aredes-sociais/Howe_The_Rise_of_Crowdsourcing.pdf

Howe, J. (2008). Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business. *Wired magazine*. <http://bizbriefings.com/Samples/IntInst%20---%2012Crowdsourcing.PDF>

Khan, V. J., Dhillon, G., Piso, M., & Schelle, K. (2016). Crowdsourcing user and design research. *Collaboration in Creative Design* (121-148). Springer International Publishing. doi:10.1007/978-3-319-29155-0_

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology* , 3(2), 77-101.