

# Participatory Evaluation as Starting Point to Design for Smarter Learning Ecosystems: The UTOV Case History

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**Abstract.** In the recent past it has been shown that participatory evaluation constitutes an alternative approach to traditional benchmarking of learning ecosystems capable to provide an insight on the smartness of universities and schools. Such alternative approach has also been shown capable to make emerge problems and desiderata from the opinions of all players involved in the educational processes.

In this paper we report on the outcomes of a participatory evaluation process carried on along three years at the University of Rome Tor Vergata to show how one can use them to go beyond the evaluation stage and guide a bottom-up design process to foster the achievement of smarter learning ecosystems.

**Keywords:** Smart learning ecosystems · Participatory evaluation · Design for smart learning ecosystems

## 1 Introduction

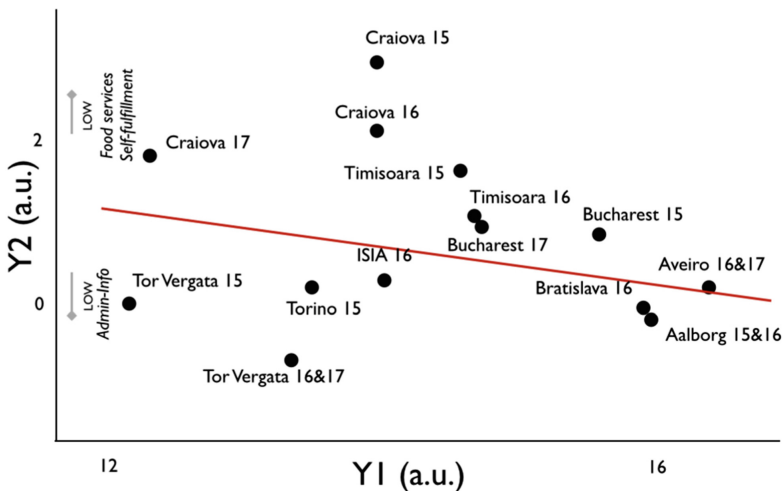
In the recent past we have shown that usual approaches to University benchmarking, although useful to catch the interdependence between campuses and pertaining territories on macro socio-economical basis (Giovannella 2014), are not capable to intercept the criticalities of the local contexts and, as well, expectations of the players involved in the learning processes. In particular they fail in identifying the multidimensional wellbeing state of the students that, after all, are the main target of the learning processes.

To make emerge descriptions of the learning ecosystems closer to students' feelings and expectations - and when possible also to those of the other players involved in the learning process (teachers, technicians, parents, territorial stakeholders) - ASLERD (ASLERD 2015) has developed a bottom-up participatory evaluation procedure (Giovannella 2015) that has been tested and validated on several European Universities (Giovannella et al. 2015; Giovannella et al. 2016) on a three years period by now. ASLERD approach allows to perform a multidimensional evaluation of the learning ecosystems and to work out a set of numerical indicators and indices (see for example Table 1). These latter serve as basis to perform a principal component analysis (PCA) (Jolliffe 2002; Hotelling 1933) and compare the levels of smartness achieved by the campuses. Accordingly to this procedure, the overall smartness of the University of Tor Vergata appears to be quite limited when compared with most of the other campuses

(see Fig. 1) involved in the validation procedure, and did not changed substantially along the period of observation: three academic years (see Table 1).

**Table 1.** Mean values and standard deviations of the indices worked out from the answers given to the quantitative questions of the ASLERD questionnaire. The data refers to the academic years: 2014–2015, 2015–2016, 2016–2017.

Dimension	2014–2015	2015–2016	2016–2017
Infrastructure	5,86 ± 0,23	5,60 ± 0,23	5,96 ± 0,23
Food service	5,94 ± 0,22	6,23 ± 0,20	6,28 ± 0,19
Environment	6,35 ± 0,25	6,6 ± 0,20	6,87 ± 0,21
Access to admin service and info	5,91 ± 0,20	5,83 ± 0,20	5,95 ± 0,17
Mobility	6,40 ± 0,24	6,61 ± 0,20	7,14 ± 0,18
Safety	6,24 ± 0,26	6,88 ± 0,25	6,91 ± 0,21
Socialization support	5,28 ± 0,22	5,72 ± 0,20	5,99 ± 0,22
Challenge	5,38 ± 0,20	6,09 ± 0,19	6,23 ± 0,18
Satisfaction	6,85 ± 0,22	6,92 ± 0,18	7,21 ± 0,20
Self-fulfillment	6,98 ± 0,21	7,22 ± 0,17	7,41 ± 0,17



**Fig. 1.** Positioning of the universities on the plane identified by the two principal components, Y1 and Y2. Y1 and Y2 have been derived from a PCA applied to a reduced set of indices: Infrastructures, Food services, Access to admin service and info, Support to socialization, Challenges, Self-fulfillment selected as explained in (Giovannella et al. 2016). The red line indicates the direction of increasing “smartness” (from left to right).

Beside multiple choice questions useful to extract numerical indicators, ASLERD questionnaires contain also open questions aimed at making emerge criticalities and expectations on each one of the dimensions that contribute to define the level of smartness of a learning ecosystem (Giovannella et al. 2015). To have a better insight on students’ feeling we decided to analyze the answers they gave to such open questions.

The outcomes have been used as input to start a bottom-up design process aimed first at engaging and empowering students to foster an support the campus evolution toward the achievement of a higher level of smartness.

In the following, thus, we present first the outcomes of the text analysis and, then, we show how they have been used as input of a design process intended to mitigate the problems emerged from the survey. Main goals of the design process have been the creation of new services to be used on mobile phone and the improvement of some of the existing ones. To conclude we describe the outcomes of the on-going participatory validation procedure of the proposed solutions.

## 2 Data Analysis

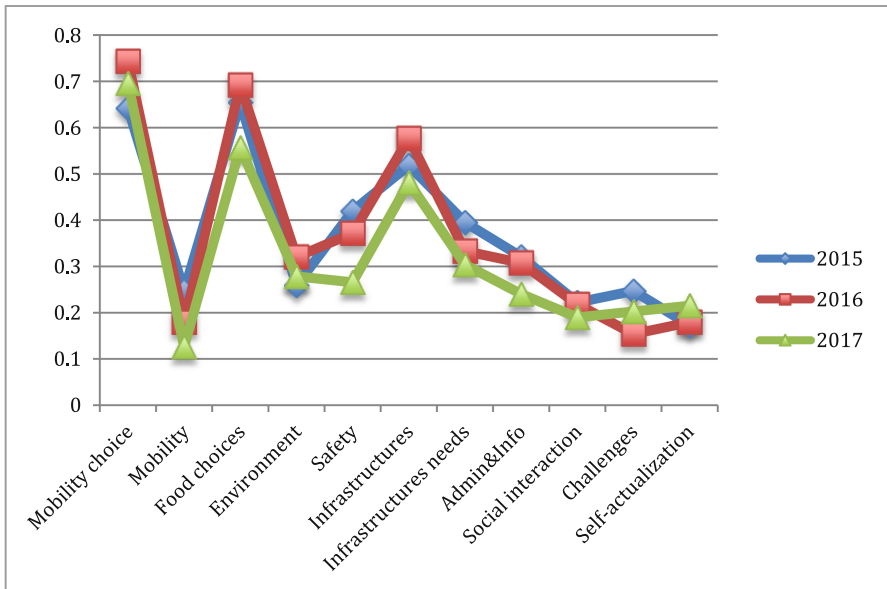
During last three academic years (a.y.) the ASLERD questionnaire for Campuses has been filled by a sample of students of the Tor Vergata University, mainly bachelor ones, attending curricula either in the scientific and in the humanistic domains. 81 students took part in the survey during the a.y., 2014–2015, 78 students in a.y. 2015–2016 and 80 in the present a.y. Overall, about 30% of the respondents were male and 70% female. In all three runs we observed a similar “fatiguing” effects: around 70% of the students answer the first open questions while the last one was answered by around 20% of the participants (see Fig. 2). All multiple choice questions, on the other hand, were answered by more than 90% and only a small fatiguing effect were observed. These are observations that guarantee the trustability of the collected data (see Ref. (Giovannella et al. 2016)).

The numerical outcomes (mean values and standard deviations) worked out from the multiple choice questions are reported in Table 1. It is worthwhile to stress that they stabilize – with oscillations of the values contained within 1–2% - any time 40–50 people of a given population answer ASLERD campus questionnaire.

The meaningful increase of some of the indicators (more than one standard deviation), between a.y. 2014–2015 and 2016–2017, highlighted in grey, is mainly determined by the involvement of a larger number of students attending humanistic courses with respect to those involved in a.y. 2014–2015 survey. If we compare the outcomes of the surveys carried on during a.y. 2015–2016 and a.y. 2016–2017 no meaningful variations can be detected and this is well explained by the similarity of the composition of the student populations. Students attending humanistic courses, in fact, seem to have a better feeling on some of the aspects that contribute to the determination of the overall smartness of the campus.

As stated above, the questionnaire includes also open questions that were formulated to make emerge explicitly the criticalities hidden behind numerical evaluations (indicators and indices) and to address all topics that contribute to the overall level of smartness of the campus and, thus, to the student wellbeing. Here below we report the outcomes of the text analysis that has been performed on the answers given by the students to the open questions.

It is worthwhile to stress that comparing the three data sets, the overall emerging landscape did not change substantially.



**Fig. 2.** Percentage of people who answered open questions as function of the order of presentation of the questions for academic year 2014–2015 (blue), 2015–2016 (red), 2016–2017 (green).

**Mobility.** On average more than 40% of the students use private transportation because the public transportation system is not considerate adequate: the suburbs are not fully covered and often multiple connections must be used by people living in there; often the transportations are crowded, the traveling time too long and service frequency too low. On the other hand public transportations are used to spare money and by people that have no alternatives. Cars are used because parking is not a problem at the University, because no time has to be lost in waiting for a bus and, overall, to feel free to move at any time. Bikes are, basically not used because biking in the city is considered very dangerous due to the heavy traffic and to the travelling speed of the cars.

**Internal Mobility.** Since the campus is one of the largest in Europe students are required to cover quite relevant distances to move between faculties and to go to the student canteen (this is particularly true for the students of the science faculty). No internal shuttle service is available and displacement with public transportation may be quite time consuming. In addition students claim that the indoor signage is quite outdated and this does not allow always to find classes, offices and professors' rooms. Similar problems about signage have been detected also in Aveiro (Galego et al. 2016).

**Food services.** A large number of students think that having a lunch at the student canteen is too time consuming either because of the time of the displacement and because of the queue that could be quite long, depending on the time slot chosen. Often the break they have at lunch time is not long enough. On the other hand, food sold by faculty bars is not considered to have an interesting quality/price ratio. Because of this most of the

students try to avoid to have a lunch in the Campus and when strictly necessary they bring a lunch-box from home.

Similar problems have been detected also in Aveiro (Galego et al. 2016) and in Trento (De Angeli, 2014).

**Environment.** Two are the main students' concerns. The first one is related to the maintenance of the green spaces (mainly grass cutting and plants care) and of the urban furnishings (park benches, vases, etc.) The second one concerns the separate waste collection that seems not to be practiced in a satisfactory manner: often the bins for the separate waste collection are missing or full.

**Safety.** Surveillance of large area of open parking is quite problematic and in fact the main complaint is for car thefts and damages and, as well, for the lack of controls. We may note, however, that the percentage of students that answered the open question about safety is consistently decreased in a.y. 2016–2017, see Fig. 2, possibly to indicate that such criticality may have diminished with the time.

**Infrastructures.** Maintenance of the infrastructures is one of main criticality that emerges from the survey. The status of chairs, desks, air conditioners, etc. tends to get worst and worst with the time, while equipments tend to get obsolete. The wi-fi connectivity is slow and intermittent. In some cases the classrooms are too small and only few places for students to study or socialize are available. Often students have to go around to find for available spaces (ex. unoccupied classrooms). The lack of a sufficient number of spaces dedicated to student activities has been detected also in Aveiro (Galego et al. 2016).

**Administrative and info services.** Information relevant for students provided by the university website are considered incomplete or difficult to be found. Digitalization of the administrative services are not complete and often students are obliged to go to the student administrative offices with the risk to stay for quite a bit in the queue. Getting in touch with professors seems also quite complicated.

**Social interaction.** Concerns on the support offered by the University to the social interaction are focused on two main topics: (a) a quite limited number of cultural and sport activities; actually the university has no strong and organized student unions; the few existing associations are not interacting among them, promote only rare events and haven't reasonable aggregation spaces; (b) the limited and sporadic activities dedicated to job-linking, networking, a better knowledge of the territory and, more in general, the presentation of opportunities for the students. Criticalities listed in (b) have been detected also in Aveiro (Galego et al. 2016).

**Challenges.** Strictly correlated with the issues listed at the letter (b) of the previous topic (*social interaction*) are the complaints about the reduced number of challenges that involve students: projects, collaborations, lab activities, etc. It is very important to

stress a trend that is very general for Italian learning ecosystems: students feel themselves under-challenged with respect to the competences that they think to have developed.

In fact they feel more *satisfied* and *self-fulfilled* than challenged.

Students, apart few exceptions do not complaint about the quality of the teaching but, rather on the possibility to transfer learning on practical activity and on the possibility to transform knowledge into skills and competences.

Considering all above, the emerging picture is that of a campus characterized by a limited capability to attract the students. Not by chance the main reason to choose the campus is its proximity to home. Immediately after comes the uniqueness of the curricula (chosen mainly by students involved in scientific curricula). Only about 25% have chosen the campus on the basis of the perceived quality of teaching and learning. At the end students seems to be quite happy with teaching and their personal development, but due to the criticalities described above *do not develop a sense of belonging*.

### 3 Design for Smarter Learning Ecosystem

To go beyond the evaluation phase and to empower students, the outcomes of the ASLERD questionnaire has been used to involve some students attending the degree in Media Science and Technology in a design process aimed at identifying solutions capable to mitigate the criticalities emerged and, thus, to help the campus to achieve a higher degree of smartness and student to increase their wellbeing. After a brainstorming activity focused on how to achieve, at least partially, the expected goals the focus has been concentrated on the design of an application for smartphone capable to offer a set of services, summarized here below.

**Mobility.** To mitigate the problems with external and internal mobility the app will offer a trusted car sharing service. An additional proposal is to offer also a bike sharing service for internal displacements but of course this is a service that would imply also a commitment by the University or by private investors. Another service offered by the app will be an interactive map of the campus that is expected to integrate also information on spaces (e.g. free classrooms) that could be used to carry on students' activities and the availability of professors and assistants.

**Food services.** The app will offer the possibility to see the menu of the week, to make her/his own choice and to reserve the preferred time slot to take a lunch, provided that the student has demonstrated her/his trustability. The aim is to mitigate the queue problem and, thus, reduce the time needed to have a meal. Another goal is also to optimize food consumption and preparation time with the hope to favor the increase of food variety and support the preparation of special food for those who need it. An app with similar functionalities, iFame, has been developed by the students of the Trento University (De Angeli 2014).

**Environment.** The interactive map offered by the app will provide information on the position of the collection points that allow to operate the separate waste collection and on the filling status of bins and dumpsters.

Another functionality will allow the students to report about maintenance problems (green space and urban furnishings) and to organize maintenance activities.

**Safety.** As for the environment section the app will allow to report on safety problems with the aim to develop a map (space and time) of the critical issues and support the University in organizing a better surveillance service.

**Infrastructures.** Again the app will allow to report on problems. In addition it will allow to monitor the time that will elapse from reports to troubleshooting by university. It will also allow students to organize, in special case, voluntary troubleshooting.

**Administrative and info services.** As for *Food services*, the app will allow to book appointments with student secretary and teachers and, as well with any other relevant structure offering services within the University. This to avoid queues and time wasting for students, but also to improve the efficiency of the University services.

**Social interaction.** The app will offer the possibility to organize events and activities and to look for the needed human resources. Moreover the app will propose a rewarding mechanism (credits) that can be used to get discounts, priorities or that can be exchanged to get help from other members of the community.

**Challenges.** The app will offer the possibility to announce or launch challenges either internal to the University and external, i.e. proposed by companies, associations, municipalities, etc. Also room to report on the outcomes of the participation in the proposed challenges will be provided.

Overall the application aims at facilitating the constructive interaction among the players involved in all activities of the learning process in order to mitigate criticalities and solve problems, if possible in a participatory manner. It is also intended to support the development of a truly student community and to take as much as possible advantage of all the available opportunities that may derive from collaboration and cooperation.

Very simple rewarding mechanisms have been included to challenge students, provide advantages and strength relationships. Much more could be done on the gamification of the processes but it will be left to future revisions of the proposed application.

Before to start the development of a medium profile prototype we have put in place a validation process that was intended to involve more students. Preliminary outcomes of this on-going process are described in the following paragraph.

## 4 Design Validation and Conclusions

Taking into account the goals of the application we have prepared a new questionnaire to involve a consistent number of students in the validation of the proposed solutions. In Table 2 we report a summary of the questions that have been asked and the outcomes

of the validation process. 125 students from all University faculties took part in the validation procedure, about 30% of them were male and 70% female. 100 over 125 were bachelor students.

**Table 2.** Outcomes of the validation questionnaire (depending on the formulation of the question the outcomes are reported as percentage or as mean values with the associated standard deviations.

Questions	Results
<b>Mobility.</b> How useful would be a student car sharing service?	7,32 ± 0,18
<b>Mobility.</b> Would you share your car, in case you have one?	yes = 52%
<b>Mobility.</b> How useful would be a bike sharing service?	6,77 ± 0,21
<b>Mobility.</b> How useful would be an interactive map to support internal mobility?	8,20 ± 0,18
<b>Mobility.</b> Would you contribute to keep the map updated?	yes = 87%
<b>Food service.</b> How useful would be a service to select the menu and to book the time slot to take the lunch at the student canteen?	7,34 ± 0,21
<b>Environment.</b> How useful would be an interactive map to support separate waste collection?	5,84 ± 0,24
<b>Environment.</b> Would you contribute to keep the map updated about the filling levels of bins and dumpsters?	yes = 74%
<b>Environment.</b> Would you use an application to report on maintenance problems?	yes = 90%
<b>Environment.</b> Would you contribute as volunteer to keep clean and take care of the public area of the University?	yes = 61%
<b>Safety.</b> Would you use an application to report about safety problems?	yes = 93%
<b>Safety.</b> Would you contribute as volunteer to the surveillance of the public area of the University?	yes = 46%
<b>Administrative and info services.</b> How useful would be a service to book meeting with student secretary and more in general to avoid queues at the University's offices?	8,51 ± 0,15
<b>Challenge.</b> Would you contribute to keep updated the information about challenges and opportunities for students?	yes = 70,4%
<b>Social interaction.</b> How useful would be an application to share with other students problems and solutions and to organize activities and events?	7,23 ± 0,20
<b>Rewarding mechanism.</b> How much a rewarding mechanism could entice you to participate in the social activities referred to by the previous questions?	7,68 ± 0,19
<b>Student community.</b> How much do you feel to belong to a student community?	5,37 ± 0,19
<b>Student community.</b> How much do you perceive the existence of a student community?	5,31 ± 0,19
<b>Student community.</b> Apart from helping in mitigating problems, how much an application offering the functionalities described in the previous questions would contribute to support the development of a student community at the University?	7,39 ± 0,16

The outcomes of the questionnaire made emerge a strong attitude for problem reporting and a reasonable availability to contribute to keep information about the campus updated, but also a scarce propensity to be involved in social activities and in sharing her/his own car. An active university citizenship may certainly be encouraged by the activation of rewarding mechanism (reduced university taxes or other discounts).



However rewards could be not fully sufficient because of the absence of a cohesive student community and of a very low students' sense of belonging.

Despite of the lack of internal cohesion and sense of belonging, students think that the proposed application may: (a) drive the development of a student community at least to share, and find solutions to, common problems; (b) help to organize activities/events.

Getting into some more details:

**Mobility.** The amount of people that would be available for car sharing may considerably increase if the application will guarantee sharing of the expenses (fuel), and, overall, reliability of the passengers on several aspects.

Possibly the application should also allow to organize "meeting hours and corners" aimed at supporting car-sharing.

Bike sharing is considered a nice idea but too difficult to be implemented due to the lack of cycling paths and the dangerousness of the standard roads.

**Food service.** Students feel that an application will not be able to solve the problems of the queue at the canteen since they think that such service should be accompanied by a reorganization of the timetable of the lessons and, possibly, by the realization of a distributed system of students' canteens.

**Environment and Safety.** Active citizenship to take care of the common space is not considered a task for students. Moreover most of the students think that they have no time to contribute. Service should be provided by the University.

**Social activity.** A relevant part of the students tend to spend at the university the strictly needed time to attend lessons. The remaining part attempt to study where possible, since places in the studying area and libraries are limited. Only a very limited part of the students is interested in social activities also because of the lack of established and active student communities/unions.

We may observe that the lack of an established and cohesive student community doesn't make perceive the University as a place smart enough to be "lived", but rather as a physical space where one wishes to spend only the time needed to benefit of the services of interest. At a first superficial glance you get the impression that the students' well-being is strictly related to the efficiency and efficacy of services and opportunities provided by the University. At a second in depth scrutiny of the outcomes of the questionnaire, however, the desire to be part of a more cohesive student community emerges. Students, in fact, hope that the proposed application could help not only in reporting problems to have them mitigated but also in supporting the development of a student community.

The case study reported in this paper shows that ASLERD systemic and holistic bottom-up strategy to achieve a participatory evaluation approach represents also a significant starting point to activate student engagement. This is an important step forward with respect to the use of monitoring and evaluation procedures aimed only at benchmarking and at producing rankings, moreover it is also a step forward respect to procedures aimed only to produce a top-down action plans (regardless of the fact that the evaluation strategy could have been a bottom-up and participatory one). In the past

a step toward the design for a Smart Campus have been done in (Galego et al. 2016) but the outcomes of the analysis were not used to activate students and engage them in a design process. Even before a very nice project, “Smart Campus – Creating services WITH and FOR people” (De Angeli et al. 2014), were launched within the University of Trento with the aim to integrate smart campus and smart city applications to support not only academic life but also socialization and practical smart mobility. The initiative has been very successful in engaging students and citizens through user centered design methodology and hackathon but it was not sustained by the use of any “smartness” framework.

Many other universities are interested and involved in the development of the so called “smart campuses” but usually top-down design strategies are adopted and the focus is mainly on testing smart infrastructure (smart grid, etc.) as pilot for future implementations needed for the so called “smart cities”. Since in all these cases the adjective “smart” is strictly related to the improvement of technological infrastructures and not to the wellbeing of the students (or other campus’ players) they are not deemed relevant for this specific context.

For the future it would be very interesting to see if the process of engagement and empowering described in this case study would be adopted by the University of Tor Vergata as a “modus operandi” and, as well, if it could be transferred to other Universities or learning ecosystems like schools.

Considering the outcomes of (De Angeli et al. 2014), together with those of the validation questionnaire (see Table 2) it would be also very interesting to investigate further the role and relevance that a cohesive community may have in the development of a fully University citizenship and, thus, in driving an overall increase of the smartness of learning ecosystems.

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