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Bringing real-world problems into the classroom[i]

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Abstract. Real world problems are a challenge and a motivator for students to learn understanding and using the concepts of systems and actors. But using real world problems in the classroom is not without challenges and dilemmas. In the paper we explicitly address the issue of the need for quite intense support for the students when tackling real life problems and the consequent dilemma of high quality support versus the urge for more efficiency in education and for keeping costs at an acceptable level. Also, teaching such a challenging topic and the group work and discussion involved puts more pressure on the teachers to avoid free ride behavior, as the boundaries between 'right' and 'wrong' are not so strict as in the harder sciences as mathematics or mechanics.

In the Faculty of Technology, Policy and Management both freshman Technische Bestuurskunde bachelor students and engineering bachelors in the Engineering and Policy Analysis master program are taught the basic concepts of systems analysis and are challenged to apply these concepts in practice. We will amongst others discuss some of the cases and the simulated practice we use in the classroom to create a safe learning environment, allowing for misunderstanding and mistakes to happen without causing damage or interference with real stakeholders, rather supporting the students' learning processes. We will pay special attention to how these problems are introduced in class, amongst others by using filmed interviews and simulations.

Keywords: teaching, learning, systems analysis, simulation

1. Introduction: teaching how to deal with complex multi actor problems.

Teachers in policy analysis and systems thinking typically love complexity and ways you can deal with it. We like to teach our students that disagreement exists not only about solutions but also about the nature of problems and for that reason we preferably focus on this typical kind of "wicked problems" we face in contemporary networked societies (Mason & Mitroff, 1981; Radford, 1977). Traditional methods of dealing with problems, where complex issues are often considered an intellectual design question and are approached by giving research and science a central role, no longer suffice (Koppenjan & Klijn, 2004). Confronting students and professionals with the various forms of uncertainty and providing them with tools to discuss and analyze these situations therefore could be considered a first step in coping with this complexity we face in our modern societies. In this paper we will discuss practice; 'our practice', and we will not touch on theories about education and learning too much, we just want to share experiences and ideas to stimulate interaction amongst peers.

People learn through good education in many different forms; by listening to inspiring stories told by a teacher; by observing, by playing (serious) games, through experiments. However, they learn only if these new observations, ideas and impressions can be tested, related, interpreted, heated and enriched by own experience, opinions, norms, values, feelings and insights of the student or in confrontation with the ideas of someone else.

Real learning only happens if the students open up for new ideas, new insights, when they are prepared to be vulnerable, to challenge their own certainties and consequently allow themselves to feel a bit uncomfortable.

Consequently, teaching staff needs to create a safe environment for learning. Such a safe environment can be created in the classroom in formal teaching, in teaching based on practical experience and/or through facilitating a social learning process through a good process design and by imposing rules of the game that allow for a safe and respectful interaction.

Such learning should allow for active interaction both amongst peers and with supervisors or experts; it is an environment that should allow for making mistakes and for active reflection by the student on his or her own learning process. Clearly learning is not about knowledge, cognition and ratio alone; it is about addressing and stimulating different parts of the human brain with words, images, sounds, smells, tastes and emotions.

Good teaching that addresses the complex problems of our societies cannot do without real world problems. Part of teaching involves providing students with tools (methods, models etcetera), another part requires the development of the ability to apply these tools to real world problems. Analyzing complex problems is an 'art and craft', while it typically deals with problems that are 'messy' with analysts finding themselves in a 'swamp'. Thus, getting students 'into' these swamps will need to be part of a curriculum in which students learn how to deal with complex problems. Of course we do have sophisticated mathematical or statistical methods for analysis but problem structuring is conceptual in nature: how to select system boundaries, how to choose between different levels of abstraction, how to decide whether or not to include certain actors or factors in the analysis? Making such choices requires reasoning and judgment. Developing the craft of such reasoning and judgment is best served if it is done with real world problems. Moreover, as many of our students have selected these degree programmes precisely because they recognize the importance of 'systems thinking' and the complexity involved in real-world problems, they are interested in knowledge that helps them confront these real-world problems. What better way to capitalize on this intrinsic motivation of students then by allowing them to engage with real world problems, real world messes and real world swamps – initially in a 'safe' way?

Different groups of students may encounter different types of problems. Students who have developed a strong 'system knowledge', know so much of the details, that it is hard for them to look at these systems at a higher level of abstraction. They bring real-world problems with them to the course, but making choices and balancing between detail and aggregation is difficult for them. There are also students, especially at the Bachelor-level, who come into a curriculum with a less developed knowledge of a particular system. Because they do not know the details, it is not difficult for them to develop some fairly abstract models to represent system factors and actor networks. However, there is a risk that such analyses stays too superficial. These students may not take into account the complexity of systems because they simply do not 'see' this. For these students, real world problems have to be 'brought' in as part of the course.

In this paper we present three different, but also related, examples of how we approach the teaching challenge of bringing real-world problems into the classroom. This is done in three ways: by virtually bringing real stakeholders to the classroom, by filming discussions among or interviews with stakeholders and by simulating analytical real life situations and applying the techniques on the fly. We discuss each of these three in a different section of the paper, which we then conclude with a discussion of underlying themes and questions triggered by these three examples. Rather than presenting a definitive solution to the challenge of real-world problems in systems teaching, we hope to trigger a critical reflection and generate discussion with this paper.

2. Bringing actors (virtually) to the classroom: Visual Problem Appraisal

The idea that people learn most from real life and in interaction with other people are the guiding principles of the course 'policy analysis of multi-actor systems', which is part of the Engineering and Policy Analysis master program. Consequently insights and experiences from actual research projects are used in classroom situations. The latter can take different forms. The simplest way is the introduction of examples from practical research projects in teaching; we tell how analyses were executed, what challenges we faced, what choices were made; who were involved, who refused to participate, what limitations are inherent to the method used and so on. For instance examples of stakeholder analysis executed for third parties are presented in our lectures on actor-network analysis techniques.

More important and influential and way more interactive is the use of the visual problem appraisal (VPA) methodology. While working in interdisciplinary and intercultural groups, students are challenged to explore and

structure a highly complex real-life problem, which is framed as a consultancy assignment in an unfamiliar environment. Central to the VPA is learning in semi-interaction with filmed stakeholders in a real problem situation and in direct interaction with the colleagues in the team. In formal higher education VPA has proved to be a strong and motivating learning environment that enhances students' personal learning orientation and generates enthusiasm. (Witteveen & Enserink, 2007)

VPA KwaZulu-Natal

For a couple of years we have been working with a VPA on coastal zone management issues in Kerala (India), but this spring (2012) we executed a pilot with a new VPA on rural livelihoods in KwaZulu-Natal (South Africa). In this paper we will use materials and examples from the latter pilot. Some 40 master students participated in the pilot.

Typically a VPA workshop starts with music (Zulu drums) and participants filling out a form on their current knowledge: "What do you know about..". This immediately confronts students with their (perceived) lack of knowledge, but they get reassured in the next hour where it proofs that together they do know a lot, in this case about South Africa, its population, its history of apartheid, and a little bit about rural livelihoods, and we discussed how to prepare your travels, and what you would want to learn about once you are there, and don't forget about vaccinations? They then are told that their challenge would be "to draft a research agenda for the University of Zululand and specify/detail one particular subject and make it into a research plan". This is the actual challenge UniZul is facing right now and student results are fed back to UniZul.

For starting up we presented them the following narrative and from that very moment on we addressed them as research consultants and took ourselves the role of Headquarters (HQ):

> *You are in a first job with an internationally operating consultancy firm. With the new job you started building a house of your own at the compound of your parents and siblings. One afternoon while having some drinks with your friends on the veranda of your new house your i-Phone trembles. Head office is calling you! The firm won a tender to advise the University of Zululand in designing a research agenda on rural livelihood issues. Your manager selected you to make a success out of this assignment and promises to mail some more information for you to get prepared. Oh, he is not quite sure when you have to depart for KwaZulu-Natal but it might be soon.*

From that moment on groups have to be formed and students are wondering where to start and what to do. Moreover they have limited time and can only meet a limited number (five) respondents out of a total of 19 available to them[1]. Usually in the first interview the consultants discover the complexity of the issue; respondents tell about other issues than anticipated and everything seems connected; in the second interview they check and find contradictions and they get inspired by the differences in perspectives and discrepancies in the stories told and they get anxious to meet more people. Actually many students complain about being allowed to meet 'only' five informants, they would have preferred to meet them all. In his evaluation one student expressed his understanding of this situation as follows: *"I would keep limited number of interviews that is possible to watch. In the end we have to decide and understand in very short time what is our main focus. If we are in the extreme case to leave the next day for an unknown country we will face the same problems and we will not have enough time to watch all the interviews."*

Students experience the encounters with the interviewees as 'near to real life'. It shows from the way they speak about the interviews during debriefing sessions:

- *'we had the luck to interview…'*
- *'This is what he was saying…'*
- *'After we listened to those four people…'*
- *'The painter put it like this…'*
- *'It made us feel as we were there!'*

Results

Initial results indicate great interest and commitment of students in the 'mediated encounters' with farmers, labourers, fisherman, policy makers, miners, a leather tanner, the hairdresser, the landscape painter and others. TUD student modify their initial interventionist problem statements to multi-actor perspectives. The history of

[1] In this pilot we had available 19 finished interviews out of the envisioned 28 at the official release of the VPA KwaZulu-Natal in Spring 2008 in Empangeni (S.A.).

apartheid, as manifest in current South Africa gains depth as they witness the stories of black and white farmers, positioning it in a context of the reality of the land reform policies. The inconceivable high HIV prevalence rates, social exclusion and poverty bring resilience of rural livelihoods on scene.
Students were deeply impressed by the knowledge and especially the wisdom, the openness and honesty of the interviewees. Engaging with people being that open and honest about their problems and being allowed to *'listen to stories you otherwise would never have heard'* also touched them emotionally.

As a facilitator you sense the vibrant atmosphere and the student's engagement in the issue. They take their role serious, considering themselves to be in the position of a consultant and talking with distinction about the people they have 'met' and their concerns and issues. In between interviews groups are debating the meaning of the stories told and discussing strategies and their choice of respondents.

We asked the groups to present their findings in a presentation book; a compilation of PPT slides with a short explanation and they were supposed to give a five minute pitch on their research proposal. Their reports should include the list of interviewees, a mindmap or a causal diagram of the story of one of the interviewees, a systems diagram, and their research plan and research questions. For the students it was interesting to see that they all came up with related though different proposals and subjects; some concrete, some more principal and abstract proposals. Even groups who had interviewed the same respondents came up with completely different proposals, eliciting the importance of (disciplinary) biases and choices made down the road of drafting your research plan.

Concluding: the VPA exercise is perceived as a simulation that comes close to reality and offers opportunities for intensive learning and feedback on learning strategies. The latter can also be seen from the E-mail we received from Riccardo: *"I believe all of us have found it very inspiring, touching and having a taste of what our work may consist in the future."* Yingxin mailed: *"It is stimulating and encourages students to think independently and learning the analytical methodology in practice."*

3. Showing discussions among or interviews with actors

Description of the issue addressed and the used approach

Developing a useful problem formulation and reporting this in an issuepaper is an important skill of an analyst of complex problems. Part of a course that teaches this to novice students is to work with 'running case'. A real-world problem for which students would develop their problem formulation and issuepaper. For this case, some materials would be made available through the internet, usually in the form of a limited number of reports, news clippings and websites. Students would be encouraged to supplement these materials with information that they would collect themselves.

Over the years, a recurrent bottleneck in the quality of the issuepapers, was the relatively superficial treatment of the issue under study, as visible in rather superficial analyses and little insightful interpretations of findings by students. At the same time, it could be observed that when students had access to one or two key informants, the quality of their work would visibly benefit. Often, this access was 'accidental', through the existing social and family networks of a student. Given student numbers in the course (some 150 per year for the last few years), requiring all the students to conduct interviews related to the same issue, did not seem a very practical or feasible idea. Instead, it was decided to experiment with the use of video-taped interviews for the course in the spring of 2010.

In preparation of the course, interviews were held with four key informants, each of whom represented one of the (expected) critical actors in the case. For the case of offshore windfarms, representatives of the following four actors had been selected: the Ministry of Economic Affairs (responsible also for energy policy in the Netherlands), the Ministry of Public Works and Water Management (responsible for spatial planning in the North Sea), an energy company active in developing offshore windfarms, and the operator of the national electricity transportation network in the Netherlands (TSO Tennet). These interviews were edited for content, ensuring that each interview-video lasted a maximum of 30 minutes. The consultation of at least two of these interviews was designed into the course, to ensure that all students would be aware of the interviews, and would indeed access (part of) these materials.
In addition to the interviews, also an external expert was invited to introduce the case in a guest lecture at the start of the course. Furthermore, a 'beauty contest' was organized whereby final assignments from selected students would be reviewed by a panel of practitioners – consisting of the people who had been interviewed for the videos.

Evaluation of student motivation and the quality of final assignments

It is difficult to evaluate the impacts of an intervention as the one described here. There is no reference group against which to evaluate. For instance, student groups differ from year to year, some teachers differ, and also the case assignments differ from year to year. Nevertheless, an evaluation attempt was made. Students were asked to provide feedback through an evaluation of each of the three above interventions, as well as the impact these had on their motivation for the work on the issue-paper for this course. Also, the course teachers evaluated their own experiences during an evaluative meeting at the end of the course, after grading the issue-papers.

The results of these evaluations indicated that 'overall' students were positive about these three interventions. From the 108 filled-out evaluation questionnaires, average scores, on a scale from 1 to 10, 10 being most positive, students rated the use of a guest speaker and filmed interviews with a score well over 7 (7.3 and 7.4). The interviews were particularly appreciated for their information value. Students who did not like the interviews as much, cited a lack of relevant information, or the 'long boring stories' as a reason. The external speaker was appreciated for a clear introduction to the case, and an enthusiastic story. The use of a beauty contest was also evaluated positively, but somewhat less (6.7). All in all, students indicated that these interventions did have a positive influence on their motivation for the course work. They felt more informed, and hence capable of delivering a better analysis. They felt they were working on something that could also have value in the 'real world', but also, they indicated that seeing that teaching staff puts efforts into organizing their course, motivated them to deliver quality work. However, they also indicated, that next to 'real world' inputs, also the more traditional means of regular weekly assignments combined with discussions and feedback helped them to keep motivated and to keep working.

In the discussion among teachers, it was observed that the interventions did not have a clearly visible impact on the quality of the final issue-papers. The 'classic' bottlenecks were still visible: methods could be applied, but the interpretation of findings, and the synthesis across methods remained weak. Also, it appeared that many students had confined themselves in their analysis to the materials provided by the teachers: interviews and guest lecture. These served to replace documentation and reports that they would otherwise have had to collect themselves. Thus, interviews provided a worthwhile source of information, but also acted as a source of 'bias', reducing the vision of the students-as-analysts to the information provided in two or three interviews.

4. Simulating real life complex problem situations

Students get highly motivated to try and apply new knowledge, ideas and techniques the moment they can imagine finding themselves in a complex situation, feeling lost, looking around and wondering how to get grip on the complexity. In practice though courses are often taught driven by theory. A teacher tells the students about theoretical concepts and about a good way of applying them. Students, especially the ones keen on passing the exam, quickly develop a sense for what is 'correct' and what is not. Teaching in this rather classical sense is basically making the students copy the teachers' behavior and, at best, hoping the students will apply it onto self-experienced problems in a later stage.

A different approach is to raise student's interest in analyzing complex problems through simulating real life complex problems. Not by sketching techniques or theoretical concepts, but by sketching a situation of complexity that students can imagine they might face, either now or later in their life: "Imagine yourself as manager of a company and being faced with societal pressure to increase the environmental performance of your company, without reducing its profitability". Or, being a hospital manager, facing the problem of how to learn from errors being made in care taking, without hurting patients, violating privacy laws or getting involved in liability law suits. As most students see themselves in the role of manager of director in the future, it is very difficult for them, even for the first year bachelors, to discard this as 'not interesting'. This is why they have chosen the curriculum in the first place!

The trick, then, is to show students that analytical techniques are so widely applicable that they almost always give you a way to get grip on a complex situation. In other words, to move from a feeling of being lost and wandering around, to a situation of control. Not by convincing them with a frontal lecture, but by actually doing the analysis with them, on the fly, on a large black board in front of class. Inviting them to participate and contribute with their analytical ideas.

This approach also gives the opportunity to show what happens if analytical tools are used in a less practical way (a way that traditional teaching would call 'wrong'): Just do it on the blackboard and show what it leads to.

What happens in practice? The course teaches basic techniques to get grip on a complex multi actor setting. Grip in such a way that eventually you are able to help other people to make decisions about what to do under uncertain conditions. The way you get grip on such complex situations is to make the problem very explicit and to rationalize (i.e. to compare) different potential solutions for the problem on a set of well-balanced criteria.

Step one is to formulate the heart, the essence of the problem, in such a way that people recognize it, that involved actors are motivated to work with you on solving it. In class a situation is sketched, for instance the discussion around noise hindrance of aircraft, that everybody who reads newspapers knows is an hot issue and not easily resolved. What is the problem here actually? No noise of aircraft is the answer from the student audience. All right, let's get rid of the aircraft then. No, that is not possible, we still want to fly! Ah, so there is a tension between society's desire to fly and noise hindrance! Then how about 'How to reduce the noise hindrance, without sacrificing our ability to travel quickly to all places in the world'.

Step one is easy for the audience, as it is a problem that is far away from their world, maybe they might think they might work in such problem fields in the future, but it is definitely not something that is very hot issue in their daily lives. So let's take it to their world. What is your problem? The audience might react with issues ranging from what to eat tonight, what to wear to a party, how to get better transport to the university and so on. The same question and answering starts again here: "I don't know what to eat?"; "Well, order a pizza."; " This is not what I like"; "Go to a fancy restaurant."; "That is too expensive"; "Ah, there is tension between food that you like and it's price?"; "How about 'How to have a good evening dinner, without spending too much money?"'.

5. Discussion and conclusions

Bringing real world problems into the classroom can be done in many ways. The three examples described above show some interesting differences and commonalities and give rise to many issues for discussion. Some of these issues are highlighted and discussed in this final section of the paper.

Many possible answers

When, like in section 4, you are working out examples with your students in front of the class, it is important to show a variety of possible problems that students or future analysts can face when confronting complex problems. Even more important it is to show the characteristics certain problems have that make them very suitable for the multi actor problem structuring techniques that are part of the course. In order to avoid that the group of problems is too small and students narrow down, a huge range of different cases is presented and we discuss the characteristics they share and don't share, and then pick one (usually let the classroom vote!) to work out in detail.

In the VPA and issuepaper examples the above challenge returns. Students have to make a conscious choice of the problem they want to analyze and the level at which they want to formulate the problem. What is the problem to be solved; what is the system, which behavior should be studied and how to delineate? In the theory part of the latter courses they are told to use the means-end diagram to structure their thoughts to establish the problem level by continuously asking 'why'; why does my problem owner want to do this and then making a conscious decision on the right level? When confronted with real stakeholders though, students find that reality is more complicated and that problems more intertwined than in the neat text-book examples. In VPA the facilitators just confront students: 'real life is about making conscious choices and legitimating them'. It is made very explicit that there are many ways out and there is no one best solution or way out of the dilemma; the first plenary feedback session exhibiting that everyone has framed the problem differently therefore is a revelation and a relief to most students. Something alike happens when preparing for writing an issuepaper; conscious problem framing and delineation are central to that exercise too and is intensively discussed in class.

Standardization

The teacher / facilitator has a big influence on the learning process. To what extent can this influence be reduced, or, to what extent is it possible to standardize teaching methods and interactions with students, and the evaluation of student assignments?

A difficult issue with working out examples that students bring in the classroom (section 4) is that the product you are working towards is not very tangible, it emerges in the interaction with the students, and in the increase in student's motivation and desire to start trying themselves on other problems as this might be their job later. It is hard to make an interaction explicit. The goal of the interaction is clear, and maybe also, to a certain extent, a couple of rough guides on how to set up the interaction with the students. However, making explicit what exactly takes place in the interaction between teacher and students in the classroom that makes people try for themselves on other problems, it not easily passed on from one teacher to another.
For the VPA a facilitator's guide is available containing tips and tricks for feedback sessions, which intends to support the facilitator and standardize to some extend the feedback. Nonetheless the way facilitators operate in practice is very different; what questions are asked during debriefing sessions? Are students debriefed individually or as a group? How much attention is paid to active listening and content analysis; and how much time is devoted to structuring and modeling; does a good story prevail over a good model or the other way around? From the example it is clear that the simulation itself offers ample opportunity for all kinds of feedback and exchange of experiences on field-work, professionalism, conceptual modeling, consultancy and client-relations, just to mention a few. The only thing that is standardized are the interviews; full transcriptions allow the teachers to give precise feedback on the content analysis made by the students.

Nice and well-prepared materials

The evaluations show that students value the fact that teachers and professors have worked visibly to organize and prepare classes and class materials. It motivates (at least certain) students to put energy into the course and to generate good and well–attended products. The appreciation by the students shows from formal appreciation in the evaluation forms and from the attention paid to the lay-out of their products. However, both in the VPA and in the issuepaper example the analytical quality of the products delivered by the student groups was not noteworthy better than before we used the filmed interviews. Nicely illustrated reports and beautiful prezi's are handed in, despite the explicit announcement that 'form' would not pay. Tempting as it is to grade higher beautiful stuff, we do try to focus on the content of the analysis made by the students rather than on the looks of the report.

A safe learning environment

When working out examples in front of the class, on the fly, with the students (section 4), it is rather the organizing than the preparation that makes students try for themselves. By showing your course in practice and inviting the students to participate with you, there is room to make mistakes, to try in a safe environment and to discuss the effects of different approaches to the same problem. It is much different from telling students what they do, or worse, tell them all things that are 'wrong'. It is the attitude of the teacher to be open for all suggestions and to 'show weakness' – in a sense that he also does not have the final one and only answer – that drives the motivation of students to also give it a try. The worst thing that could happen in such a situation is that a student shrugs his shoulders and says, 'OK, if it is this what you want to have to make me pass your course, I will do it'.

The safe learning environment in VPA and the issuepaper example has a slightly different connotation. Both resource persons and students are in a safe environment because of the semi-interaction. Resource persons are not harassed by groups of students interfering with their daily life and asking them impolite questions. Students can watch and re-watch resource persons and listen and re-listen to their stories while displaying their bewilderedness, disbelief, admiration, disgust or whatever emotion without harassing the stakeholders and without interfering in sometimes sensitive personal situations. What is more important: as a facilitator you can discuss these emotions and what it means to be a professional, and you can invite them to watch again and listen to the stories told in between the lines: "this man did not tell anything about our problem", "she said her family died from this disease?". When it comes to student motivation the two citations at the end of part 2 are convincing evidence of student engagement.

Some dangers in simulating reality

All three examples showed ways to simulate a part of real world situation in a classroom context. In doing so, they naturally emphasize certain aspects of reality, while ignoring or downplaying others. For instance, one of the effects observed in using filmed interviews, was that these interviews provided the main basis for analysis, and seemed to be replace the use of literature for a significant part. In the start-up session of the VPA students typically mention internet/google as their main source of information for preparing their trip but seem to forget about that soon. In the VPA Workshop design the latter is anticipated by introducing an explicit assignment to browse the internet for at least two hours in between sessions to familiarize yourself a little bit with KwaZulu-

Natal and rural livelihood problems. Studying reports and scientific literature as might be hoped for when students have to write an issuepaper is beyond VPA, but indeed can be a problem. To stimulate students to use the literature we added the requirement to have a literature list featuring at least some references from the scientific literature forcing them to go to the (electronic) library and search for articles?

Group dynamics

Student motivation and 'work' ethic often are also influenced by group dynamics. These include both dynamics in the smaller project groups, but also the dynamics in the full class of students. When examples are worked out together with students in the classroom (referring to section 4), you also change the group dynamics, slowly, over the years, but still. There is nothing to hide anymore for the students, as they have had all the opportunities in class to come up with their problems and discuss them. It slowly becomes more difficult to blame a course or a teacher if they did not pass the exam, as everybody knows what the good way is to master the material: make sure your questions are being addressed in class! Many times, students who failed tell us they know they should have been prepared. It is even an often heard comment from student to student. Somehow, it becomes less cool to do less work. The norm slowly becomes 'active working and participation' over the years, rather than 'sit back and blame the outside world for failing tests'. This is exactly the idea behind the approach, passing on the responsibility for the course result to the student, rather than to the teacher.

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