A comprehensive framework for accreditation and pedagogical support process formalization
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The Royal Institute of Technology (Sweden) - KTH  
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QUALITY CONTROL ASSESSMENT SHEET

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1 PUBLISHABLE SUMMARY

1.1 PROJECT CONTEXT AND OBJECTIVES

The objective of this deliverable is to provide a white paper, an evolving work document, how to integrate challenge driven education model to the programs of the universities and to demonstrate the potential benefits of such approach. The objectives are to provide a structured approach to partner universities and external stakeholders to (i) integrate such challenge driven education to degree curricula including the necessary accreditation and examination formats, and (ii) provide external stakeholders in local communities to be an active partner and beneficiary of such activities. The white paper will evolve over the project period from concept note to a supported operational principles and a light infrastructure for providing support, mentorship, and sharing best practices via a joint platform agreed and supported actively by many universities.

1.2 MAIN RESULTS IN THE REPORTING PERIOD

The main results have been (i) providing a training workshop in Dar es Salaam in 2015 in close association with World Bank Negawatt event, (ii) planning the detailed content for the 2nd training workshop in September 2016 in Dar es Salaam, (iii) demonstrate the impact of such activity and the local innovation capacity by working together with NegaWatt Challenge of World Bank by couching the student team looking the local community water issues and winning the World Bank challenge completion globally, (iv) jointly developing the first new curricula at M.Sc. level to be approved by the local university councils before Fall 2016, and (v) initiating development of Community of Practice with special focus on challenge driven education and related organizational supporting structures such as Technology Transfer Alliance as part of Sci-GaiA Science Gateway. The findings of these specific activities are here summarized in Deliverable D2.1. This is the extension of the KTH internal publication Guide to Challenge Driven Education, which summarize the earlier best practices. Within this deliverable we try to outline the path to more formal structure to be usable and supportive in qualifying courses and/or curricula under challenge driven education label. The approach here is very analogous as adopted earlier in CDIO (Conceive-Design-Implement-Operate) curricula paradigm, with integration of quality assessment system developed earlier in European Institute of Innovation and Technology (EIT) for master education.

1.3 EXPECTED FINAL RESULTS AND POTENTIAL IMPACT

Challenge driven education model integrated to multiple curricula as an integral part of course structure and examination requirements is the key element for sustainability. This can be achieved only if the interested partners have both support and tools to integrate the project learning format as an integral part of the their degree curricula satisfying the national curricula requirements for the degrees associated. As already seen, such type of education mode has a high motivation factor among the students, helps the universities and their faculty towards better local integration with local external stakeholders for strategic development and research. If successful, the outlined activity will maintain and excite a community of practices around joint pedagogic development and
sharing experiences for better learning outcomes among our students. And finally, with focus on local issues in the local context, will most likely lead to better preparedness of the students for skills and challenges in their future working life.

2 TECHNOLOGY TRANSFER ALLIANCE (TTA) AND OPEN SCIENCE PLATFORM SUPPORT FOR TTA

This chapter clarifies the content and focus of Challenge driven education and TTA. Furthermore the chapter summarizes the progress on the TTA platform implementation.

2.1 CHALLENGE DRIVEN EDUCATION AND TTA

People that enrol in university studies are often driven by a wish to make a difference in society. Universities around the world share a large pool of young, creative, curious students that want to have impact. To unleash the potential of young learners, to provide them with the skills to achieve their goals and support their entrepreneurial mind-set is a constant challenge in university education. Hence, the way we teach and train future generation is of utmost importance for both the individuals at our universities as well as for the development of our societies.

Specialized knowledge will always be at the core of a university graduate's expertise. Challenge Driven education paradigm advocates that specialised knowledge be complemented by and built through open-ended, challenge based, interdisciplinary team work typically as student project format. Such an approach will enable students to bridge the gap between knowledge and societal demands, enabling them to make a contribution to society. Society cannot waste the talents of young people by leaving them unprepared to enter the workplace smoothly and speedily after graduation. Skills in solving open problems in teams greatly increase a graduate's employability. In addition, we believe that the integration of open-ended, needs-driven problems in university education provides crucial competences for future decision-makers – for both the known and the unknown challenges ahead of us.

Different initiatives and reforms have been developed to address the two challenges described above: that engineering education isn’t really as problem-oriented as it should be, and that educational environments not well enough designed to ensure that students gain the best from them.

One engineering education reform initiative is CDIO (which stands for Conceive, Design, Implement and Operate, see in more details at [www.cdio.org](http://www.cdio.org)) founded in 2000 by MIT, Royal Institute of Technology (KTH), Linköping University and Chalmers University of Technology. Today in 2014 almost 100 higher educational institutions from all over the world are members. The first four CDIO requirements for the reform of engineering education are:
The program adopts the principle that product, process, and system development and deployment - conceiving, designing, implementing and operating – are the context for engineering education.

Challenge driven team based project courses are thereby a common element, in order for the students to work in a context that looks and works like their future work places. The education emphasizes the technical fundamentals, while strengthening the learning of personal and interpersonal skills; and product, process, and system building skills. The integration of disciplinary knowledge and skill training is thereby a key element of CDIO.

The learning outcomes of students in a program should be set in a way that reflects the viewpoints of all key stakeholder groups: students, industry, university faculty, and society.

Curriculum and pedagogy are revised to make engineering education more likely to attract, retain, and graduate qualified students into the profession, without compromise to quality or content. A common answer to the main needs for change in engineering education seems to be students working in team-based challenge driven project courses.

The Challenge driven education is an extension of the CDIO principles in 3 main areas:

- Problems are defined by the external stakeholders addressing real life problems and challenges with truly open ended formulation. The students need to develop a working relation to the problem owner towards co-creation and co-innovation and integrating pieces of knowledge and experience beyond what they have learned in their basic courses. Thus the students will develop skills to handle the ambiguity and the need to co-create and co-crafting in order to provide solutions to the challenges.

- Problems may have a multidisciplinary character resulting the need to co-locate students to new environments where expertise and experiences in other disciplines can be met. Typically such environments are provided in format of Open Labs, Makerspaces or Design factory type of set-ups. So basically the theoretical knowledge and conceptual framework is moved to the more practical engineering context with hands-on work on designs and crafting the solutions.

- The students will be exposed to peer learning in addition of team work skills and project management issues through interaction with other students hopefully with different discipline background. This is fostered by the target to large project teams requiring self-organization and discipline among students.

The role of the teacher here has changed from lecture and knowledge transfer unit to be a mentor and support/safety-net for the teams and a catalyst for knowledge creation and learning.

Obviously the above teaching and learning methodology provides a number of challenges in order to be successful:

- Involved teachers need to be familiar with the operational mode and develop their skills in handling the teams and projects such that the pedagogic targets and intended learning
outcomes are satisfied. This is a continuous process which can be initiated by training the trainers, but a continuous support and community of practice reference group are need for the further development.

- Students need a proper feedback framework on their progress, an assessment of their learning with respect to the intended learning outcomes, and acceptable and fair methodology to evaluate and assets the student’s individual progress and achievement for the grading need to be well defined before the course start.

- For the faculty organizations and universities, the challenge driven educational modules need to be integrated to the degree requirements and as an integral part of the curricula. Here are the issues with formulation of national degree requirements as well as university level refinements of such. For individual teachers promoting challenge driven education model, it is important to provide feedback to his/her own organization so that such acceptance decision to integrate such modules to curricula can be made.

Technology Transfer Alliance (TTA) is an alliance formed by a number of interested academic partners to promote and develop Challenge Driven Education models and infrastructures supporting the adoption and further development of CDE. The TTA is a non-for-profit network of universities interested in:

- Having an impact on development of the societies in which they exist;
- Problem-oriented, project-driven learning with a focus on innovation and entrepreneurship and with interaction with local business and societal stakeholders;
- Offering students and faculty members opportunities to contribute to important projects for academic credit and increasing international interaction for student exchanges and joint development among involved faculties.

The TTA supports members in:

- Internal Academic development of pedagogical models and examination methods for problem-oriented, project-driven learning following the CDE paradigm);
- External networking with external stakeholders to define, fund and implement projects.
- Providing a community of practice and supporting it via Open Science Platform and science gateway

The TTA is thus a network of universities. The existing program structure is defined by the members of network without any obligatory commitment. This has hindered its growth to certain extent. In an ideal case, the complete program structure requires an institutional framework, membership with obligatory commitment, and organizational structure with well-defined roles and responsibilities of the assigned people.
The TTA network was established as non-profit association under Swedish law with KTH as the leading partner. To meet its objectives through independent and fully functioning activities, TTA must be organized and registered as an association or a consortium of its member universities with commitment affirmed by the respective deans and presidents of the universities.

Universities with the intention of introducing project-driven course linked to TTA can be members of TTA. New partner will be invited through time. When the membership grows in numbers and by activities, managing full members and recruiting new members to the different activities requires a systematic and standardized process. As of now TTA membership is for free.

The TTA Collaboration Platform is intended to be a web-based platform containing an integrated set of tools, applications, data repositories that are accessed via a portal: the TTA Portal. The motivation of developing this platform is to support collaboration and training and to foster education among the partners, sharing of all sorts of resources and dissemination of results. The platform will allow each partner to submit content such as project proposals, project documents, news update, information sharing via content lists and other kinds of content such as video or other multi-media contents that cover in a secure manner. All collaborating partners will have access to contents through proper authentication mechanisms based on Identity Federations and fine grained access control and will be able to edit contents easily through web pages (content management system). Some of the events will include seminars, webinars and presentations. The platform will also incorporate social media including Twitter, Facebook and LinkedIn links. The TTA portal serves as an entry point for repository and other partner services that can be used by all the partners. Ultimately, the platform will evolve into a full blown Science Gateway as content and applications will be developed that can be utilized by others beyond the existing partners mentioned in this proposal.

As a part of collaboration platform some praxis for Intellectual Property Issues (IPR) need to be defined. Most importantly TTA will promote that all projects will need to define the IPR policy and issues before the project starts with all involved partners and participants. The basic approach can be very simple openness and open access of data, results, and tangible objects produced as part of the project work. However, in order to support the innovation process, some intellectual property management in open innovation can be established following e.g. the EU guidelines on that.

2.2 TTA WORK PROGRESS AND ACHIEVEMENTS DURING THE PERIOD

The key aspect has been the first draft for the TTA Open Science Platform based on tools and methods developed in Sci-GaiA project for science gateways. The TTA platform is currently fully integrated to the Sci-GaiA tools and portfolio. The first versions were released in Summer 2016 hosted physically in Italy, and most recently the platform has moved to KTH and operates in the KTH server cloud on virtual machines. The TTA portal will be cloned in Africa by DIT in Dar es Salaam. Both DIT, University of Dar es Salaam and KTH are committed to maintain and develop further the platform beyond the project period. The current situation in terms of available content in the TTA portal is limited but will be increasing during the 2nd year of the project when different users will start using resources and contributing to the resources in an active way while adopting challenge driven education modules to their curricula. So the key challenge is to activate the user community and connect existing experienced users to the new ones, who are currently in planning or developing phase of challenge driven education modules. This will be facilitated by adding useful material in terms of execution of courses, supporting material for governance issues of the courses within universities, and examples and inspirational material from existing projects. The starting point is to connect the material on existing KTH web pages on challenge driven education\(^3\) and the old TTA portal\(^4\) to the new one offering a broader range of services and support through the overall Open Science Platform behind the Sci-GaiA portals\(^5\). Also project results, like obtained in the World Bank Negawatt global challenge\(^6\), need to be added as inspirational material both for teachers, students, and university management

The TTA portal can be found at web address: [http://www.ttaportal.org](http://www.ttaportal.org) with a target to support CoPs for challenge driven education.

The TTA Platform is implemented according to three logic layers as shown in Figure 1.

The 1\(^{st}\) layer is a virtualized hardware infrastructure composed by:

- A server installed with the award-winner Liferay ([www.liferay.com](http://www.liferay.com)) enterprise portal framework and the Catania Science Gateway Framework ([www.catania-science-gateways.it](http://www.catania-science-gateways.it)) which allows to seamlessly interface Distributed Computing Infrastructures (Grid, Clouds, HPC dedicated clusters, etc.), both in Africa and in the rest of the world;

- A server installed with the event management software Indico ([http://indico-software.org/](http://indico-software.org/)) which is a web application to schedule and organize events, from simple lectures to complex meetings, workshops and conferences with sessions and contributions; the tool also includes an advanced user delegation mechanism, allow paper reviewing, archival of conference information and electronic proceedings.

- A server installed with the “de facto” standard mailing list manager Mailman ([www.list.org](http://www.list.org)).

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4. [http://www.ttaportal.org](http://www.ttaportal.org)
All the services composing the 1st layer are open source, based on standards and will belong to the single domain tta-portal.org. The 2nd layer is composed by the services’ administration team. The 3rd layer is composed by the editorial board of the Portal and by the developers of applications to be integrated in the Science Gateway, both already existing and developed by TTA projects.

Figure 1. Logical structure of the TTA platform

The TTA portal has been installed on the Virtual Machine with the latest version of Liferay (v7.0.1 GA2) and the Future Gateway API (the evolution of the Catania Science Gateway Framework). All content from the old portal https://tta-portal.misc.kth.se/ were copied to the new portal, with addition on the customization of layout, themes and more web contents specifically on the TTA project menu and create sub categories on it.

The TTA Portal is based on the Future Gateway (FG) framework (an evolution of the previous CSGF – Catania Science Gateway Framework) which uses the new version of Liferay 7 Enterprise Portal as the Content Management System (CMS) for management of the front-end content and features. The figure below shows the architecture of all the components and how they interact with each other.
The architecture is divided into two main parts:

- The front end portal (APIFrontEnd) which is a Python-based service using the Flask micro framework to provide a REST-based interface

- The backend engine (APIServerDaemon) which is a Java servlet running as a daemon on top of the Tomcat application server
  
  - The FG engine uses the SAGA and JSAGA (the Java implementation of SAGA) OGF standard to manage jobs that are submitted on the available distributed grid and cloud infrastructures. The engine, through the API Server, exposes these functions as REST APIs that can be utilized by any client that can make REST requests.
  
  - The TTA portal - The front end of the portal is running on top of this FG engine. It has the sub category in the Sci-GaIA OAR and one can manually upload the contents/data and assign DOI to them which may be visible to the authors in the ORCID profiles.

Figure 2. The system architecture
With the link address is: https://orcid.org/my-orcid. Also, the membership and partnership forms were uploaded to the OAR and linked them to the platform with the addresses: https://oar.sci-gaia.eu/record/205 and https://oar.sci-gaia.eu/record/206 for anyone to access them. The Contact form was created and assign the administrative people to receive mails using google group. The TTA Forum was also created and linked to the Forum page: http://discourse.sci-gaia.eu/c/projects/tta-al.

The portal has been installed with the event management software Indico (http://indico.org) and linked to the Event Menu with the link address: http://agenda.ttaportal.org, and one of the workshop created was: https://agenda.ct.infn.it/event/1232/ Currently the portal is transferred to KTH cloud service centre and running o virtual machines with scalable resources with old web service address: https://www.ttaportal.org/.

3 QUALITY ASSESSMENT FRAMEWORK FOR CHALLENGE DRIVEN EDUCATION

In this chapter the more detailed information on the progress and approach chosen for future development of Challenge Driven Education (CDE) best practices and working models for quality and accreditation are described, piloting it locally in Dar es Salaam jointly with World Bank and local universities, planning the program content for training-the-trainers for September 2016 towards CDE implementation in the new approved educational master and doctoral programs and quality assessment and learning enhancement (QALE) approach in CDE.

3.1 WORK PROGRESS AND ACHIEVEMENTS DURING THE PERIOD

Based on gained experience, a first successful pilot with a group of students were deemed necessary for motivation and for creating excitement among students, teachers, and faculty organizations. Luckily Word Bank is organizing a Negawatt challenge global competition which provided an ample pool of excited students from multiple local universities, high visibility and impact, and some elementary funding sources for students and traveling. World Bank chose KTH
for coaching the teams and organizing the first selection of the teams moving the next level, and for the 2nd phase KTH and UDSM carried out the coaching of the remaining two projects with more extensive support based on CDE pedagogic model. In the Negawatt challenge the teams, consisting of students from different universities in Dar es Salaam were coached and trained jointly by KTH and University of Dar es Salaam (UDSM), College of ICT (CoICT), in CDE format, resulting to a winning proposal and a new start-up enterprise focusing on the project results for clean water resource efficiency7.

Based on achieved impact and obvious local connectivity of the educational activities, UDSM, College of ICT, was interested to develop these CDE concepts to be part of their curricula. Such new Master and Ph.D. curricula in IT and computer system engineering were developed with university decisions in August to start the new curricula already in fall 20168. This can be as a reference program for many other African universities for integration of CDE to the educational degree programs. For the implementation purposes, a CDE oriented training of the future teachers in such program with CDE methodology were planned as the dedicated workshop and synchronised time and content wise with the 3rd Sci-GaiA workshop in Dar es Salaam on Open Science in Support for Education9 in September 2016.

The three day workshop was planned to be organized in Dar es Salaam 6-8.9.2016 with the following focus. Global challenges are often materialized locally and render solutions in a local context. In good circumstances, they may be scaled up into global solutions. The lack of investments in certain areas or lack of certain infrastructure in emerging and developing economies offers unique opportunities to explore entirely different solutions to problems that are beyond the horizon of our present imagination. They could thrive and develop rapidly in the fertile innovation ecosystem that is provided by universities and their interface to society. Thus, from a university perspective, connecting research, education, and innovation to an effective knowledge triangle is of paramount importance.

8 see http://www.coict.udsm.ac.tz/academics/programmes
The new university outreach approach consists of three fundamental concepts forming the pillars for activities and actions:

- **Strong commitment and support of Open Science and related transparency and global cooperation as defined in the recent Dakar Declaration** \(^{10}\) on that. This is facilitated and empowered the recently development Open Science Platform\(^ {11}\) with focus on integrating the knowledge triangle and providing Science Gateways.

- **Introducing a new approach for societal stakeholder integration through the Challenge Driven Education** \(^ {12}\) model and Technology Transfer Alliance supporting a comprehensive multi-partner interaction.

- **Physically co-locating the activities to university initiated co-creation, co-design, and co-drafting centers forming the local Open Labs and Maker Space meeting places and critical infrastructure resources for integrating problem owners to various solution providers especially from academia.**

With these pillars we have already seen new innovation capacity generated, new excitement and renewal of the academic environments, and above creating broad social and societal impact especially for problems which require multidisciplinary approach for solutions and business creation.

This workshop has focus on CDE in the above context with three thematic days:

- **Governance,** how the universities at different level can actively utilize CDE from various organizational perspective and to integrate CDE to the curricula.

- **Pedagogic models** how to do it in practice and sharing the best practices already established.

- **How to outreach for impact and success and various practical experiences on that towards integrating outside stakeholders to the education.**

The aim of the workshop is to provide participants concrete tools and shared practices for CDE and prepare the participants to lead and to contribute for CDE.

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\(^{11}\) [http://www.sci-gaia.eu/osp](http://www.sci-gaia.eu/osp)

\(^{12}\) [http://www.kth.se/challenge](http://www.kth.se/challenge)
The detailed workshop program draft is presented in Annex 1 and the course material can be found on the web site: http://agenda.ct.infn.it/event/1232/other-view?view=indico_infn_meeting. The workshop gathered around 60 participants (despite the fact that the workshop did not cover the travel and lodging costs of the participants, but was free of charge) mainly from Tanzania.

3.2 FRAMEWORK FOR SUPPORT OF CHALLENGE DRIVEN EDUCATION

As stated before a number of reference systems do exist for quality assurance and learning enhancement model. These starts from more formal Bologna process (or ABET in USA), CDIO for project centric learning to EIT models for planning curricula at advanced level. The common factor to all of these are:

- Transfer learning to more student centric from teacher centric
- Provide a framework for intended learning outcomes such that curricula can be compared or to be made more equivalent independent of specific implementation details
- Provide similarity across disciplines so that interdisciplinary course content can be integrated to disciplinary oriented curricula.

The key differences is the level of formalities how the evaluation and accreditation is performed. In European and African system the national ministries of education, or state universities itself, has the main responsibility for organizing and carrying out the formal accreditation processes. However, in order to enhance international or interdisciplinary co-operation, some more refined and specific guidelines are needed. The CDIO initiative at global level tries to fill this gap with well document guidelines; however the integration process across disciplines or national systems is limited. One of the attempts to bridge intentional co-operation and cross-sectoral co-operation (e.g. between academia and industry or society at large) has been the European Institute of Innovation and Technology. However, the process as they proposed is too extensive and heavy, so in practice some more light weight approach is needed in order to meet the expectations. In Sci-Gaia project we aim to focus in this specific target: a light weight framework which can enhance interdisciplinary co-operation of students from different schools and which integrates them a joint projects with external stakeholders focusing on real challenges and problems within our societies.

13 http://agenda.ct.infn.it/event/1232/registration/registrants
In such approach there are a number of the issues which need to be addressed and handled in a proper manner:

- It need to be evidence based in two ways: both from pedagogic research base that the framework is supported by our understanding what state-of-the-art university education is and that the well-defined intended learning outcomes within the degree requirements and curricula content can be met by the CDE.
- It should provide a robust learning environment towards the skills needed for the challenges of the working life
- It need to provide a robust and tangible strategy to integrate the external stakeholder to the goals of education and for meeting the degree requirements.

In order to meet these requirements CDE need to identify the overarching learning outcomes which are the following:

- Value judgement and sustainability competencies for students. The ability to identify the short – and long-term future consequences of plans and decisions from an integrated scientific, ethical, and intergenerational perspective and to merge this into a solution focused approach, moving towards a sustainable society.
- Innovation and entrepreneurship skills. The ability to identify and to translate innovations into feasible business solutions with customer base.
- Creativity skills and competencies. The ability to use knowledge, ideas and innovations, and technology to create new or significantly improved products, services, technologies, business models, or industrial/business jobs, and new customer segments and businesses.
- Research skills and competencies. The ability to use cutting-edge research methods, processes, techniques and technologies towards providing solutions to real societal challenges and towards new venture creation and growth and to apply these also in cross-disciplinary teams and contexts across participating universities, schools and external stakeholders
- Intellectual transforming skills and competencies. The ability to transform practical experiences into research problems and challenges. Creating an attitude to see the daily problems as gold mine of solutions and business opportunities.
- Leadership and competence. A high ability for decision making and leadership, based on holistic understanding of education, research and innovation to a value creation process in context of limited size teams and contexts.
In addition of these over-arching learning outcomes criteria CDE based curricula need to satisfy three major criteria

- Robust focus and content within the framework of the specific degree curricula to satisfy the national and international criteria for examinant for e.g. for master degree in a specific discipline
- Highly integrated, learning by doing and openness to the world,
- Outreach strategy and policy locally and internationally for external stakeholders and for academic partners.

From this perspective the quality assurance and learning enhancement system need to be establish that are involved in order to create to create trust which

- Is evidence based, rest on evaluation and have potential to drive quality in teaching and learning,
- At it can be used as planning and evaluation base for programs satisfying CDE criteria
- Includes the professionals in academia and outside in order to create trust base and motivation to use it
- Has a clear stakeholder perspective,
- Is constructed so to act as planning and evaluation tools for the CDE content
- Focuses on added value which it can create to the society

The quality indicators which need to be addressed and evaluated are thus

- Compulsory requirements, meaning that the education is part of the degree program, can integrate external stakeholders, and can accommodate students from other schools/faculties, other universities locally, or internationally as part of the project team
- Uses aligned teaching for achieving intended learning outcomes and have the coverage of overarching learning outcomes
- Has proper learning environment and facilities to support external stakeholder integration
- Provides results on evidence based for student learning and stakeholder integration to the learning process
- Evaluates the stakeholder experience and impact of education not only for preparedness of challenges for the working life for students, but also evaluates and documents the societal impact in a systematic ways

The assessment of these can be done in multiple ways as already used today in national or international context

- Full review of programs and context by national or international evaluation board with respect to the national degree requirements and specific requirements as proposed here for CDE. We feel this is
too heavy and the university management is not willing to do it because it does not produce any added value with respect what they in any case need to do for their degree granting rights (typically done by national Ministries of education, like in Sweden, on regular basis)

- Self-assessment and external body for accreditation and evaluation. We feel that even this is not realistic as over heavy instrument and process for motivating various partners and multiple faculties to join in (e.g. as done within EIT framework).
- Peer review on voluntary basis with respect to documented content and goals for education organized as presentations for those who are already practitioners (e.g. as done in CDIO).

In order to create and enhance impact we propose a model consisting all these elements but in a more light version. We are interested only in programs which satisfies the national degree requirements. For the CDE target we need to develop and provide the self-evaluation material exploring and probing the criteria as given above in order to facilitate locally the systematic and aligned development of content within programs. And finally, based on self-evaluation material, a peer review process within the community of CDE practitioners with feedback for the future development and potential interaction among participating universities.

For the self-evaluation process the material need to be tested and developed in close co-operation with those who are already part of the CDE process and with those who are developing new programs or changing the format of existing programs towards CDE. The most important fact is that the self-evaluation need to be useful and productive for those who are in the process. Thus this will be an iterative process where the self-evaluation guidelines are developed jointly with the “new comers” such as e.g. UDSM or DIT in Dar es Salaam or new partners in Europe and Asia.

The self-evaluation material consists of contextual framework and templates which each new partner need to fill and share within the community. The sharing need to happen via TTA portal as developed within this project.

The key purpose for this development is to facilitate the university cooperation across faculty/school boundaries or across national boundaries so that a heterogeneous group of students can address the real world challenges and learn skills for their future working life. The unification of the CDE content and its format will facilitate free mobility for students and new perspective and
competence resources (internationally and multi-disciplinary perspective) for the local problems which need to be addressed through the partnership with local stakeholders. Thus students from EU can participate with the same degree oriented learning outcomes to projects in Africa or vice versa societal challenge from a new and innovative perspective, as we have learned through the World Bank Negawatt Challenge.

4 Future Tasks and Summary

This chapter provides the activity plan for developing the content of this deliverable to the final form during the 2nd year of the project and provides a summary of our strategy.

4.1 Project Tasks for the Second Year

As we have learned during the project that success can be only based on real needs from those who are working concretely and hands-on with the issues. Thus we can see few follow-up steps from the activities during the first year:

- Organizing the train-the-trainers workshop in Dar es Salaam in September for proving context and sharing the experiences on content
- A higher level faculty meeting in early December addressing the concrete faculty and university level needs for the framework discussed in chapter 3. This has been agreed to happen in Stockholm in early December,
- Based on this feedback from this, to provide the first draft of quality assurance and learning enhancement and self-evaluation material model for the review of the participants in September workshop and update that based on the feedback further through network conference call.
- Organizing a 2nd face-to-face workshop in Dar es Salaam with those individuals who are committed to develop the CDE concept in their curricula and to perform the self-evaluation and the peer review for this. The realistic time frame for this is February 2017.
- Using the produced material and practical experience, organize 1-2 additional partner meetings in Africa for the development and integration of CDE to the existing or new curricula. The first targets will be in Ethiopia and Nigeria, where there are partners who has
expressed strong interest and commitment for this type of development. This will happen late spring 2017 and will be based on experiences and feedback as we will receive through the experiment in Tanzania.

- Place all material and results to our TTA science gateway, as described in chapter 2, to facilitate dissemination and dialog with additional partners. This is ongoing activity.

4.2 SUMMARY

In this deliverable we have outlined an evidence based approach for challenge driven education and created a science gateway based infrastructure to promote and to support this activity. So the aim is not to provide theoretical models but models and best practices based on success and impact in the environments they will be utilized. This is the only way to create commitment and resources at local level without the need to pay those.

Secondly, the approach is based on modern learning concepts already utilized in many pan-European or global initiatives recently. However, may of the existing models are either to bureaucratic or do not provide enough support to local actors and individual teachers, so a new model is proposed in this deliverable combining the TTA science gateway with a framework for templates for self-evaluation and peer support and approval via TTA science gateway.

The practical implementation will be the content for our work in the 2nd year as well as documented in the final deliverable for the project.
5 ANNEX 1 TTA WORKSHOP CONTENT IN SEPTEMBER IN DAR ES SALAAM, TANZANIA

TTA and Challenge Driven Education

from Tuesday, 6 September 2016 at 08:00 to Thursday, 8 September 2016 at 18:00
at Dar es Salaam (COSTECH)
Tanzania Commission for Science and Technology (COSTECH) P.O. Box 4302, Ali Hassan Mwinyi Road, Kijitonyama (Sayansi) COSTECH Building, Dar es Salaam, Tanzania,

Web: https://agenda.ct.infn.it/event/1232/

Registration: https://agenda.ct.infn.it/event/1232/registration/register

Description This workshop is Organised by KTH, DTI, COSTECH, Sci-GaiA and will be held in COSTECH, Dar es Salaam, Tanzania.

Support Email: TTAplatform2016@gmail.com

Presentation material and updated agenda can be found at web site: http://agenda.ct.infn.it/event/1232/other-view?view=indico_infn_meeting

Challenge Driven Education Workshop Overview

Global challenges are often materialized locally and render solutions in a local context. In good circumstances, they may be scaled up into global solutions. The lack of investments in certain areas or lack of certain infrastructure in emerging and developing economies offers unique opportunities to explore entirely different solutions to problems that are beyond the horizon of our present imagination. They could thrive and develop rapidly in the fertile innovation ecosystem that is provided by universities and their interface to society. Thus, from a university perspective, connecting research, education, and innovation to an effective knowledge triangle is of paramount importance.

The new approach consists of three fundamental concepts forming the pillars for activities and actions:

- Strong commitment and support of Open Science and related transparency and global cooperation, as defined in the recent Dakar Declaration[^4] on that. This is facilitated and empowered by the recently development Open Science Platform[^5] with focus on integrating the knowledge triangle and providing Science Gateways.
- Physically co-locating the activities to university initiated co-creation, co-design, and co-drafting centers forming the local Open Labs and Maker Space meeting places and critical infrastructure.

[^4]: http://www.sci-gaia.eu/dakar-declaration/
[^5]: http://www.sci-gaia.eu/osp/
[^6]: http://www.kth.se/challenge
resources for integrating problem owners to various solution provides especially from academia. With these pillars we have already seen new innovation capacity generated, new excitement and renewal of the academic environments, and above creating broad social and societal impact especially for problems which require multidisciplinary approach for solutions and business creation.

This workshop has focus on Challenge Driven education in the above context with three thematic days:

- Governance, how the universities at different level can actively utilize Challenge Driven Education from various organizational perspective
- Pedagogic models how to do it in practice.
- How to reach for impact and success and various practical experiences on that.

The aim of the workshop is to provide participants concrete tools and shared practices for Challenge Driven Education and prepare the participants to lead and to contribute for Challenge Driven Education activities in their home universities with the local context. We hope this will inspire all involved in this workshop.

**Tuesday, 6 September 2016**

08:30 - 09:00 Registration

09:00 - 14:30 Governance Session

09:00 Welcome: Global challenges for the future of university education 30'
Speaker: Prof. Wyss Ramon (Vice-President, KTH)

09:30 Workshop organization, goals and practicalities 15'
Speakers: Prof. Hannu Tenhunen, Dr. Amos Nungu

09:45 Quality enhancement and development of challenge driven education 1h0'
Speaker: Prof. Anna-Karin Högfelt (Director of Faculty Training, KTH)

10:45 Tea Break 30'

11:15 Design thinking in Challenge Driven Education 1h15'
Speaker: Prof. Ann Lantz

12:30 Open Science Platforms in integrating knowledge triangle (education-research-innovation) 1h0'
Speaker: Prof. Roberto Barbera (University of Catania - Italy)

13:30 Lunch 1h0'

14:30 - 16:00 Group discussions and assignments

Day 1: the local university perspective:
- Challenges in quality assurance
- Credits and activity flow
- Needs for teacher training and how the teachers need to be supported

16:00 - 16:30 Tea Break
16:30 - 17:30 Presentations and discussion on team work results for Day 1
Wednesday, 7 September 2016

08:30 - 09:00 Registration
09:00 - 13:30 **How to do it session**
09:00 **Introduction 15’**
   Speaker: Prof. Hannu Tenhunen
09:15 **Examples of “success” - sharing experiences 1h15’**
   Speakers: Dr. Taajamaa Ville (UTU, Cross border projects), Dr. Amos Nungu (Hands-on projects for improved weather forecasting)
10:30 **Tea Break 30’**
11:00 **Using Design Thinking in Societal Challenges 45’**
   Speaker: Prof. Ann Lantz (KTH)
11:45 **Quality enhancement and development of engineering education: A CDIO and challenge based approach 45’**
   Speaker: Dr. Anna-Karin Högfelt (Director of Faculty Training, KTH)
12:30 **Lunch Break 1h0’**
13:30 - 15:30 **Group discussions and assignments**
   *Day 2 Project work and team formation: the local partnership perspective:
   How to organize groups in the projects
   How the groups need to organize themselves
   Selection and identification of good projects*
15:30 - 16:00 Tea Break
16:00 - 17:00 Group discussion continuation
   *Examination, grading, assessments (Individuals vs Groups)*
   *Industrial expectations and requirements*
17:00 - 18:00 Presentations and discussion on team work results for Day 2

Thursday, 8 September 2016

08:30 - 09:00 Registration
09:00 - 14:15 **Impact and Success**
09:00 **Impact – How to create success 15’**
   Speaker: Prof. Hannu Tenhunen
09:15 Governance and credit assessments in multi stakeholder educations 1h15'
Speaker: Prof. Hannu Tenhunen

10:30 Tea Break 30'

11:00 OpenLabs for supporting education, TBD (Examples from partners) 1h0'

12:00 Lunch 1h0'

13:00 Open education for open problems 45'
Speaker: Dr. Ville Taajamaa (Researcher, University of Turku and Stanford University)

13:45 Integrating Innovation & Entrepreneurship to projects and education: Examples from UDSM, EIT, KTH (TBD) 30'

14:15 - 14:45 Concluding remarks and final joint discussions

How to create impact and success?
How to measure success?
What we can do together next?

WORKSHOP FINAL IMPLEMENTATION AGENDA AND PRESENTATION MATERIAL CAN BE FOUND ON THE WORKSHOP WEB SITE

14 http://agenda.ct.infn.it/event/1232/other-view?view=indico_infn_meeting