SUSTAINABLE CONSTRUCTION FOR HIGHER EDUCATION FOR THE FUTURE

PROJECT TURN THE TITANIC (PTTT)

PROJECT PLAN
Project Turn the Titanic (PTTT) is ambitious and premised by the view that current built environment higher education in South Africa is not adequately responsive to the needs and demands of the nation as expressed in the National Development Plan 2030 (NDP) and its priority to improve the quality of education, skills development, and innovation. It seeks to critically assess and review learning as it is currently implemented in built environment education at South African universities. It aims over an initial period of two years through active and collaborative engagement with all stakeholders in the built environment higher education space to improve the quality and outcomes of built environment education. PTTT is aligned with the United Nations Sustainability Development Goal 4 (SDG4), which requires inclusive and equitable quality education and promotion of lifelong learning opportunities and with the SDG11, looking at how to achieve sustainable cities and communities.

In the face of persistently high unemployment, skills shortage and changing workplace demands in the construction sector, the way that the necessary knowledge is organized must be critically examined and reviewed - not just what is taught but how it is taught, how it is assessed and how feedback is provided. There is a clear case for a more “resilient” education; one that is able to adapt to and be delivered effectively when confronted by new challenges and changes, which are happening increasingly frequently lately such as, for example, the impact of COVID-19. Pedagogic practices need to be scrutinized to determine their relevance and appropriateness to support engagement with the various built environment disciplines in a holistic way. The disconnect between academia and industry has been well established by several studies. Improved built environment education, arguably will lead to higher and more productive employment which industry needs.

PTTT recognizes the challenges, demands, and pressures on the construction sector of exponentially rapid technological advancements driven by Industry 4.0. South African construction higher education must become more relevant, transformative, and explore the use of alternative innovative instructional strategies to better prepare graduates for the world of work and professional practice which is increasingly technology-driven. The focus of these strategies must shift from teaching to learning. Instead of the current lecturer/instructor-centered 'sage on the stage,' 'chalk and talk' approaches where students are passive learners, they should be student-centered with students being active in their own learning and instructors becoming facilitators of learning. Imperatively, PTTT is aware that these choices are informed by national guidance and frameworks influenced by accrediting bodies and professional registration councils, shaped by institutional culture and strategies, and enhanced through engagement with stakeholders. It is this awareness that motivates PTTT.

Sustainable Development Goals and the Need to Improve

There is a definite need in South Africa to build human capabilities through education. On the state of higher education (HE) the NDP Commission reported that the performance of existing institutions in South Africa is characterized by serious imbalances and ranges from world-class to mediocre offerings. Continuous quality improvement is needed as the HE system expands at an increasing pace. A major challenge is that the current poor school education increases the cost of producing graduates, and a relatively small number of black students graduate from universities.
In terms of SDG 4 this project has been scoped to contribute to several goals through a critical analysis of existing construction education trends and challenges at South African universities. Learning outcomes must be improved so that graduates especially Historically Disadvantaged Individuals (HDIs) are better prepared to enter their chosen professions. These include within the sphere of built environment higher education and in terms of SDG 8, enabling built environment students at universities to acquire the knowledge and skills needed through innovative and transformative education learning strategies to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development. Current built environment education programs at South African universities arguably fail to adequately deliver on these critical outcomes largely because of outmoded instructional delivery approaches which are constrained by the focus on content rather than on the development of the professional skillset of competences needed by a 21st century entry-level built environment professional.

What is the Problem?

Since the 1980's undergraduate engineering and built environment education has been attempting to improve its learning outcomes so that graduates from these programs are better prepared to enter their chosen professions and occupations. Notably, construction programs around the world have implemented many different types of innovative teaching and learning strategies that include variants of constructivist inquiry-based learning in their curriculums to increase the development of critical and synthetic thinking that is the foundation of current professional practice. For example, Aalborg University in Denmark, Twente University in the Netherlands, and ETH Zurich in Switzerland each have established dedicated centers to support the types of innovative and teaching strategies that they have embraced and practice in their engineering and built environment programs. No such center exists in South Africa probably because of the adherence to traditional modes of instruction that are instructor-centric with emphasis on teaching rather than learning.

Almost every construction program (other than those mentioned earlier) that has implemented innovative approaches such as inquiry-based learning has done so within the traditional instructional paradigm of the lecture course – ‘chalk and talk’ or ‘sage on the stage’— the system that every major study of education at universities blames for the inability of undergraduate education to produce the critical or synthetic thinking needed for careers in built environment disciplines and professions.

Criticisms of current approaches include, inter alia,

- difficulty of students to make connections between the various silo subjects and modules in the standard curriculum
  Comment of a UKZN graduate: The SBL helped to a certain extent to prepare for the working world as helped to merge the different modules into one and how it contributes to the working world.

- inability of graduates to 'think on their feet' to solve construction problems that had not been covered in the academic program while at university
  Comment of a UKZN graduate: I think my previous role as PM benefited more, looking at the work function and the amount of reliance and collaboration I had to do with other disciplines. There are definitely pros as far as opening up more holistic ways of thinking.

- Disconnect between content and current industry practice
  Comment from the CEO of a contractor: I agree that Uni’s are not teaching what we need students to learn. The course content is so old. My nephew is studying at Uni and I've looked at some of his assignments and what he is asked is not how we do things at work.
What is the Historical Context?

Around 1980, a movement for large-scale reform in undergraduate engineering education followed several influential studies that concluded that these disciplines were not producing qualified graduates ready for their professions. There was a general impression—eventually confirmed by data—that the capacities of students to think critically and synthetically were not being properly developed by existing curriculums or methods of instruction. The consequence has been that industry or employers have consistently accused academia of not producing graduates who could be productively employed as entry level construction professionals without any further input and extensive training by the employers themselves. As a result, there has been a growing disquiet from industry about employing university graduates from built environment education programs. Further, these studies recognized that engineering and construction instruction suffered from an outdated, teacher-centered model for educating students and that fundamental change was necessary. Informed by research in teaching methodology and cognitive science, engineering and construction disciplines began shifting from the traditional lecture-based classroom format to emphasize active, research-based, and problem-based student learning (PBL).

During the 1990s and the 2000s, many built environment programs throughout South Africa and around the world introduced some manner of design projects, capstone projects, integrated curricula, project- and problem-based learning, and inter-disciplinary groupwork. Collectively, these pedagogies can be described as “inquiry-based learning.” All forms of inquiry-based learning are constructivist methods of education. As opposed to “teacher-centered,” constructivist pedagogies are “student-centered.” Characteristics of these pedagogies include:

1) reflectively connecting new learning to students’ existing cognitive structures;
2) being founded upon discursive, socialized instructional environments; and
3) being dependent upon collaborative and cooperative learning between students.

Research has confirmed that student learning outcomes are improved using these pedagogies as compared to traditional classroom instruction practices. The implementation of inquiry-based learning pedagogies has driven many new applications in, for example, construction management programs.

However, these changes have almost uniformly been implemented within the existing paradigm of the traditional classroom. That is to say, the application of inquiry-based learning has taken place by adding problem-based assignments and projects within the normative structure of existing coursework and curricula. Within this paradigm, the instructor still acts as the source of knowledge for students, assignments tend toward a prescriptive adherence to outlined course content or syllabus, the focus remains on individual student accountability, and students have little real responsibility for the learning of their peers. Despite this general and pervasive practice, many programs in South Africa have come to believe that their curriculums are “problem-based,” and that they have satisfactorily progressed toward the benefits of inquiry-based learning pedagogies. But is this assertion true? Is constructivist inquiry-based learning being properly implemented in built environment education if at all outside of architecture? These engagements can best be described as episodic and non-immersive.
Is there an alternative approach?

The inquiry-based, studio, or problem-based pedagogy is a high-quality constructivist learning environment that accomplishes the totality of what has been seen to be desirable in inquiry-based learning. It is founded on the principle of 'learning by doing' with active engagement of students in their own learning and acquisition of the desired professional skillset. If measured against the critical and synthetic thinking learning outcomes of studio or problem-based education where it is applied, the current implementation of inquiry-based learning in construction education would arguably be found inadequate. It is further argued that such an instructional approach will better equip students with the professional skillsets to improve their employment opportunities in the disciplines of their choice. The Building Construction Science program at Mississippi State University continues since 2009 to be successfully presented using a studio-based approach with their graduates being in demand by the construction industry.

In high-quality constructivist instruction, the practice standard by which the classroom should be measured is the model of “proposition, critique, reflection, iteration”—which is a process of problem solution mirrored in professional construction practice. In this type of instruction, students propose solutions to real construction problems through the design of artifacts— which may be physical, textual, conceptual, or a combination—engage in critique of those artifacts, reflect on the critique, and then iterate the propositions. This process engages ill-structured ‘wicked’ problems that are ambiguous in beginnings, means, and ends and includes feedback provided through the manipulation of and reflection on the artifacts being made, and arrives at problem solution through cycles of iteration. Through iteration, students engage failure and correction to build their skills of self-reflection, higher-order thinking, and learning transfer. In sum, these sophisticated cognitive abilities can be characterized as “critical” or “synthetic” thinking.

Further, it is argued that under the current instructor-led and instructor-centered paradigm of built environment programs in South Africa the so-called 'smart' students are advantaged given their 'better' socio-economic and cultural backgrounds. It is advocated that using an inquiry-based approach focused on 'learning by doing' instead of 'learning by remembering' (rote learning) the playing fields will be levelled creating opportunities for all students especially those from historically disadvantaged backgrounds to perform better and achieve their goals of becoming built environment professionals.
The findings of previous studies confirmed that further work is necessary if change is to be effective to improve the quality of built environment graduates and that the following hypotheses are still relevant, namely that

1) **Built environment education** is not currently implementing inquiry-based learning in a way that would ensure its most desirable outcomes and improve the throughput of aspiring HDIs,

2) **Synthetic thinking learning** outcomes have a direct association with the quality of coursework design and instructional practices as measured by the constructivist inquiry activities of proposition, critique, reflection, and iteration,

3) **A pilot study of inquiry-based learning** instructional practices and student learning outcomes can document these problems and propose implementable solutions;

4) **Current approaches to and practices of assessment and evaluation** do not adequately evaluate whether the desired mastery of the needed professional skillsets has been achieved to prepare students for the rapidly changing world of work impacted by digitization and technological advances, and professional practice and thereby improve their employment opportunities,

5) **The academic performance of graduates** and particularly HDIs will be enhanced using an inquiry-based learning approach focused on 'learning by doing' instead of 'learning by remembering' and which is responsive to diversity and cultural contexts and backgrounds,

6) **Accrediting bodies and Councils** negatively influence efforts to bring about the improvement in the quality and outcomes of built environment education,

7) **Class size** influences the implementation of inquiry-based learning and achievement of the desired learning outcomes, and

8) **The existing profile of instructors** mitigates against successful implementation of inquiry-based learning instructional practices and desired student learning outcomes.

These hypotheses will drive the agenda of PTTT to bring about step change in built environment curriculums in South Africa by involving all stakeholders in the process as partners in sustainable built environment higher education for the future.

**PTTT Project Team**

**South Africa**

- Professor Theo C Haupt – Nelson Mandela University and formerly from UKZN and Mississippi State University
- Professor Claudia Loggia – UKZN

**International Advisors**

- Professor Lykke Bertel – Aalborg University, Denmark
- Professor Seirgei Miller – Twente University, Netherlands and formerly from CPUT
- Graham Teede – Perth, Australia, formerly Australian Institute of Building
Proposed PTTT Acon Plan

The following ambitious but realizable action plan with the aim of eventually establishing a Center of excellence for student-centered built environment higher education in South Africa is proposed to advance a program of curriculum change to produce better employable graduates who can immediately play their role productively as 21st century entry-level and provide built environment professionals able to cope with change irrespective of their chosen or preferred discipline. The action plan has been informed by intensive consultations with and study visits to Aalborg University in Denmark, Twente University in the Netherlands, and ETH Zurich in Switzerland; the successful Building Construction Science program at Mississippi State University in the USA; and the aborted experience at the University of KwaZulu-Natal in South Africa. This program is articulated into nine interlinked phases over an initial two-year timeframe.

1. Phase 1 - July 2024 - A Construction Education Summit

Host the Construction Education Summit 2024 (CES24) in Gqeberha over two days that involves participation of all stakeholders in current built environment higher education in South Africa, namely HODs and HoSs, representatives from accrediting bodies and Councils, and industry practitioners drawn from multiple built environment disciplines. The planned program will include exploratory and PBL workshops by invited facilitators and keynote addresses that feed into breakout workshop sessions.

2. Phase 2 - July 2024 - Establish a PBL Website

A dedicated PBL website will be developed and set up after the CES24 that will support PBL in South Africa by sharing experiences, case studies, research findings and relevant literature.

3. Phase 3a - July 2024 - A PBL Bootcamp (Instructors)

Invite to a three-day long focused PBL training workshop (bootcamp) a cohort of instructors from universities in South Africa that have committed to implementing some form of PBL in their existing curriculums in 2024. The bootcamp will be run by a team of PBL specialists drawn from Aalborg University in Denmark, Twente University in the Netherlands, and University of Pretoria in South Africa. The specialists will train the instructors to use PBL techniques in their classrooms including developing appropriate learning outcomes. The number of participants in the PBL instructor boot camp is expected to be about 15 pax besides the team of PBL experts.

4. Phase 3b - July 2024 - A PBL Bootcamp (Students)

Invite to a three-day long PBL implementation workshop a cohort of students registered at the universities where the bootcamp instructors are affiliated during which the students will execute a real-life construction PBL problem under the facilitation of the instructors who had participated in the bootcamp as preparation of the 2025 PBL implementation phase. The instructors will be supported by the team of PBL experts. Feedback from the instructors, students and experts will be collected for analysis and dissemination. The completed projects will be assessed by a panel of industry practitioners. Representatives of the accrediting bodies and Councils will be invited to participate in the bootcamp as observers of PBL in action. The number of participants in PBL implementation bootcamp besides the industry practitioners and accrediting body and Council representatives will be about 50 pax.
4. Phase 4 - July 2024 - the ASOCSA Built Environment Conference

A special PBL track will be included in the 18th Built Environment Conference of the Association of Schools of Construction of Southern Africa (ASOCSA) where the findings of the relevant Research papers on PBL and other similar approaches will be delivered in this track.

5. Phase 5 - January 2025 - A Construction Education Summit

Host the Construction Education Summit 2025 (CES25) in Gauteng over two days that involves participation of all stakeholders in current built environment higher education in South Africa, namely HODs and HoSs, representatives from accrediting bodies and Councils, and industry practitioners drawn from multiple built environment disciplines. The planned program will be like CES24 and include relevant workshops and breakout sessions to develop PBL further in the South African context.

6. Phase 6 - January 2025 - Preparatory Workshop for Instructors

A two- or three-day preparation workshop will be held with instructors at universities that will implement PBL in their curriculums. The number of participants in the PBL preparation workshop is expected to be about 15 pax besides the team of PBL experts.

7. Phase 7 - March 2025 - Exchange Program with International Partners

Facilitate the visit by a cohort of instructors and academic leaders to Aalborg University in Denmark and University of Twente in the Netherlands to meet with their counterpart PBL practicing instructors. Cost of participation in this exchange program to be borne by the participants.

8. Phase 8 - April 2024 - Establish Center of Student-centered Built Environment Education

Establish a Center of student-centered built environment education (CoSBEE) in South Africa

9. Phase 9 - June/July 2025 - A Multi-disciplinary PBL Implementation Workshop

Invite to a two-week long PBL implementation workshop in Pretoria a cohort of students registered at the University of Pretoria in multiple disciplines, namely architecture, civil engineering, construction management and quantity surveying where the students will execute a real-life construction PBL problem under the facilitation of a team of PBL experts. Feedback from the instructors, students and experts will be collected for analysis and dissemination. The completed projects will be assessed by a panel of industry practitioners. Representatives of the accrediting bodies and Councils will be invited to participate in the bootcamp as observers of PBL in action. The number of participants in the multidisciplinary student PBL implementation bootcamp besides the industry practitioners and accrediting body and Council representatives will be about 30 pax.
Proposed PTTT Management Structure

The composition of the PTTT management structure will be finalized and is envisaged to comprise of:

- A Governance Management team comprising of at least 3 members drawn from ASOCSA Lifetime Achievement Award recipients and/or experienced retired built environment academics
- An Advisory Board comprising of at least 9 representatives drawn from international advisors, project funders, built environment professional and/or registration bodies and accreding bodies
- A Student Advisory Board of at least 3 representatives drawn from universities who are implementing PBL

The PTTT management structure will meet with the PTTT project team at least twice a year during the initial 2-year period and thereafter at least once per year. It is envisaged that the PTTT management structure will drive the establishment and management of a Center of student-centered built environment education (CoSBEE) in South Africa.

Request for Support and Financial Contribution to Project Turn the Titanic

Without the timely and active participation of all participants in the built environment higher education space Project Turn the Titanic will be impossible and the outcomes disastrous. The agenda and plan of PTTT are ambitious but the overall long-term impact on the construction sector will be enormous. It has become clear to the PTTT team that without committed financial support PTTT is doomed to hit the proverbial iceberg. The need is great but the return on the investment will be even greater. The entire industry will benefit exponentially. Universities will graduate 21st century professionals who will be critical thinkers, problem solvers, able to cope with the unknown and uncertainty, and responsible citizens. The industry will have better qualified graduates that can be seamlessly employed. Graduates will be better prepared for the world of work and professional practice.

The following diagram shows the roles and responsibilities of the key stakeholders involved in the PTTT.
Interesting Websites on PBL/SBL:

https://www.iaspbl.aau.dk

https://www.en.aau.dk/about-aau/profile/pbl

https://www.pbl.aau.dk/

https://journals.aau.dk/index.php/pbl

https://www.utwente.nl/en/cbl/

https://www.caad.msstate.edu/academics/majors/building-construction-science